Factors Influencing Public Support for Managing the Mountain Pine Beetle Epidemic

by

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Abstract

The mountain pine beetle (MPB) epidemic is the largest recorded outbreak in British Columbia's history currently covering almost 10 percent of British Columbia's 9.2 million hectares of forest. The problems it poses are not merely ecological but also social and economic. An evaluation of the public's perceptions of mountain pine beetle management alternatives provides decision-makers with information needed to reduce conflicts, identify communication priorities, and make balanced decisions concerning the use and recovery of affected areas. A survey was administered to 312 respondents, half in Prince George, a more forest-dependent community, and half in Kelowna, a less forest-dependent one. While this research found considerable public support for increased harvesting, it did not vary by location even though the residents of Prince George, the more forest-dependent community, were more concerned about the economic impact of the MPB than the residents of Kelowna. Concern for the economic impact of the MPB was not associated with support for harvesting. In contrast, the residents of Prince George reported greater knowledge, which was associated with support for harvesting. Finally, holding an ecological modernization viewpoint was not associated with location but it was associated with support for harvesting. Although respondents in the two study areas were concerned with the economic impact of the mountain pine beetle, the driver for supporting increased harvesting appeared to be a belief that human intervention can solve environmental problems. This research demonstrates the value of an examination of the social determinants of public support for strategies for managing natural disturbances in the policy making process.

Preface

The survey, “Public Perceptions of the Mountain Pine Beetle,” was conducted as part of a larger project and received ethics approval, H04-80768. A visualization component to the survey was developed by Dr. Meitner. I administered the survey portion and analyzed the data. The initial results from the study were posted online by Natural Resources Canada as a working paper, Mountain Pine Beetle Working Paper 2008-6, “Public Perceptions of Mountain Pine Beetle Alternatives,, with co-authors Mike Meitner, John Nelson, and Stephen Sheppard.

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Dedication

To my father and grandmother who would have been the first people to congratulate me upon completion of my degree and have contributed significantly to my personal growth.

1 Introduction

"We're losing the forest."

"The forest used to be a green, lush area. Now it's dead, red or grey and brutally logged and left as slash."

"The landscape has changed drastically with the outbreak."

These comments were typical of the ones expressed by the residents of Kelowna and Prince George who participated in a survey of public perceptions of the mountain pine beetle (MPB) outbreak. They provided vivid expressions of the impact of the outbreak on the local forest ecosystem. Policy-makers need to take public opinion into account when making decisions about how to respond to environmental problems such as the mountain pine beetle epidemic.

1.1 Purpose

Natural disturbances, such as the mountain pine beetle, can profoundly affect the environmental, social, and economic quality of communities through their potential to reshape ecosystems quickly and drastically. This ecological change disrupts the flow of social goods and services and forces communities to adapt to new environmental conditions. While the initial disturbance typically unfolds rather quickly, the

environmental effects and resulting recovery/adaptation strategies occur over much longer time frames. Because of this time lag, it is imperative to find ways to help communities understand the implications of environmental decisions made in response to natural disturbances so that they take long-term as well as short-term results into account before choosing which response to support. The primary purpose of this thesis is, therefore, to measure public support for mountain pine beetle management alternatives in two communities in British Columbia that differ in their dependence on the forest industry and to explore factors that might be associated with that support. .

1.2 Background

As a native of forests throughout western North America, the MPB is a normal part of the pine ecosystem, including its natural disturbance cycles. Outbreaks began in the late 1970s and early 1980s "in vast areas of mature lodgepole pine from northern Utah into British Columbia" (Gibson 2003:57). According to McGarrity and Hoberg (2005), a lack of coordinated efforts to control the outbreak in its early stages contributed to this epidemic. Since 1999 the beetle population has grown to epidemic proportions, becoming the most destructive forest pest recorded in British Columbia's history (McGarrity and Hoberg 2005). The mountain pine beetle has already decimated over 13,500,000 hectares (BC Ministry of Forests and Range 2008). A Ministry of Forests (MOF) report projected that the MPB threatens to destroy 76 percent of the 1.35 billion cubic metres of merchantable pine on B.C.'s timber harvesting land base by 2015. If current warmer climate conditions continue, the mountain pine beetle could cover the entire Canadian boreal forest in the next decade.

Traditional forest practices have left a legacy of environmental problems that fostered the conditions conducive to mountain pine beetle outbreaks, particularly in British Columbia. The widespread availability of large stands of aging lodgepole pine, several consecutive years of warm winters, several years of drought, past fire suppression, and selective harvesting have left millions of acres susceptible to the MPB. The mountain pine beetle epidemic thus is arguably the result of anthropogenic changes to the environment, ranging from traditional forestry practices to global climate change.

The mountain pine beetle is projected to kill up to 90 percent of lodgepole pine in the Rocky Mountain National Park in the United States as well as 23 million acres in Western Canada (Sheldon 2007). As McGarrity and Hoberg (2005) have concluded, the mountain pine beetle outbreak itself will cause a major disturbance to the ecosystem. It poses a major threat to pine species, to the other flora and fauna of the interior, and therefore to local biodiversity. The MPB clearly changes the composition and access to undisturbed forests. This in turn may have an effect on individuals' perceptions on the aesthetic beauty and good of the forest. Although the MPB is often framed as a threat to a single resource—the pine trees, however, the impact threatens the health of the other species. Furthermore, the impacts on such a large scale could affect a radical change in ecosystem services, the loss of which would have serious consequences to the livelihood of surrounding communities not just locally, but globally, and not just for the current population but for future generations as well.

Policy options, with regard to the epidemic, range from letting the mountain pine beetle outbreak take its course without intervening to sanitizing the forests by harvesting all of the lodgepole pine. According to some experts, the outbreak has grown to such a degree that the only option left is to sanitize the infected areas by clearcutting the trees, an option that produces some economic good out of what is otherwise an environmental disaster. Taking a utilitarian approach, proponents of harvesting infected forest areas argue that salvaging timber creates some benefit for the public when the MPB epidemic has left few, if any, other non-extractive uses for the pine forests.

Now that the MPB outbreak has reached epidemic proportions, the policy and management focus has shifted from trying to control the infestation to trying to minimize the loss of timber resources by accelerating harvesting and sanitation operations (Nelson 2007). This policy focus involves establishing optimal salvage harvesting levels while making concessions to conserve non-timber values, restore forest resources, and prepare communities and industry for both the boom and the bust of economic activity in the forest industry (McGarrity and Hoberg 2005). While clearcutting infected areas may increase jobs in the short run (the boom), they will disappear for at least a generation until the forests grow back (the bust). In short, future generations face the loss of biodiversity in the pine forests and the resources derived from them, including jobs and recreation. As McGarrity and Hoberg (2005:14) noted, the economic effect of the MPB is positive in the short run and negative in the long run:

> The large-scale salvage of dead and susceptible trees in infested areas will produce a 'boom' in the BC economy especially in towns and cities in the interior over the next decade. Unfortunately, the timber supply uplift will

> be followed by significant declines in harvest levels, posing grave challenges to these forest-dependent communities in the interior.

Thus, the mountain pine beetle's damage to huge tracts of pine forests across British Columbia will reduce both the supply of available timber and the number of jobs in the forest sector. Furthermore, "each job in the forest industry supports roughly two indirect jobs. When well-paid forest workers lose their jobs, the community's income drops and other sectors, such as retail, the housing market and the service industry, fall off" (Natural Resources Canada 2006:54). In short, the job loss will affect not only those employed directly by the forest industry but also those whose jobs are dependent on the income of those working in forestry, disrupting the social fabric of the affected communities.

The dependence of communities on the traditional forest sector and the severity of the infestation in their area will determine how strongly they will be affected.
The forest sector plays a major role in many local economies throughout British Columbia. The portion of jobs dependent on the forest sector (including indirect or public sector positions dependent on forest revenues) can be as high as 22 percent (Kittredge 2002). The Cariboo region has an estimated economic dependence on the forest industry above 26 percent while the Thompson/Oakanagan region is between 10 and 14 percent (Kittredge 2002). Kittredge (2002) demonstrated that those regional economies are disproportionately dependent on the forest industry for revenue. Some communities, therefore, may be disproportionately affected by the mountain pine beetle.

Communities within close proximity to forests infested by the mountain pine beetle are likely to be more strongly affected by the outbreak, therefore, than those further away because of strong links to forest environments. At the time of the study, Prince George, the first site surveyed, was at the heart of the mountain pine beetle outbreak while Kelowna, the second site, was on the leading edge. These two communities provide an opportunity to understand how different characteristics, particularly the degree of dependence on forests, shape public perceptions of the mountain pine beetle epidemic, particularly public support for various management options. While the Prince George and Kamloops regions show relatively similar population levels, the responsiveness of each region to a forestry export shock, or rapid decline in supply or demand, would be markedly different. Transfer payments, the forest sector, and the public sector each contributed on average between one-fifth and one quarter of the local economies between Kelowna and Prince George (Horne 1999). The BC 1996 Census (Statistics Canada) revealed that Kelowna's economy is primarily dependent on the public sector (21 percent) and transfer payments, such as welfare and retirement pensions (20 percent), while Prince George's economy was largely dependent on forestry (33 percent) and the public sector (24 percent) (Horne 1999). In short, while Kamloops and Prince George are experiencing similar levels of mountain pine beetle infestation their dependence on forestry differs greatly.

The greater Kamloops region including Kelowna derived under 10 percent of its income directly from forestry; in contrast, the larger area around Prince George derived between 30 and 40 percent of its income directly from forestry (State of Canada's Forest Report

2006; BC's Heartlands Economic Strategy - Forests 2004). As Patriquin et al. (2005:944) observed, "the Prince George economy is clearly more dependent on forestry than that of Kamloops and therefore, less able to absorb the negative shock of future timber shortage." In Prince George, the forestry export shock caused key attributes to the net regional product (NRP), such as employment to change by 0.30 percent —compared to Kamloops with a respective change of 0.15 percent.

Therefore, Prince George is generally regarded as a forest-dependent economy. Residents are more likely, therefore, to be exposed to MPB-related issues, especially, economic loss. Kelowna, as a larger city, is less dependent on timber supply. I hypothesize that Prince George residents will perceive more personal economic impact as a result of the MPB outbreak than Kelowna's. I also hypothesize that Prince George residents will have more knowledge about the MPB than Kelowna's.

The ramifications of this epidemic are far greater than the simple effects on timber supply, even though alone this damage would constitute a clear and present danger to the Province and its citizens. The mountain pine beetle creates other problems in addition to its impact on the local economy and its stress on both social and ecological services in communities such as Kelowna and Prince George. The effects on recreation and tourism, which depend on the scenic qualities of the environment, for example, are enormous. As the opening quotations from survey respondents indicated, people's surroundings are being transformed into seas of dead and dying trees. The mountain pine beetle outbreak, therefore, affects a variety of social values, including visual quality and outdoor

recreation potential, as well as environmental effects, including runoff from increased soil erosion, greater risk of major flooding, and wildlife habitat loss. Damage to the forest caused by the mountain pine beetle increases the risk of forest fires, which in turn, can cause property damage, decreased water quality, community disruption, and possible loss of life. In short, the effects of the mountain pine beetle outbreak are wide reaching. If left unmanaged, it will likely continue to change forest composition in ways that are unacceptable to the public.

Increasingly governments require public participation in forest management and land-use decisions. This study, therefore, examines public support for harvesting as a MPB management strategy. Specifically, it seeks to understand how economic considerations and environmental values affect public support for increased harvesting in areas infested by the MPB. The basic question is whether ecological or economic concerns drive support for MPB management strategies. I hypothesize that of the forest-dependent community, Prince George, will be more likely to support harvesting than the residents of Kelowna. Furthermore, they will hold a more anthropocentric set of environmental values.

The purpose of this research is to provide policy makers grappling with identifying solutions that will ease the burden on affected communities with public input. The degree to which affected communities support government initiatives to manage the mountain pine beetle may depend on how explicitly community values have been incorporated into policy. Public input provides resource managers with an understanding

of residents' expectations and decision-makers with the social license to create policy reflecting the values of community stakeholders that include the general public in addition to industry. Assessing public opinion can provide insight into not only the level of public support for harvesting as a mountain pine beetle management strategy but also the factors that influence that support. Managers can use the results of this study of public perceptions of the mountain pine beetle epidemic in two affected communities, Kelowna and Prince George, to guide policy, address risks, evaluate trade-offs, and identify barriers to action.

1.3 Public Policy Background

According to Stedman et al. (2004), the forest sector dominates rural British Columbia. In contrast to the US where operations occur on private land, about 80 percent of harvesting takes place on public (primarily provincial) lands across Canada (CFS-NRC 2006). In 2005, the forest industry directly employed approximately 80,000 people in British Columbia (Canadian Forest Service and Natural Resources Canada Report 2006). Thus 15 percent of employment is directly associated with forestry. While forests in Canada are a public resource, most harvesting occurs on public land, and a significant portion of the population is directly employed or indirectly dependent on forest industry revenues. As a result, the forest industry is considered the steward of public land and community well-being, and forest industry interests have considerable power within forest governance.

Throughout the late nineteenth and twentieth century, large bureaucratic systems built on the direct ownership of forests by governments provided extractive logging rights to

private firms following standard models of scientific forestry (McCarthy 2006). In the post-World War II era, in both British Columbia and the United States, these bureaucracies "privileged timber production over other uses of the forests" (Pralle 2006:144). Ninety-five percent of British Columbia's forests are provincially managed by industrial forestry using "high-volume, low-value-added, export oriented production; large-scale clearcuts; and an explicit assumption that old-growth forests would be gradually logged and replaced with more quickly growing second-growth forests," thereby privileging short-term economic gain over the long-term interests of future generations (McCarthy 2006:90).

In British Columbia, long-term, relatively comprehensive forest tenures are the primary means through which the government distributes rights to these resources. Forest tenures assign extensive control over public forests to timber corporations for periods of 25 to 99 years. In contrast, in the United States, "companies bid for the right to log particular areas of forest but did not gain either the long-term control over federal lands, or the broader sets of rights and responsibilities, that accompanied forest tenures in British Columbia" (McCarthy 2006:88). Currently, "this institutional framework in which responsibility is delegated to private firms to carry out public objectives therefore serves as the key mechanism through which any changes in objectives and therefore management policies must be implemented" (Nelson 2007:464). Close ties between timber companies and governments in both BC and the US have maintained a largely closed policy subsystem shielded from public scrutiny.

Postwar forest governance took place largely behind closed doors between the Ministry of Forests and timber and labor organizations, excluding public stakeholders who had little formal recourse. Although the market often drives political arrangements, other influential drivers, such as social movements, have resulted in new governance patterns ranging "from constitutional change to changes in forest planning process requiring opportunities for public review and comment" (Hoberg 2007:3). Environmental groups have sought to reform such closed governance systems, sometimes successfully (Cashore et al. 2004; McCarthy 2006).

The Province of British Columbia has a history of groups advocating for radical changes to forest governance ranging from complete decentralization of forest management to nationalizing the timber industry. According to McCarthy (2006:91),

> despite this long history of dissident, alternative, and utopian thinking and practice linking forestry to the well-being of rural communities in British Columbia, and to broader notions of democratic relations between communities and their environments, the dominant model of industrial forestry and associated tenures remained largely unchanged until the 1980s and beyond.

Environmental campaigns in the 1980s and 1990s targeted contentious forest policies and practices, such as clearcutting (Cashore et al. 2004; McCarthy 2006). Because laws in Canada "lack the action-forcing and citizen lawsuit provisions" that have provided effective public recourse in the United States, "protesters turned instead to direct action at both ends of the timber commodity chain" (McCarthy 2006:91). These effective campaigns and boycotts created a much publicized "controversy revolving around BC

forest practices threaten[ing] the entire industry with a serious loss of both profits and 'social license'" (Cashore et al. 2004:67).

Recently, growing recognition of the failures of traditional forest management to achieve its objectives, technological and geographical "restructuring in the timber industry, mounting awareness of ecological damage, and the growth of effective environmental movements have called this entire edifice of forest governance into sharp question" in both Canada and the US (McCarthy 2006:88). Hoberg (2007) noted that more recently regulations concerning land use and forest practices have addressed environmental concerns. Challenges to the dominant forest paradigm have resulted in new policies protecting wildlife and ecosystems, increasing public participation, and reforming governance systems.

Entrenched industry interests, provincial economic reliance on forestry, and perceptions of an unlimited supply of timber have reinforced the status quo and contributed to the stability of the dominant forest paradigm even in the face of public protest (McCarthy 2006). In a backlash to expanded public oversight and a stricter Forest Practices Code introduced by the New Democratic Party in the 1990s, the 1997 Jobs and Timber Accord has advanced a neoliberal mode of forest governance including environmental protection cost-benefit analyses, consolidation of the existing tenure system, and increased industry access to public timber (McCarthy 2006).

In short, historically in Canada, provincial governments and the forest industry dominated the decision-making process regarding forest management. More recently, First Nations and environmental non-governmental organizations have become important actors in shaping forest policy. An environmental problem that crosses not only provincial boundaries but also national boundaries, such as the mountain pine beetle, pushes governance to become more centralized and even internationalized. The MPB's harmful impact on forest dependent communities has the opposite effect, producing pressure for more local and regional involvement in decision-making, particularly concerning management strategies that might mitigate that negative effects on local communities. As the MPB spreads, as the forest products market changes, or as other actors weigh in, especially First Nations, the federal government and other national or even supranational organizations may increasingly be called upon to participate in the decision making process. Conversely, the creation of regional mountain pine beetle action coalitions in the province of British Columbia[1] might reorganize the decision-making process in the opposite direction by decentralizing it. In the case of the Omineca Beetle Action Coalition, for example, local government officials collectively represent the interests of the region on the board and their involvement could mean the devolution of authority to affected communities.

The mountain pine beetle, therefore, has amplified calls for opposite forms of governance that is both for increased federal and provincial government intervention and support in a

[1] Currently four Action Coalitions exist: the Omineca Beetle Action Coalition, Cariboo-Chilcotin Beetle Action Coalition, First Nations Mountain Pine Beetle Initiative, and the Southern Interior Beetle Action

decentralized structure that affords communities a larger voice in the decision-making process. Larson and Ribot (2004:2) noted that, most decentralization reforms are based on the argument that "the increased efficiency, equity and inclusion that should arise from decentralization result in better and more sustainable management." The provincial and federal governments have developed policies to address the mountain pine beetle in consultation with other stakeholders, including First Nations, environmental organizations, and the forest industry. While Natural Resources Canada, Canadian Forest Service, and the Mountain Pine Beetle Advisory Board are the primary federal actors concerning the MPB, the BC Ministry of Forest and Range have taken the lead on the mountain pine beetle producing the Mountain Pine Beetle Action Plan 2006-2011. The BC Mountain Pine Beetle Action Plan (2006:3) opened by stating, "This plan provides a framework to guide all provincial ministries and agencies, and to assist communities, First Nations and stakeholders to identify and carry out what must be done." Thus, language found in the plan both explicitly and implicitly recognized the importance of including stakeholders in decision-making.

1.4 BC MPB Action Plan

The Mountain Pine Beetle Action Plan 2006 to 2011 outlined British Columbia's efforts to mitigate the threat of the mountain pine beetle to the economic and social well-being of BC communities as well as the environment. It listed a range of approaches from the allocation of new temporary forest tenures and increased annual allowable cuts to the designation of a new office, the Provincial Bark Beetle Coordinator, and provincial cooperation through a memorandum of understanding (MOU) between BC and Alberta.

Most of the strategies of the BC government as outlined in the objectives of the Plan primarily seek to provide information and economic assistance.

The Mountain Pine Beetle Action Plan identified seven core objectives to mitigate the impacts of the mountain pine beetle on economic, social, and ecological forest values. Despite rhetoric to the contrary, the plan was primarily focused on the economic impact on communities and the forest industry in particular and relied heavily on adjusting harvesting levels and prices to meet ecological and economic objectives. The development of the regional action coalitions seems to have been a creative move providing local stakeholders with some autonomy over certain functions especially in directing government economic assistance. It does not appear, however, to shift decision-making power over strategic considerations, to move the focus from economic to environmental or other concerns, nor from the current generation to future ones.

In 2008, the First Nations Leadership Council, which includes members of the BC Assembly of First Nations, First Nations Summit, and Union of BC Indian Chiefs, issued a press release, "It's Time for Ottawa to Take Mountain Pine Beetle Crisis Seriously," criticizing the federal government for moving slowly on its promise to deliver economic relief to First Nations. Other organizations, such as the David Suzuki Foundation, have been vocal opponents of the intense salvage operations in favor of a more ecosystem-based approach to managing the MPB epidemic. In contrast, the Council of Forest Industries largely echoes government rhetoric describing the immediate need for salvaging additional volume "enabling the province to capture value before these trees

deteriorate and to expedite the reforestation of infested areas" (Council of Forest Industries 2011). Each stakeholder is independently asserting its influence. As such, coupled with increased liberalization of the forest tenure system and extending autonomy to affected communities, the forest dependent communities should hypothetically have an in-built trust for the forest industry and government to deliver accurate information about the mountain pine beetle as they are likely to receive mutually beneficial outcomes.

While the federal government has coordinated inter-agency support and various initiatives, its limited jurisdiction over the MPB outbreak has led it to focus primarily on funding research and development, assisting First Nations, compensating private land owners, and helping impacted communities to reduce fuel loads. Similarly at the provincial level, restoration of forest resources is largely aimed at both overcoming the gap in timber supply expected to occur after salvage operations are complete and minimizing the risk of future epidemics. The BC government is exploring ways to mitigate the future fall down in timber supply through, for example, the use of fertilization, planting of fast growing species, and innovative silviculture strategies (McGarrity and Hoberg 2005).

The MPB policy debate today is not centered on the threat to biodiversity; instead it revolves primarily around the loss of forest resources, specifically timber and associated jobs. I hypothesize that residents of Prince George, at the center of the infested area, will be more likely to support extracting the remaining economic value of the timber through harvesting than residents of Kelowna. Replanting strategies seem to be driven by the

need to provide the greatest economic utility as quickly as possible, for example through replanting with fast growing species, and not necessarily on ensuring the greatest biodiversity, for example through replanting with diverse species to reduce the risk of another MPB epidemic. I hypothesize that residents of Prince George, an infested area, will support strategies that speed regrowth, including replanting with pine, using fertilization, and planting genetically engineered species.

1.5 Hypotheses

Since the primary scope of this study is to determine whether support for harvesting differs between two communities that vary in their level of resource dependence, I hypothesize that Prince George residents will:

1. promote anthropogenic values over ecocentric ones;
2. have higher levels of trust in social institutions, particularly in government and the forest industry, to provide accurate information about the Mountain Pine Beetle;
3. have more knowledge about the MPB;
4. perceive more personal economic impact as a result of the MPB outbreak;
5. be more likely to support harvesting as the management strategy; and
6. be more likely to support strategies that speed regrowth, such as fertilization, than residents of Kelowna.

2 Literature Review

2.1 Overview

Examining the social composition of communities has traditionally been the domain of sociology; however, forest managers and other natural resource management researchers are increasingly incorporating social, psychological, and economic analysis into forestry. Conversely, sociologists, psychologists, and geographers are increasingly employing the methods and theories of their disciplines to examine forestry issues. As a result, researchers are taking a variety of approaches to examining the relationship between forests and the communities surrounding them, especially when faced with a natural disturbance of the magnitude of the current mountain pine beetle outbreak.

To broaden the myopic approach of technical assessments on timber supply and ecological inventories to address the social effects of forests, natural resource managers are more frequently using research methods from geography and social science, such as Geographic Information Systems (GIS) and public opinion polls. In the conclusion of his study on forest disturbances in rural communities of Alaska, Flint (2007:1607) argued that

> technical risk assessments focused on presumed immediate threats to property and safety such as fire without assessing the perceptions of local residents may miss broader risks that are important to local populations. A more inclusive risk assessment process incorporating local risk perceptions can highlight areas of agreement and disagreement between technical or scientific interpretations of risk and local sentiment.

Reliance on technical risk assessments poses problems for decision-makers seeking to understand the relationship between public perceptions and public action, between belief and behavior.

Technical assessments (CFS-NRC 2006; Fall et al. 2004; Flint 2007; Horne 1999; Kittredge 2002; McIntire and Fortin 2006; Patriquin, Wellstead, and White 2007; Ruzner and Hawkins 2006; Schrier 2006; Wilson, Issac, and Gara 1998) frequently framed forestry issues as either economic or biological. In contrast to technical assessments, social research (Derksen and Gartell 1993; Flora 1998; Harshaw and Tindall 2005; Olli et al. 2001; Parisi et al. 2004) has consistently found that context matters and that access to social capital is an important dimension bridging belief and behavior. Controlling for local social, economic, and spatial factors including social capital, community size, and education, Parisi et al. (2004:109) found that "communities in economically disadvantaged regions are less likely to engage in community environmental activeness." Smaller communities lead to lower levels of environmental activeness, revealing "the social costs of space." High unemployment and poverty rates do not explain differences in environmental activeness, however. An examination of community constraints (e.g. size, education, poverty), therefore, can aid researchers in identifying demographic variables, such as age, gender, and class, that are associated with environmental beliefs and that are likely to lead to community action.

While policy responses have primarily focused on addressing timber supply and consequent economic outcomes, some researchers (Kimmins et al. 2005; MacKendrick

and Parkins 2005; McFarlane et al. 2006; Nelson 2007) have attempted to understand the broader implications of the MPB epidemic for community cohesion, stakeholder engagement in participatory public policy processes, and future social and environmental risks associated with natural disturbances. A growing body of research (Buhyoff et al. 1982; Colorado Forestry Advisory Board 2006; Flint 2007; Kimmins et al. 2005; Kneeshaw et al. 2004; McFarlane et al. 2006; McIntire and Fortin 2006; Schrier 2006; Sheppard and Picard 2006) outlined the potential negative effects of natural disturbances in general and the mountain pine beetle in particular beyond timber supply, including increased wildfire risk and damage to habitats and wildlife, visual/aesthetic values, tourism and property values, as well as the forest industry, particularly its employees. Among the potential negative impacts reported, there may be positive effects from the mountain pine beetle such as an increase in jobs to support salvaging efforts, the reduction in weak timber stock, and a thinning of overcrowded stands resulting perhaps in a more visually dynamic scene and viewer appreciation. The following sections explore a wide range of research including technical assessments, visual quality analysis, natural disturbance studies, environmental attitudes research, and policy reviews, to understand the issues at stake in the mountain pine beetle outbreak.

2.2 Remote Sensing Assessments

The mountain pine beetle outbreak led to a flurry of technical reports and research grants distributed through national and provincial agencies. Technical assessments of the MPB outbreak are primarily concerned with managing the ecological risks and potential timber supply loss. As the mountain pine beetle has grown from small outbreaks to a widespread epidemic extending beyond British Columbia into regions of Central Canada

and the United States, increasingly researchers seek large scale, high resolution, multi-spectral imagery that can detail the outbreak from the time of its origin to the present. Due to the spatial extent of the attack, remote sensing has played an essential role in the identification, assessment, and forest operations directed towards monitoring and controlling the mountain pine beetle epidemic in North America. There is little evidence, however, of a multidisciplinary use of remote sensing to evaluate social issues related to the mountain pine beetle (MPB). The following summary of remote sensing's application to the MPB briefly describes how it can be used to understand the dynamics of a tree, a stand, or a forest and its application in identifying a stand under attack.

2.2.1 Discussion of Remote Sensing Vegetation

Lodgepole pines have small and more densely packed tufts, or a dense foliage composition. According to Jensen (2007:361), an understanding of the physiology and pigmentation characteristics of a plant will allow researchers to identify "when chlorophyll absorption starts to decrease, either due to seasonal senescence or environmental stress." Stressed trees will often have a lighter tone. White et al. (2007) described the progression of a MPB attack and the visible changes in foliage, noting that a combination of aerial and ground surveys can be used to detect significant changes.

2.2.2 Spectral Resolution

Broadly speaking, changes in the foliage denote the progressive phases of a mountain pine beetle attack from the green phase (where there is a drop in sapwood moisture), through the red attack phase (foliage fades from green to yellow to red), ending (a three-year process) in the grey attack phase where all of the needles are gone (Coops et al. 2008; Gillanders et al. 2008; White et al., 2007). Price and Jakubauskas (1998:1631)

concluded that spectral retrogression can be used to detect insect affected stands, noting that, "if a site, monitored over time, shows increasing brightness with little change in greenness, an insect infestation maybe indicated." The rapid mortality of trees from beetle kill increases spectral brightness of a forest stand within a short time frame.

Due to the natural variability of pine stands, it is difficult to separate low levels of stressed from healthy stands at 30 meter spatial resolution even when using hyperspectral satellite data. Satellite imagery, specifically IKONOS, has been used with a high rate of accuracy in detecting areas of low to moderate infestations. White et al.'s (2007) study examined Hyperion-derived foliage moisture indices for reliability as a method for detecting mountain pine beetle red attack damage at the landscape level. In general, these indices assume that as stress caused by the mountain pine beetle increases, the moisture content of foliage decreases and the reflectance in the water absorption region increases, enabling greater detection of levels of mountain pine beetle attack. According to White et al. (2007), those indices incorporating both the shortwave infrared (SWIR) and near infrared regions of the electromagnetic spectrum were significantly correlated with levels of mountain pine beetle damage. While the study supported the continued use of the TCT (Thomas Tasselled Cap) Wetness Index, it did find Hyperion imagery capable of detecting lower densities of red attack damage.

2.2.3 Spatial Resolution

Small focused studies can provide great detail on stand dynamics but large scale investigations would aid research on the regional effects and spread of the MPB epidemic. Landsat TM and ETM+ sensors have been used as reliable sources of imagery

for mountain pine beetle red-attack mapping applications. Coops et al. (2008:161) verified that using Landsat -7 ETM imagery in conjunction with a vegetation wetness index yielded a classification accuracy of red-attack damage between 67 to 78 percent. Coops et al. (2008:160) found that 70 to 92.5 percent accuracy of low infestation to red attack detection could be determined when using a clustering technique on 4 meter multi-spectral IKONOS imagery.

2.2.4 Temporal Resolution

Changes associated with the ecological processes of the mountain pine beetle infestation occur over a spatial as well as a temporal scale. Remote sensing can be used "to monitor the rate and magnitude of landscape fragmentation and loss of connectivity resulting from both mountain pine beetle disturbance and operational and salvage logging" (Gillanders et al. 2008:519). Coops et al. (2008) responded to concerns over the need to mitigate the economic impact by collecting information on the location and extent of the mountain pine beetle infestation using remote sensing techniques. The effectiveness of mitigation approaches (silvicultural treatments; prescribed burning; and attractants, repellants, and insectides) are generally measured using ground-based methods. The authors argued, however, that remotely sensed data should be included as a part of a broader multi-scale monitoring of the effectiveness of management approaches to reduce forest damage resulting from the Mountain Pine Beetle.

Multi-disciplinary research could uncover geographic relationships between communities, economies, and the mountain pine beetle impacted forests as well as other values across affected landscapes are, as the preceding survey of the literature related to

the mountain pine beetle epidemic reveals, typically out of the purview of conventional remote sensing studies. For instance, distances between the leading edge of the mountain pine beetle epidemic and communities with mills or forest operations could serve as a basis for conducting social surveys, projecting economic cost studies, and identifying policy priorities. When responding to ecological problems such as the mountain pine beetle epidemic, remote sensing data needs to be combined with social and economic indicators as part of the policy making process.

2.3 Technical Timber/Economic Assessments

As the following section demonstrates, technical timber assessments use conventional economic models to determine management strategies. They too typically fail to incorporate additional ecological and social values. Management decisions are often based on what timber supply and economic assessments determine is best for the bottom line.

Technical assessments of the MPB outbreak have acknowledged the importance of stand species composition (Runzer and Hawkins 2006; Shore, Safranyik, and Lemieux 2000; Wilson et al. 1998). Runzer and Hawkins (2006), for example, found evidence of the beetle moving into younger stands in the Prince George Timber Supply Area, depending on the species composition prior to attack. Shore et al. (2000) have developed a system for rating the susceptibility of stands to MPB attack across British Columbia based on the susceptible basal area, in conjunction with the proportion of lodgepole pine, degree of infestation, and differences in host resistance. Lodgepole pine mortality also increases the risk of spruce budworm susceptibility as species dominance shifts.

According to Wilson et al. (1998:244), "there is growing concern that the lodgepole pine mortality will allow shade tolerant understory trees and new regeneration to quickly dominate stands, shifting species composition towards true firs and Engelmann spruce." As overstory lodgepole pine mortality increases, there is a corresponding increase in understory density of firs and an increase in susceptibility to budworm attacks due to the lowered chemical defenses as a result of densely packed host trees. Wilson et al.'s (2006) models suggested that reducing density and canopy closure could promote stand shifts toward less (budworm) susceptible species especially in conjunction with planting shade intolerant species; however, this benefit might come "at the expense of higher fire or mountain pine beetle risk" (Wilson et al. 1998:244).

Government reports in particular have reflected the growing need to manage economic risks associated with the mountain pine beetle. Many of the provincial reports included similar information highlighting the spread of the mountain pine beetle and its devastating effects both ecologically and economically, providing substantive baseline forest and industry statistics (BC Census 1996; CFS-NRC 2006; Horne 1999; Kittredge 2002; Schrier 2006). For example, the provincial report (BCMPB.v5) estimated the peak mortality in British Columbia occurred during the summer of 2004 at an annual mortality of 141 million m^3. Without management intervention, the report concluded that pine mortality caused by the MPB will reduce timber supply over the long-term. The forest report for the state of South Dakota also revealed extensive pine mortality due to mountain pine beetle kill covering approximately 15,000 acres of private forest land and

much of the Black Hills National Forest (Piva et al. 2002). In an area where prairie and cropland is dominant, this sort of loss to natural disturbances, whether wildfire or beetles, can devastate the forest landscape.

A review of the Ministry of Forests and Range 2008 News Releases[2] related to the MPB illustrates the numerous efforts to commit resources to local and regional stakeholders. British Columbia's Mountain Pine Beetle Action Plan details new licenses and tenures to be made available to increase harvesting levels as a policy response to ease both the economic and ecological impacts of the mountain pine beetle outbreak. According to Patriquin et al. (2007:939), "The large rate of tree mortality has resulted in a significant increase in the annual allowable cut (AAC, i.e., the amount of timber that can be sustainably harvested annually) in order to capture the value of standing dead timber through salvage cutting." The downside to increasing the provincially mandated AAC is a likely future timber shortage and resulting economic downturn.

Patriquin et al. (2007) highlighted the policy challenge created by the short term need to salvage economic value from the affected timber and the long-term need for environmental and economic recovery. The beetle infestation adversely affects economies through the downgrading of log (prices), displacing jobs, and increasing harvesting levels that leave forest dependent communities without access to future resources. The provincial plan is to reforest affected areas and encourage growth in other industries (Schrier 2006).

[2] http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/news2008.htm

McGarity and Hoberg (2005) expected that the annual allowable cut would increase in an effort to salvage MPB-damaged timber, resulting in a short-term economic boom followed by a downturn and a timber shortage. Economic activity and benefits to other sectors, such as service and retail, experienced during the increases in harvesting would shrink once the available timber falls below baseline levels or when beetle-kill timber has no marketable value (Patriquin et al. 2007). Patriquin et al. (2007) found that declines in timber supply would have serious economic consequences on all industrial sectors in addition to forest dependent communities.

The Canadian Forest Service's (2006) report on the state of Canada's forests also emphasized the economic implications of the MPB on British Columbia:

> In September 2005, the province released its Mountain Pine Beetle Emergency Response: Canada-B.C. Implementation Strategy, a three-year business plan for the $100 million contributed by the federal government to mitigate the effects of the infestation. In addition to its Mountain Pine Beetle Action Plan, the province will invest in developing new uses and new markets for the affected wood; increase the annual cut in the south-central area; award licenses to companies in local communities; and assist communities in the north-central interior in reducing the economic impacts of the epidemic. (CFS-NRC 2006:13)

Mills across Canada are closing and with increasing costs, the softwood lumber dispute,[3] the rising value of the Canadian dollar, decreasing demand from the United States for

[3] The softwood lumber dispute between the United States and British Columbia is expected to reduce timber demand and potentially 16,000 forest sector jobs (Kittredge 2002).

timber products, and the MPB outbreaks, forest communities are in decline. (See the "In Focus: Forest Industry Competitiveness" chapter for more details—CFS-NRC 2006.)

While Canadian reports have emphasized the potential economic losses resulting from the MPB epidemic, US reports have warned of further risk to ecosystems, recreation opportunity, and property. For example, Colorado's 2005 report on the health of its forests examined the conditions leading up to the expanded MPB attack and the increased potential of wildfire, negative effects on recreation, and private property losses. The report also provided an update on the spread of the spruce bark beetle as well as the mountain pine beetle throughout Colorado's central region, highlighting the importance of managing the aspen forest that these two beetles have not yet affected (Colorado Forestry Advisory Board 2006). The lack of a clear strategy to reverse the harm caused by the MPB has led policy makers and forest managers to prioritize the conservation of Colorado's trademark aspen forests and to focus responses within areas where the MPB threatens critical infrastructure and public safety. The on-the-ground implications of this change in strategy include increased use of prescribed burning and thinning as well as further restrictions on grazing animals to promote the growth of aspen and reduce risks associated with the current forest composition.

2.3.1 Approaches to Forest Management

Fall et al. (2004) exemplified the conventional approach to forest management, while Adamowicz and Veeman (1998) argued that forest policy must integrate both ecological and economic values and Kangas and Kangas (2004) explored different approaches to incorporating social and ecological sustainability into the economic calculations used in

forest management. Fall et al. (2004) sought to integrate spatial timber supply and forest management models with mountain pine beetle population models at spatial scales over 1,000,000 ha in Lakes, Kamloops, and Morice timber supply areas. They considered three types of effects of applying different strategies under different conditions: area attacked and volume of trees killed by beetles over next 10 years; volume of trees/timber salvaged and non-recovered loss expected; and cumulative timber supply impacts. Their results suggested that investment in management strategies should be assessed according to the threshold of attack. They concluded that while intensive fine scale treatments are warranted, in cases above the threshold, focus on mitigating the impacts is a better use of resources.

Adamowicz and Veeman (1998) argued that there is an ecological-economic disconnect and successful policy must integrate both concerns. They examined two approaches to including environmental concerns in forest policy. The first, a somewhat utilitarian approach, included environmental concerns in the economic calculus to maximize net social benefits. Considered a more biocentric strategy, the second approach was based on the "natural disturbance paradigm" that argued that "sustainability of biodiversity and ecosystem processes is … best achieved by designing harvesting systems that closely mimic the intensity, timing and effects of natural disturbance regimes" (Rothstein and Spaulding 2010:1164).

Incorporating social and ecological values requires new approaches for handling uncertainty in assessments. According to Kangas and Kangas (2004:179), "non-timber

variables have been given increasing weight in forest management planning, and they are often imprecise or vague. Such situations include uncertainty about the meaning of certain concepts, such as 'biodiversity', 'recreation', 'scenic beauty', 'sustainability', equity' or even 'forest health'." Kangas and Kangas (2004:183) argued that

> social aspects are increasingly important in forestry decision making. Involving the preferences, values and opinions of people in decision making also requires a new attitude towards the uncertainty analyses: the laymen may not be able to give probability distributions for their beliefs, but need easier techniques to elicit and understand uncertainty assessments. In these social aspects, the 'new' uncertainty theories might have their best applications. Other important examples are some ecological considerations, for which the basic information is scanty and expert opinion has to be relied upon. When such non-timber variables are of major interest, or the planning process involves many laymen, a non-probabilistic framework is recommendable: the probability distributions for timber-related variables easily lend themselves to fuzzy set calculations.

Kangas and Kangas exemplified the growing interest in expanding economic calculations of timber supply by considering ecological and social sustainability when making forestry decisions.

Given the competing paradigms within forest research, researchers have struggled with how to bridge the gap between attending to the social consequences on forest-dependent communities, especially economic harm, and protecting biological priorities. As a result, many researchers have argued for an integrated model for identifying risks (i.e. environmental, economic, and social) that incorporates public values and processes (e.g. visual quality assessments, political consensus, increased stakeholder consultation in planning, ecosystem based management, and decentralization of authority and ownership). Much of the recent research in the area (e.g. Kimmins et al. 2005; Sheppard

2005) emphasized frameworks for public participation and the inclusion of visual representations in forest management. There are three bodies of research: those that focus on public participation, those that focus on the use of visual representations, and those that see both as mutually beneficial in forest management.

2.3.2 Public Participation

Some researchers, such as Mascarenhas and Scarce (2004), Wood (2000), or Hoberg (2008), focused on surveying public use and attitudes, studied social networks, and examined decision-making or governance. The movement towards certification, sustainable forest management, and inclusion of First Nations values has also led to devising and testing new stakeholder consultation processes to manage conflict. Sustainable forest management requires public input at various geographic scales to balance social, economic, and environmental welfare in perpetuity. Researchers (Sheppard 2005; Sheppard and Meitner 2005; Sheppard et al. 2006) argued multiple criteria at the landscape level need to be included for a balanced process to occur. For example, Sheppard (2005:1515) explored the use of new methods for achieving public participation in sustainable forest management at the landscape level, providing a framework consisting of "principles, process criteria, and preliminary guidelines for designing and evaluating sustainable forest management planning processes with community input." Sheppard et al. (2006) argued sustainable forestry involves a social component and should use multiple methods to identify public values at different levels in the decision making process at various scales. Similarly, according to Mascarenhas and Scarce (2004:34), "from the perspectives of the respondents interviewed, a successful public planning process's legitimacy is marked by the extent to which it encourages

'stakeholder' representation and involves those groups at all stages of the planning process, from identifying the terms of reference to the plan's implementation and monitoring."

Public complaints concerning extraordinary discretionary power, professional arrogance, and privileging of private interests over public engagement led to congressional acts formalizing procedures for public participation in the US in the 1970s (McCarthy 2006; Pralle 2007). Similarly in Canada, past land-use planning processes (e.g. Clayquot Sound) have been viewed as failing to include local or diverse interests and stakeholders. As a result, the public and politicians have actively promoted consensus-based decentralized planning processes.

Purcell and Brown (2005) pointed out that decentralization, especially to the local level, might not translate into sustainability; instead they argued that at any scale, complex socio-political relationships exist which may not hold ecological sustainability as a goal, suggesting that decisions should be left to experts on a provincial or national level that are accountable to a larger public. Robson, Hawley, and Robson (2000), however, found that Canadians in particular locales shared very similar perspectives to those in the nation as a whole, suggesting localized processes might be ideal for serving local needs while also including national or other diverse interests. Although their findings showed the local public in the Fraser Fort George Regional District more concerned with economic values and clearcutting practices, all the samples surveyed, both provincial and national, value broadbased ecosystem management over single resource management. In addition,

Robson et al. found lack of trust in government agencies and general agreement that forest management should be more responsive to local resident values, thereby alleviating concerns about the effects of leaving national resource decisions to local publics. Similarly, Mascarenhas and Scarce (2004:34) argued that "a legitimate plan will also attempt to balance regional and provincial concerns with local interests, and expert knowledge with local knowledge."

While much of the natural disturbance literature in forestry (e.g. Adamowicz and Veenam 1998) either detailed the importance of dynamic ecological functions or promoted integrating disturbance regimes into management, social perceptions could influence land-use decisions and management. Conflicts surrounding the visual impact of extensive logging practices and wildfires, for example, have prompted researchers to examine how the public would rate the relative importance of the disturbance and recovery characteristics to manage public priorities better and to alleviate conflicts. Xu et al. (2003) estimated biodiversity, aesthetics, and rural employment impacts to forest management and willingness-to-pay across different communities. Their results suggested the public considered job losses a decline in social welfare, leading them to conclude that understanding the trade-offs the public makes provides "important information for improving the efficiency and equity of forest ecosystem management" (Xu et al. 2003:247).

Public understanding of the origins of a natural disturbance, whether fire or MPB, is an important factor influencing support for forest policy (Kimmins et al. 2005; Kneeshaw et

al. 2004; Nelson 2007). Surveys of forest plots displaying mountain pine beetle and fire disturbances revealed that forest vegetation responded differently to fire than to the MPB. In particular, "although the widths were comparable between the disturbance types, fires generally had steeper boundaries (more pronounced) than MPB, largely due to higher peak tree mortality within the disturbances" (McIntire and Fortin 2006:309). McIntire and Fortin promoted integration of disturbance regimes (creating boundary complexity) into conservation and forest management strategies similar to the "natural disturbance paradigm" forest management approach as a community adaptation approach to the mountain pine beetle.

Kneeshaw et al. (2004) advanced the study of various fire-specific situational factors that influence the normative beliefs of the public and support for fire management actions. Though there was little variation in the acceptance of different fire management actions, they noted that the origin of the fire was one of the most important factors influencing people's decision to put out or let the fire burn. In addition, the "relative importance of risk of private property damage and forest recovery was consistently high in influencing acceptability of all three management actions, and the relative importance of outdoor recreation was lowest in the three models" (Kneeshaw et al. 2004:486).

Kimmins et al. (2005) described the origins of the MPB epidemic as a complex result of functions among the forest ecosystem, climate changes, natural disturbances, forest harvesting regimes, and forest values as evidenced within policies and uses. As

significant as its environmental costs are, they argued that the mountain pine beetle is a social issue. Consequently, management plans should reflect social values.

2.4 Visual Quality Assessments

Conventional approaches to addressing forest management problems, such as the mountain pine beetle, have centered on economic analysis and timber quality assessments. As the MPB epidemic grows, greater public attention prompted a political response. As the Mountain Pine Beetle plan first developed in 2001 and updated for 2006-2011 demonstrated, provincial policy approaches and political understanding of the ecological problem were often limited to expert economic risk assessments. These assessments tended to exclude public values or assumed the public good was best served through resource improvements. Attempts to address community concerns through the policy process expanded public participation and prompted research initiatives. In addition to expanding public involvement in forest decision-making visual representations have also been used to measure the importance of aesthetics and quality of life values in basing forest management priorities. By incorporating the use of visual representations of management scenarios, land managers were able to communicate with the public about the ecological origins and function of the mountain pine beetle; assess ecological, aesthetic, or biophysical factors affecting public perceptions; identify social concerns; and determine public support for management alternatives.

Although new forestry techniques and principles often include public participation and visual quality assessments, they have not necessarily become common practice with regards to forest decision-making processes. Some research explores the use of computer

generated images to examine visual corridors without public input or aerial photographs to monitor changes in forest composition and management (Rhemtulla et al. 2002). Scenic assessments were often constructed to gauge people's aesthetic judgments absent of their association with any other social values.

Increasingly, forestry research (e.g., Kimmins et al. 2005; Seely et al. 2004; Sheppard 2005) emphasized the value of incorporating visual quality assessments into an expanded planning process that included public participation. For example, Naussauer (1995:161) found that individuals prefer orderly appearing ecosystems over dense and seemingly unmanaged ecosystems. She noted, however, that "ecological function is not readily recognizable to those who are not educated to look for it. Furthermore, the appearance of many indigenous ecosystems and wildlife habitats violates cultural norms for the neat appearance of landscapes."

As Gobster (1999) argued, presenting information alongside visualizations can increase ecological understanding as well as support for forest management. Others, such as Kimmins et al. (2005), were more concerned that conventional approaches neglected other forms of knowledge, such as traditions inclusive of First Nations, some of which come from visual cues or aesthetic judgments. Sheppard (2001) suggested that greater visual and verbal transparency on behalf of land managers would gradually increase public knowledge and support. Introducing the theory of visible stewardship, Sheppard (2001:159) argued that it

> adds a key missing ingredient to the ecological aesthetic for working (human-modified) landscapes: that, other things being equal, we find

> aesthetic those things that clearly show people's care for and attachment to a particular landscape; in other words, that we like man-modified landscapes that clearly demonstrate respect for nature in a certain place and context.

While the theory of visible stewardship "can incorporate the role of scientific knowledge as described in the ecological aesthetic, it goes beyond the provision of scientific information (such as through interpretive displays and signs) which cites ecological benefits, and embraces certain social concerns" (Sheppard 2001:160). Sheppard's theory underscored the need while managing ecosystems to address public values and knowledge.

Kearney (2001) demonstrated the value of providing information to the public about forest management practices to increase support. Informational interventions describing benefits to wildlife and jack pine regeneration significantly increased participants' preferences for scenes depicting clear-cuts. The combination of descriptions and visualizations had a significant effect on public perceptions. Similarly, Buhyoff et al. (1982) provided information about the presence of insect damage to one group and withheld it from the other. They found that the presence of dense forests, long viewing distances, and mountainous terrain mitigated the negative visual impact for observers without information about the insect damage. Informed observers gave a lower rating on scenic beauty measures to damaged stands, especially those in the red top stage. Sheppard and Picard (2006) state that it is not clear to what effect information about forest conditions have on respondent's visual-quality ratings. It is possible, they caution,

that the public has already learned that beetle damage is “bad” and providing information prior to scenic beauty ratings may reinforce popular negative perceptions.

To test whether providing information about ecosystem management can improve the acceptability of visual impacts to forest resources, half of the participants—office workers and students—in Brunson and Reiter’s (1996) study were given information about the management of certain stands. The office workers who were provided information about ecosystem management were more likely to rate the managed stand higher than their peers. In contrast, students who received verbal instructions and information rated the managed stands lower than their peers, revealing the importance of carefully crafted messages for targeted audiences. Brunson and Reiter (1996) attributed the division between students and office workers to differences in environmental awareness, supporting the conclusion that scenic judgments have both cognitive and affective components.

Ribe (1999) showed simulated scenes depicting different retention, harvesting, and undisturbed patterns to a sample from Oregon and Washington. He found that providing information on ‘new forestry’ techniques to respondents viewing 15 percent retention harvests produced positive effects on perception ratings. In the absence of any information, perceptions of scenic beauty are no different, however, than conventional clearcuts, illustrating, on the one hand, the positive effect an improved understanding of ecologically balanced forest practices can have on individual aesthetic perceptions, and,

on the other, that "new forestry" practices are not inherently transparent as more ecologically sustainable.

Ribe's (1999) work on aesthetic perceptions of clearcuts supported Gobster's suggestion that information can inform an ecological aesthetic as well as support for new ecosystem-based management techniques. Ribe (1999:115) argued that

> when managers seek to optimize the social acceptability of forest practices they should pay attention to more than appearance. Instead they should seek to integrate the appearance and content of the landscapes they manipulate. This could be consistent with ecosystem management decision making where the "appropriateness" of landscapes, as proposed by Gobster (1996) or Tlusty (1992), rather than just their appearance, is the main objective.

Gobster argued that the more knowledge individuals had about the ecological functions of forests, the more likely they were to support forest practices and develop an aesthetic appreciation for managed forests. According to Gobster (1999:60),

> Leopold and others (e.g., Carlson 1995; Rolston 1995) have stressed the importance of scientific knowledge as an important ingredient in the comprehension and appreciation of ecological beauty. Information can be an important tool in conveying knowledge about the intent and purpose behind sustainable management practices, especially for some activities like prescribed burning where it is difficult to employ design cures to make such activities more acceptable to the public (Brunson and Reiter 1996). On-site signage, interpretive nature trails, volunteer stewardship programs, and the like can aid in communicating information to the public.

Many researchers (e.g., Gobster 1999; Sheppard 2001) found that providing on-site information about forest management through in-the-field interpretative signs, for example, increased the likelihood of public support.

Researchers (Buhyoff, Wellman, and Daniel 1982; Brunson and Reiter 1996; Ribe 1999) used visualizations to test differences in public support for management scenarios between informed and uninformed audiences. In general, providing information prior to or concurrent with viewing forest operations increased positive aesthetic responses to managed forests. Buhyoff et al. (1982) demonstrated that in the absence of information about insect damaged stands, however, the presence of dense forests and long views mitigate the visual impact to the naïve observer – the vast number of trees and expanded frame of view obscured the apparent insect damage.

In his later work, Ribe (2002) tested differences in perceptions of scenic beauty and management of Pacific mountain scenes. Ribe (2002:775) found that aesthetic perceptions correlated with support for management scenarios but were

> not perfect proxies for perceptions of acceptability within sets of people with similar and strong environmental attitudes. The same measurement protocol applied to similar participants, with only a change in instructions about the quality to rate, can produce significantly but not radically different average ratings. Environmentalists see significantly less acceptability than scenic beauty, whereas people favoring resource extraction see more acceptability than scenic beauty. These opposite ways of modulating aesthetic perceptions into more cognitive ones disappear only among the most beautiful scenes where all perceptions converge, as they do for everyone.

Environmental attitudes towards resource protection, therefore, can create differences in preferences. He concluded that aesthetic preferences can serve as a proxy for management preferences only in groups with homogeneous value orientations.

Where public acceptance of forest management generally corresponds with aesthetic preferences (the greater the beauty rating the greater the support for management), some scholars suggested that age, recreational use, and gender (Brunson and Reiter 1996) as well as attitudes towards particular environmental issues, such as resource protection (Brunson and Reiter 1996; Ribe 2002), differentiate groups that would otherwise rate the quality of beauty and management similarly. For example, Ribe (2002:757) found that

> All participants saw very beautiful scenes as acceptable, and the two rating types were correlated but diverged in ways corresponding to environmental attitudes. Participants with opposite attitudes rendered the two ratings in reversed ways: Those favoring resource production had lower standards for both qualities, rated acceptability higher than beauty, and saw ugly scenes as acceptable. Those favoring resource protection had higher standards for both qualities, rated acceptability lower than beauty, and needed beauty to see acceptable management.

Although scenic beauty did correlate with acceptance of management scenarios, environmental attitudes towards resource protection influenced management preferences (Ribe 2002). Supporters of development rated acceptability higher where they saw scenes as less beautiful; conversely, supporters of protection required a higher quality of beauty to deem a management approach as strongly acceptable.

Public protests concerning forest operations as well as these survey results indicated that Canadian forest values and practices are in conflict. What the public desires (clean ecosystems) is out of sync with the results of forest management, especially extractive practices. Gobster (1999) claimed that forest values, such as ecological sustainability and aesthetics, often conflicted with forest practices. Drawing on the work of Aldo Leopold, he proposed adopting an ecological aesthetic to reconcile differences and advance

policies and management. In *The Sand County Almanac* (1949), Leopold, notable environmental philosopher, laid out the 'Land Ethic,' one of the most influential ideas in contemporary ecological theory and environmental conservation. Leopold (1949:262) argued "a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

Gobster (1999) showed how aesthetic interests can dictate practices and how past conceptions of scenic beauty have perpetuated a static and superficial landscape. As he (1995:55) noted,

> the USDA Forest Service's 'Visual Management System' (1974) and programs of other public agencies were developed to identify aesthetic values in the landscape, define people's sensitivity to landscape change, and set standards for preserving, enhancing, or retaining aesthetic quality and mitigating the effects of landscape development. Like the landscape painters and designers of earlier times, landscape architects who practice visual management often use formal design concepts such as variety in line, form, color, and texture to describe and deal with change in the forest landscape.

Gobster used the examples of fire management, dead and down debris, and forest fragmentation to describe some of the typical conflicts between scenic and sustainable values in forested landscapes and management. Prescribed burns, tree snags or coarse woody debris, and concentrated large harvest cuts can improve forest health and diversity yet have negative impacts on public perceptions of the visual quality of forests. According to Gobster (1996:56), "following the popular scenic aesthetic, management practices often emphasize the visual, stylized design of an ideal nature, rather than one where the dynamics of change are apparent." Advancing public ecological knowledge

that embraces the structure and function of ecosystems may create a cultural shift leading to new standards for visual resource management.

Parsons and Daniels (2002) countered the critiques levied by proponents of the new ecological aesthetic and question the connection such research makes between the popular notions of the scenic aesthetic and ecosystem health. "When ecological aestheticians call for a new ecological aesthetic, they often presume a consensus about which particular land management practices lead to ecological sustainability" where instead, they noted that, "emerging data on the relationships among appreciative nature experiences, environmental attitudes and ecologically responsible behaviors suggest that scenic landscapes may have an important role to play in the development of environmental concern, as well as mediating the relationship between environmental attitudes and pro-environmental behaviors" (Parsons and Daniels 2002:54). In so doing, they call for greater inclusion of social science in policy-making process arguing that, "psychologists and other social scientists would better serve environmental policy makers by building a scientifically defensible understanding of how and why people adopt environmental concerns and engage in ecologically responsible behaviors" (Parsons and Daniels 2002:54).

According to Sheppard (2005), there is an increasing demand for active public involvement in forestry decision making, but there are as yet few established models for achieving this goal in the new sustainable forest management context. Sheppard (2005:1515) argued for integrating "the fields of forest sustainability assessment, public

participation, decision support, and computer technology in spatial modelling and visualization" at the level of the working forest. Kimmins et al. (2005:723) concluded that "hard" science is insufficient for predicting future forest states "for which knowledge and understanding must be synthesized into decision support systems at appropriate temporal, spatial and complexity scales." They went on to argue that linking these systems to visualization software would be best suited to communicate with a diversity of audiences.

Some forestry researchers (e.g. Kimmins et al. 2005; Seely et al. 2004; Sheppard 2005; Sheppard et al. 2006; Xu et al. 2003) argued for expanding participation and decision support systems, for inclusion of public values beyond financial ones, and for use of visualizations. They concluded that sustainable forest management requires more than expert judgments. Kimmins et al. (2005), for example, promoted a more holistic approach to forest management, claiming that sustainable forest management must consider other ways of knowing and incorporate diverse approaches from the non-traditional to advanced visualization techniques into a decision support system for predicting future forest states. Seely et al. (2004) discussed the development of 'criteria and indicators' identifying economic, ecological, and social objectives as well as the hierarchical decision support system for determining forest management options. Their findings highlighted the importance of incorporating a visualization component into the decision support system as well as an understanding of the risks and patterns of natural disturbance events in the area. Both Kimmins et al. and Seely et al. argued that forest problems require more than simple technical assessments; economic, ecological, and

social indicators as well as advanced visualization techniques can contribute valuable information to managers seeking alternative means of communicating with the public. In short, visual representations make it easier to include stakeholders in a transparent forest management process.

2.5 Forest-Dependent Community Assessment

Much of the social research conducted in forestry examined forest-dependent communities (Norton et al. 2003; Parkins et al. 2001; Stedman et al. 2004; Stedman et al. 2007), assessing their well-being (Norton et al. 2003; Stedman et al. 2004), community capacity/adaptability (Davidson et al. 2003; Joshi et al. 2000; MacKendrik and Parkins 2005), or sustainability (Parkins et al. 2001). Not all communities depend on forests in the same manner. For example, according to Parkins, Stedman, and Varghese (2001), communities can be dependent on forests for subsistence, traditional logging, or park-based tourism. Researchers (Joshi et al. 2000; Stedman et al. 2004, 2007) differed in how they measured dependence and well-being using a variety of measures of forest-dependence, including variables such as human capital, size, region, and sector, such as lumber, pulp, and secondary products.

Stedman et al. (2007:633) considered a community "dependent on the forest sector if the industrial forest sector's contribution to the total economic base is relatively sizeable compared to that of the other sectors." They compared four different approaches to measuring forestry-dependence: base income, base employment, proportional income, and proportional employment. "IB (Income Based) approaches tend to identify larger communities with a stronger presence of pulp as resource dependent, and this will likely

influence the performance of these communities according to a number of indicators of well-being when compared to alternative methods" (Stedman et al. 2007:642-643). They calculated economic base dependence by "measuring the level of monetary inflows associated with a particular economic sector or the employment equivalent (number of jobs)" (Stedman et al. 2007:633). Similarly, they calculated income base dependency by measuring the income associated with the forestry sector. To obtain proportional methods for income and employment, they took "total employment (or income) in the forest industry in a given area (in our case, a CSD) and divide it by total employment (income) within the CSD" (Stedman et al. 2007:634). Comparing an economic base approach using either employment or income to a proportional approach calculated as the percentage of total income or employment derived from the forest sector, Stedman et al. (2007) found that methodological differences in determining forest-sector dependence (based on size, region, and sector differences) produced different levels of dependency which in turn affected measurements of well-being. Stedman et al. (2007:642-643) concluded that "the use of any particular method carries with it implications about the kinds of communities it will identify as resource dependent, and by implication, different conclusions about the nature of dependence."

According to Stedman et al. (2004), well-being included some measure of human capital, unemployment, and income, while Norton et al. (2003) used demographic, economic, health, educational, housing, government finances, and agricultural variables. Most researchers conducting forest-dependent community assessments agreed that assessing well-being required some measure of income and employment. Stedman et al. (2004)

explored competing theories of the relationship between community well-being and resource dependence across industries (agriculture, fisheries, mining, energy, forestry). Their results revealed that effects of resource dependence on well-being (human capital, unemployment, income) varied by industry. Therefore, dependency—and by extension well-being—could be based on the number of people employed directly by a mill, the degree to which the forest and its products provided physical subsistence to the community (i.e. forest-dwelling impoverished communities), or the cultural heritage attributed to the forests (e.g. BC First Nations or National Parks).

In the United States, Norton et al. (2003) found that timber dependent counties in the Southwest had significantly lower well-being than areas in the Northwest. They concluded that structural or systematic differences between the two regions' industry–landbase relationship (sector size, type, and output relative to available timber resources) determined their varying degree of dependency:

> For the Northwest, the major problem associated with timber dependency is the sustainability of timber resources for the wood products industries…. The problem in the Southeast is that timber dependency is associated with negative social and economic indicators. The timber dependent counties are poorer, less educated and more demographically stagnant than other counties that are timber dependent in the United States. (Norton et al. 2003: 53-54)

In the South, the forest industry resided primarily in poor areas with timber supplies generated from private lands whereas the Northwest forest industry is subject to stronger environmental policies.

Jackson, Lee and Sommers (2004) demonstrated the limitations inherent in using secondary or social indicators to evaluate social and economic changes in rural and forest dependent communities after the introduction of the Northwest Forest Plan. Aggregate figures can obscure variation within smaller areas. They argued that the collection of longitudinal and local-level data would provide a better strategy for anticipating the social and economic effects of policy changes in resource-dependent communities.

Generally, social researchers suggested that beyond geography (or proximity), particular economic, political and socio-cultural institutional arrangements explained community vulnerability to natural disturbances such as the MPB (MacKendrick et al. 2005), climate change (Davidson et al. 2003), or changes in the forest industry (Davidson et al. 2003; MacKendrick et al. 2005). MacKendrick and Parkins (2005) assessed community vulnerability to the mountain pine beetle outbreak in British Columbia and Alberta concluding that vulnerability is more than the extent of physical exposure but included a host of social, economic, and political factors that defined the community's adaptive capacity. Incorporating socio-economic and political factors changes the vulnerability rankings. MacKendrick and Parkins argued, therefore, for a pluralistic approach to environmental risk assessments.

2.6 Environmental Values

Research has shown a strong relationship between an individual's environmental orientation and his or her environmental risk perception (McFarlane 2005; Sjoberg 2003; Slimak and Dietz 2006), and environmental behavior (McFarlane and Hunt 2006; Olli et

al. 2001), as well as his or her perceptions of conflict (O'Brien 2006), and forest-specific disturbances (Flint 2007; McFarlane et al. 2006).

Researchers have devised different indexes to measure environmental orientations, such as the ecocentrism scale (Grendstad and Wollebaek 1998) and most notably the New Ecological Paradigm (Dunlap et al. 2000). The NEP has become one of the more conventional approaches to measuring environmental attitudes. While Dunlap et al. found that the NEP represented one worldview, others (Diekmann and Franzan 1999; Edgell and Nowell 1989; Noe and Snow 1989-90; Shetzer, Stackman, and Moore 1991; Furman 1998; Roberts and Bacon 1997) suggested the index may consist of more than one. Dunlap et al. (2000) acknowledged that there is considerable debate about whether the NEP represented one universal world-view or two or more dimensions. Factor analysis of the revised NEP revealed five dimensions, which they argued were part of a single ecological worldview.

Slimak and Dietz (2006:1700) confirmed that the Schwartz altruism scale explained "31 percent of the variance of the NEP scale, more than any other social-psychological and social-structural variable. These findings supported the results reported by Stern et al. (1995) that the NEP and Schwartz's altruism value are related concepts." Thus the NEP and similar indices can be used to measure stakeholders' environmental attitudes (Hovardas et al. 2007).

McFarlane and Boxall (2000) draw on social-psychological theory to examine general environmental beliefs (biocentric vs. anthropocentric) and forest values. According to McFarlane and Boxall (2000:651), reflecting "the evolution from sustained timber production to sustaining a range of forest values," previous research distinguished between two categories of held forest values: "instrumental and intrinsic (Bengston 1994), instrumental and noninstrumental (Xu and Bengston 1997), and anthropocentric and biocentric (Steel et al. 1994)." Anthropocentric beliefs refer to those that view the environment as a means of meeting human needs and desires. In contrast, biocentric beliefs refer to those that value the environment for its own sake rather than for the utility it holds for humans. McFarlane and Boxall found that respondents with higher anthropocentric values were more supportive of current forest management practices, economic development, and timber-oriented management. These studies demonstrate an emergent spectrum of orientations, dimensionality, or values posited to be connected to individuals' views of the environment. Regardless of the measure employed, differences among groups are found to be associated with issues such as timber production.

While researchers such as Dunlap have observed an emerging environmental worldview to support theories of a uni-dimensional anthropocentric – ecocentric scale, some research suggests such a narrow conception of may avoid the recognition of the variety of environmental impact theories. In their summary of three major environmental impact theories York, Rosa, and Dietz (2003) describe the environmental modernization perspective as an argument "that further modernization can solve those problems as nation-states and industrial firms come to recognize the importance of environmental

sustainability to their long-term survival" (285). With its basis in neoclassical economic theory, this perspective not only argues that advanced capitalist economies and institutions are not in conflict with the environment it presupposes that as market forces drive industry toward improved efficiency, industry will restructure its operations towards more ecologically rational and sustainable means to reduce environmental externalities. Thusly, the individual who agrees with this perspective supports the notion that continued modernization is necessary in order to reduce environmental impact and will result in increased sustainability.

2.6.1 Environmental Action

Research (McFarlane and Hunt 2006; Olli et al. 2001) has found that environmental attitudes are also related to action. For example, Olli et al. (2001:194) found that among non-members of environmental organizations, environmental behavior increased when individuals' responses exceeded the middle value on ecocentrism and the medium to high values on political egalitarianism on the New Ecological Paradigm scale. Furthermore, Olli et al. found that individuals who held extreme New Ecological Paradigm positions performed two additional environmental acts and that women out performed men by one environmental act. McFarlane and Hunt (2006) found that a biocentric orientation was negatively associated with the view that forests were being managed sustainably and influenced activism directed toward the forest sector. In her qualitative analysis of public perceptions of the forested landscape of Vermont, O'Brien (2006:269) found that "the ways in which people value trees and forests and the meanings they associate with specific places are linked to wider issues of concern over development and planning,

private and public ownership of land, and people's well being and quality of life." Her respondents wanted to participate in decisions regarding the management of public lands.

Other factors also affect environmental action. For example, Blocker and Eckberg (1997) found that social status as well as knowledge explained environmental action. Individuals of a higher social status or with more knowledge were more likely to pursue pro-environmental activities. Kanagy et al. (1994) found social status to be less important than other variables such as cohort, political affiliation, or religious attendance. Boxall and McFarlane (1995) found that greater income, age, and surrounding forest cover positively influenced an individual's environmental participation.

Harshaw and Tindall (2005) examined how environmental participation reflected the diversity of an individual's social ties and how those connections determined the forest values an individual held. Harshaw and Tindall's (2005) results suggested that the strength and diversity of an individual's social networks contributed to a diversity of identities and of forest values. In short, the broader the social network, the greater the diversity of identities and values. Strong relationships, however, were more important in determining the diversity of identities and values than weak ones. As Harshaw and Tindall (2005:441-442) explained,

> this finding is important when one considers that non-foresters had a higher diversity of strong ties, and might partly explain why non-foresters had significantly more diverse forest values than foresters do. Although one might expect that the range of weak ties would have an influence on the diversity of identities and values, as these ties tend to expose people to more diverse types of information (Granovetter 1973), it makes sense that the range of strong ties plays a more important role in influencing the

> diversity of values and identities, for the people closest to us have the greatest influence on us.

Theoretically, participation in environmental activities can come as a result of support for environmental causes, as well as participation or membership in organized environmental events/networks that can increase environmental awareness, knowledge, or beliefs. Social scientists interested in environmentalism and environmental action, therefore, often measured people's participation in outdoor recreation or membership in outdoor clubs and environmental organizations (Harshaw and Tindall 2005).

Blocker and Eckberg (1997) found trust in science to be associated with environmental action whereas Fruedenberg (1993) found lack of trust in government officials to be important in determining people's decision to take action on environmental issues. Therefore, people's level of trust in the social or political institutions that are responsible for managing the environment can affect their attitudes, risk perceptions, and behavioral responses.

2.6.2 Environmental Risk Perception

Exploring the relationship between confidence in government land managers and risk perceptions, qualitative interviews from Flint's (2007) longitudinal study suggested that salience of a natural disturbance event may influence environmental orientations and risk perceptions but it is issue sensitive. Flint's (2007:1597) "results show a decrease in the saliency of the spruce bark beetle as a community issue, a coalescence of community risk perceptions about fire, and conflicting findings about satisfaction with land managers and its relationship with risk perception." Flint (2007:1607) found a

> significant negative relationship between satisfaction with government land managers and the perception of broader threats to ecological and community well-being. This relationship in the 2006 data was not found in the 2004 data. This suggests that perceived recreancy or lack of confidence in land managers may be more issue sensitive and temporally dynamic than previously operationalized.

Flint found that the perceived impacts of the spruce bark beetle differed depending on the respondent's experience with the beetle.

McFarlane found value orientation was a better predictor of risk perceptions than knowledge or socio-cultural values. A biocentric value orientation was associated with higher risk ratings than an anthropocentric value orientation. Whereas an anthropocentric value orientation is generally found to have a negative correlation with perceived risks to forests, McFarlane (2005) found that it had a positive association with natural disturbance risks. In other words, individuals to whom natural resources were generally viewed in a utilitarian manner were more likely to be concerned with or see natural disturbances such as the mountain pine beetle to be the greatest risk. McFarlane believed that the threat of insects and disease was an emerging perception likely influenced by the mountain pine beetle epidemic taking place in British Columbia. McFarlane (2005:551) argued that, "although the beetle has not been implicated in losses to biodiversity, it is likely that the negative publicity generated around timber supply loss and economic impacts of the infestation are influencing the public's perception of risk to biodiversity."

Sjoberg's (2003) research compared three separate studies to examine the validity of various "distal explanatory factors in risk perception" including: Five Factor Model

(modeled by Sjoberg after commercial aviation assessments), Myers-Briggs Indicators; Cultural Theory (Douglas and Wildavsky 1982); New Age beliefs (Sjoberg 2002c); and the New Environmental Paradigm (Dunlap et al. 1992). Sjoberg (2003) found that only particular dimensions of his Five Factor Model and New Age beliefs[4] showed any significant relationship to risk perception. Emotional stability was positively related to risk perception and 'Macho' risk willingness was negatively related to demand for governmental risk mitigation. In his discussion of the results, Sjoberg (2003:200) noted that, "New Age beliefs had a dominating position in accounting for perceived risk, when all independent variables were included in the regression equation. It was even more powerful than gender. New Age beliefs had the largest regression weight in four of the six analyses and a large one also in the remaining two."

Slimak and Dietz demonstrated the predictive power of the New Ecological Paradigm and Schwartz's measure of altruism, which together explained up to 46 percent of the variance in risk ratings. As they noted,

> in simple models predicting risk perception with just altruism and the NEP, the R^2s for the general public and for the experienced public were higher than those for the risk assessors and risk managers for each risk scale. Thus it may be that because of their greater familiarity with and interest in environmental risks, the risk professionals … were perhaps less influenced by values and general beliefs. (Slimak and Dietz 2006:1703)

[4] New age beliefs included beliefs in a 'higher consciousness,' belief in the physical reality of the soul, traditional folk superstition, and denial of science and analytic thinking as modes of inquiry.

This study not only identified the risk perceptions of the public (high consequence low probability risks) it also confirmed the explanatory power of value-belief-norm theory. According to Slimak and Dietz (2006:1691), value-belief-norm theory connects three theoretical models: norm-activation theory, the theory of personal values, and the New Ecological Paradigm, into a unified explanation for environmentalism. The integration of these theories leads to a hypothesized causal chain of five types of variables: personal values, a general set of beliefs or worldview, in this case the new ecological paradigm of Dunlap and Van Liere (1978; Dunlap et al. 2002), awareness of consequences, ascription of responsibility, and personal norms for pro-environmental action. Furthermore, the model illustrated the influence of demographic and social structural variables (e.g. age, gender, education, income, and ethnicity).

According to Davidson, Williamson, and Parkins (2003), northern forest ecosystems were among regions at greatest risk from climate change, yet communities within the region have limited community capacity to manage such risks. Constraints on adaptability, failure to identify deforestation in the political arena, entrenched forestry investment and management, the potential of members to underestimate climate change risks, and the complexity of climate change risks can lead to being more susceptible to climate change. Davidson et al. (2003:2259) concluded that, "residents of small, rural, forest-based community, in which employment is heavily male dominated and in which a forestry company plays a predominant role in both local politics and economics, may tend to disregard information about climate change risk." Davidson et al. (2003) identified four factors most likely to explain low levels of perceived risk in forest-based

communities: first, manifestations appear as pre-existing risks and are treated as isolated events; second, messaging is often branded as environmentalist and treated as oppositional; third, risk perceptions tend to be lower in a highly-male dominated environment; and lastly, social networks are relatively closed and dominated by forest interests which in turn influences the information individuals receive.

Results from a survey in Homer, Alaska, showed a decrease in the salience of the spruce bark beetle, coalescence of risk perceptions about fire, and conflicting findings about satisfaction with land managers and the relationship issue salience has with risk perception. Researchers (Flint 2007; McFarlane 2005; McFarlane et al. 2006; Sjoberg 2003; Slimak and Dietz 2006) have pointed out that heightened risk perspectives could potentially alter individuals' value orientations, widen public divisions in the jobs versus environment debate, and influence public support for mountain pine beetle management policies.

2.7 Demographic Characteristics

Environmental geographers, landscape architects, and environmental psychologists have all generally built their studies on the premise that there is a significant relationship between geography or biophysical processes and social identities. Field et al. (2003) argue that landscape patterns are invariably tied to place and that the social processes located within can be measured by standard demographics to understand the significant relationship between social and biophysical processes. Norton et al. (2003), as noted earlier, described the differences between timber dependent communities in the South

and Northwest, suggesting differences in social construction/systems and cultural identities.

A few demographic variables consistently seem to be related to environmental values or behaviors. Dietz et al. (1998) identified age, education, and place of residence "as the only consistent socioeconomic predictors of environmentalism" (in McFarlane and Boxall 2000:659). Similarly, McFarlane and Hunt (2006:278) found that "age, sex, and education are the only social structural variables in our hypothesized model that have shown a relatively consistent relationship with environmental value orientation." Age and education were the only social variables associated with environmentalism according to both sets of researchers while age is the only variable they had in common with Olli et al. (2001). They (2001:197) found that, "in general, the significant catalysts of general environmental behaviors are gender, age, urban residence (negative), radicalism, ecocentrism, compost knowledge, and participation."

Age (McFarlane and Boxall 2000, Seippel 1999) or a cohort replacement effect (Kanagy et al. 1994) can explain differences in concern for the environment. Younger people tend to hold more positive views towards the environment. Olli et al. (2001:200) argued that age is related to environmental behavior by way of a cohort effect: "The fact that the effect of old age does not decrease when attitudes and participation are included in the regression leads us to conclude that the correlation between age and environmental behavior is an effect of generational experiences rather than an age effect."

Unlike McFarlane and Boxall (2000), other researchers found that gender had a relationship with environmental values (Blocker and Eckberg 1997), participation (Boxall and McFarlane 1995), and behavior (Olli et al. 2001). Women were not only more likely to be concerned (Blocker and Eckberg 1997) about the environment, they were also more likely to engage in activities, including responsible consumerism, resource conservation, use of nature, non-toxic, and waste handling (Olli et al. 2001). While Blocker and Eckberg's (1997) results demonstrated that women showed more personal concern for the environment than men (perhaps due to differences in socialization and status), they argued that this difference in values did not readily translate into differences in engaging in environmental action.

Kanagy et al. (1994) found that period effects, religion, and political orientation have statistically significant impacts on support for environmental spending. In the United States, Democrats were more likely to support environmental spending. In contrast, attending religious services as well as religious fundamentalism had a negative effect on environmental concern (Kanagy et al. 1994).

Higher levels of education were also associated with pro-environmental attitudes (McFarlane and Boxall 2000; McFarlane et al. 2006). According to McFarlane and Boxall (2000:657), "of the socioeconomic variables, younger individuals, those with lower levels of education, and those living in a forest-dependent community were more supportive of current management, economic development, and timber-oriented management. Income, gender, and living in an urban area were not associated with

attitudes." Lower levels of education were associated with timber-oriented management; conversely, higher levels of education were associated with environmentally based management or conservation.

McFarlane and Boxall (2000) found that, in general, forest-related knowledge was not associated with attitudes, such as preferences for forest resource protection, economic development, timber-oriented management, and sustainability of current provincial (Alberta) forest management - attitudes are more value driven. In contrast, McFarlane et al. (2006:346) found that greater knowledge about the MPB was "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."

In Norway, Seippel (1999) found middle class or skilled workers were more postmodern, which in turn positively influenced their attitudes towards the environment. Seippel (1999:147) concluded that environmentalism is affected by "postmodern values, and that environmentalism—as well as politics within late modern society more generally speaking—has a wider and more complex basis than assumed in many analyses of political intermediation in late modern societies." McFarlane and Boxall (2000) reported that income was not associated with attitudes towards forest management; however, individuals with lower income were more likely to hold biocentric values and individuals whose economic livelihood depended on the forest sector were more likely to be anthropocentric.

In sum, McFarlane and Boxall (2000) found age, education, and residence are fair predictors of environmentalism, yet the effects of income and gender are generally inconsistent. Socioeconomic factors, social influences, and knowledge had little effect on predicting values or attitudes of the respondents. Instead, McFarlane and Boxall (2000:659) concluded that "attitudes are more value driven regardless of socioeconomic status, association with environmental organizations, forest-sector dependence, or level of knowledge." Similarly, Mertig and Dunlap (2001) found that demographic variables were poor predictors of support for environmentalism because it receives broad public support. These results have implications for the increasing role public participation plays in forest planning. Age, gender, political or religious views, education, income, and class are frequently causal factors that shape environmental attitudes, preferences, and behaviors.

2.8 Social Capital

Research is beginning to examine the relationship between environmental behaviors and social networks, capital, access, and policy. Harshaw and Tindall (2005:429) defined social capital as "social goods, such as information and social influence, which are produced and dissipated through social relations." Parisi et al. (2004:99) defined social capital as "a social resource embedded in networks of association that facilitate processes of interaction within and between social groups." Parisi et al. (2004) found environmental activeness tended to be higher among communities with greater access to social capital and that other demographic variables—such as education and economic prosperity—affected the level of access individuals have to social capital.

Building on the foundations of social capital theory, Flora (1998) introduced entrepreneurial social infrastructure as an inclusive framework for understanding community choices or action. Successful collective community action is arguably based on the level/coherence of social infrastructure found in the community. As Flora (1998) or Norton et al. (2003) might suggest based on their findings, British Columbia interior communities may be more susceptible to the effects of the MPB outbreak because of the contribution the forest industry makes to the social infrastructure of a community. Furthermore, the limited social capital or entrepreneurial social infrastructure of communities impacted by the mountain pine beetle will lessen their ability to pursue alternative economic development projects. An understanding of social structures and social capital can help researchers and policy-makers identify critical processes, identities, and values in mountain pine beetle impacted communities.

2.9 Social Context

Understanding environmental behaviors requires examining social context (Boxall and McFarlane 1995; Derksen and Gartell 1993; Olli et al. 2001). Examination of the social infrastructure (Flora 1998), access to programs or social capital (Derksen 1993; Parisi et al. 2004) as well as individual's membership in particular organizations (Boxall and McFarlane 1995; McFarlane and Hunt 2006) may lead to a greater understanding of environmental behavior than conventional approaches such as gauging environmental attitudes using the New Ecological Paradigm (Olli et al. 2001) or determining relative resource-economic dependence of a community (McFarlane and Hunt 2006). Olli,

Grendstad, and Wollenbaek (2001:181) concluded that the bridge between belief and action appears to be the social context: "Social context is the only variable that significantly augments environmental behaviors across all subdimensions." Recycling results, used as the measure for pro-environmental behavior, showed that access to recycling programs lead to greater participation than attitudes towards the environment alone, although individual attitudes towards the environment enhance the effect but do not overcome the barriers to recycling (Derksen and Gartell 1993). Derksen and Gartell (1993) highlighted the importance of social context and access to promoting and reinforcing pro-environmental behaviors.

2.10 Place

Although Kanagy et al. (1994) found residence to be less important than other variables in explaining environmental beliefs, some researchers argued it is important to participation (Boxall and McFarlane 1995; McFarlane and Boxall 2000; McFarlane and Hunt 2006). Boxall and McFarlane (1995) found that membership in an organization, living in a house rather than an apartment, and residing on a farm or on acreage increased the likelihood of participation as did the amount of surrounding forest cover and geography. These are alternative ways of thinking about residence as they are all place-contingent variables. Outdoor recreational activities, for example, are invariably tied to place and it follows logically that proximity and geography are, therefore, important to such pursuits.

Geographic location within the province of Alberta and the degree of forest cover positively influenced the respondents in Boxall and McFarlane's (1995) study of

residential wildlife appreciation. McFarlane and Boxall's (2000:657) study of the Foothills Model Forest in Alberta showed "those living in a forest-dependent community were more supportive of current management, economic development, and timber-oriented management" and conversely; they found individuals living in more urban areas (Edmonton and Calgary) to be more biocentric. Racevskis and Lupi (2006) refuted the notion that urban and rural views fall diametrically along the anthropocentric-biocentric continuum. While they found differences between rural resource dependent and urban non-timber dependent communities, both market and nonmarket outputs were important to rural residents whereas non-timber dependent residents were largely concerned with maintaining recreation opportunities. In other words, there was an economic undercurrent tied to place that could be arguably challenging the prevailing theory of an anthropocentric-biocentric landscape.

McFarlane and Hunt (2006) uncovered an interaction effect between social-psychological variables and socio-cultural variables that shaped attitudes, influenced behaviors, and resulted in differences between regions. Specifically,

> the social psychological variables and social-cultural variables shaping attitudes and influencing behavior interacted with region of residence, producing different effects. In particular, belonging to an environmental organization exhibited significant differential effects. The effects of belonging to an environmental organization in a region with diverse economic and social influences, such as southern Ontario, were different than in a natural resource-dependent region. (McFarlane and Hunt 2006: 282).

In other words, McFarlane and Hunt's (2006) findings suggested that in areas where the economy was primarily dependent on resource extraction but there was also, for example,

greater knowledge about forestry issues, pro-environmental attitudes were present yet environmental activism was muted. In this instance, a biocentric orientation was associated with a negative view of sustainable forest management and was positively associated with activism directed towards industry (McFarlane and Hunt 2006).

Kanagy et al. (1994) find that residence in the Mountain Region positively affected support for environmental spending. Hays (1992:14) noted that

> The Mountain region displays major elements of both, raw material/extractive activities that have long underpinned its economy and newer major centres that have built communities and new economic activities based on the region's environmental assets: rivers, mountains and deserts. In this case the two cultures, one environmental, the other commodity, are locked more fully in vigorous combat than in any other region of the nation.

Although Hays noted the increasing political support/movement in the mountain region towards conservation, the voting record of those states positioned them at the bottom of the League of Conservation Voters.

Region of residence provided the grounds for formation of a worldview that had a strong influence on environmental membership and, therefore, on value orientation, attitude, and activism. The role of contextual effects related to economic dependence in a locality is important to consider in our understanding of the social forces influencing public perceptions related to forest issues. Forest disturbances caused by insects present both a physical and social dilemma. Flint (2007) recommended evaluating the human dimensions of forest disturbances to further our understanding of the relationship between natural and social systems in general, but on risk perceptions and attitudes in

particular. Therefore the forest disturbance as it draws around a boundary also encompasses a landscape with overlapping and possibly interdependent natural and social systems which would theoretically provide the grounds for differences in attitudes and the perception of risks.

2.11 Environmental Policy and Issue Salience

Natural disturbances can create opportunities for significant policy change. According to Nelson (2007), natural disturbances can open policy windows and drive public interest in reform. Nelson (2007) as well as McGarrity and Hoberg (2005) considered the factors driving policy responses, identifying political actors, and evaluating governance structures relevant to the mountain pine beetle management. Some researchers took a more theoretical (Fitzpatrick 1998) or policy regime approach (Cashore et al. 2001) while others (Hoberg 2008) compared different governance models (ecological vs. economic) to understand the relationship among economics, environmental policy, and social welfare.

Fitzpatrick (1998) called attention to the somewhat discordant views of social justice and ecological sustainability and built an ecological critique of social policy. He argued that social welfare had become dependent on indiscriminate economic growth and the exhausting demands on natural resources. The ecological model of welfare is defined by its recidivist, renewable, and sustainable policies. Several themes arise when researching environmental policy decisions and public values: issue salience (Freudenburg et al. 1998; McFarlane et al. 2006), human capital (Joshi et al. 2000), affluence (Diekmann and Franzan 1999), and environmental values (Jackson et al. 2004; Hovardas et al. 2007).

Abundant wood, water, labor, and transportation were the principle factors attracting the pulp and paper industry to the South although Alabama used large property tax abatements to lure companies to locate to particular communities. As an unintended consequence, tax abatements adversely affected local funding for public education. Joshi et al. (2000) concluded that underinvestment in human capital is the primary obstacle to further development in rural areas. As the general public becomes aware of an environmental problem, the issue may create a policy window during which interest groups may take action to resolve the problem through on the ground management or the government may enact new legislation. McFarlane et al. (2006) suggested that the salience of the mountain pine beetle issue has led to increasing public pressure for provincial policy to manage the matter. McFarlane et al. (2006) found that issue salience and knowledge were the best predictors of attitudes towards the mountain pine beetle; in turn, positive attitudes towards the mountain pine beetle resulted in support for less intervention although residing near the mountain pine beetle outbreak was associated with stronger support for controlling the outbreak in national parks.

Freudenburg and his co-authors (1998) took on the social costs of issue saliency and regulation in their famous work on the conflict in Oregon surrounding loggers, environmentalists, and the spotted owl, by examining the key argument against increasing environmental regulation to determine whether concerns over job losses were justified given past environmental policy. In the past, as a consequence of environmental regulation, loggers lost their jobs. In this instance, the passage of the Wilderness Act and potential job loss became a highly popularized media focus and, therefore, the salience of

the issue became associated with the environmental orientations of those involved in the spotted-owl controversy.

2.12 Summary

Heightened perceptions of ecological and economic risk may produce support for increased harvesting. The greater the perceived risks to ecology, economy, and community, the greater the support for policies to increase harvesting. Furthermore, the more those risks are associated with past mismanagement, the greater the support for harvesting. Therefore, I hypothesize that the more forest dependent community will have a higher level of support for intervention to manage the MPB. Second, I hypothesize that the more concerned individuals are with the economic impacts, the more likely they are to support increased harvesting. Third, individuals with anthropocentric viewpoints will support increased harvesting. Finally, the greater individuals' trust in social institutions such as sources of knowledge about the MPB or knowledge about the MPB, the more they will support harvesting. Subjective views about the mountain pine beetle outbreak provide important information for the policy making process. This exploratory study seeks to gain a better understanding of the social determinants of public support for mountain pine beetle management alternatives.

3 Research Methods

3.1 General Methods

Most prior heuristic socio-environmental research has centered primarily on the general relationship between environmental attitudes and behaviors and has rarely been applied to more complex environmental management issues such as those posed by the mountain pine beetle epidemic. Thus, the purpose of this research is to examine how some of the regularly studied determinants of pro-environmental attitudes, particularly residence in a forest-dependent community, perform as predictors of support for mountain pine beetle management policies. To develop a more complete model of the determinants of support for natural disturbance management strategies, I focus on variables whose relationships to environmentalism have been extensively expounded in the literature on attitudes toward the environment: residence in a forest-dependent community, economic effects, value orientations, environmental knowledge, trust in institutions, and demographic characteristics. In short, the research question addressed in this analysis is: What factors affect the respondents' support for harvesting as a mountain pine beetle management strategy? The objective of this study is to understand the factors that lead to public support for harvesting mountain pine beetle impacted forests in a more forest-dependent and less forest-dependent community.

Previous research (McFarlane et al. 2006) has found links between pro-environmental attitudes and support for positive environmental policies. The mountain pine beetle problem, however, is not a straightforward one with clear and mutually exclusive pro-environment and anti-environment stances. Therefore, the reasons for supporting or

opposing harvesting may be more complex than in other situations where the forest industry proposes to clearcut forests. The purpose of this research project is to uncover factors associated with public support for mountain pine beetle management strategies, particularly harvesting, within two communities that are differentially affected by the epidemic.

This chapter begins with a brief description of the survey research design. Next it provides conceptual definitions for the dependent and independent variables and describes how the concepts are operationalized. Then I describe the sample followed by an overview of the analytical strategy to address the main research questions. The chapter concludes with a discussion of the limitations of the research design.

3.2 Research Design

The goal of this study is to understand differences in perceptions of and knowledge about the mountain pine beetle and related issues in two communities in British Columbia: Prince George and Kelowna. Given this goal, a survey containing both closed and open-ended questions was administered to elicit information from residents of these two communities. Results from the survey provide insight into the public's support for different mountain pine beetle management strategies, particularly harvesting. The weakness of this cross-sectional study with a correlational research design is no determination of the causality can be made; however, the strength of this design is its ability to establish whether a relationship exists among many variables.

Data used in this analysis were obtained through a self-administered survey. The survey instrument was structured in three parts. The first part covered support for forestry operations, particularly those related to MPB management, trust in information sources, environmental attitudes, economic interests, and knowledge about the mountain pine beetle. Some of the questions were adapted from items in the General Social Survey (GSS) that other researchers studying environmentalism (Steil 2008; Weaver 2002) have used. The second section of the survey incorporated a visual experiment designed to assess social dimensions affecting the acceptability of management actions. Specifically, in the context of the mountain pine beetle epidemic the following were investigated: issues of the public acceptability of possible management alternatives; public beliefs of the origins of this event and how those belief frame appropriate management goals post event; and perceptions of impacts and associated mitigation strategies on non-timber and non-market values including aesthetics and recreation potential. Analysis of these visualization data is reported elsewhere (Meitner et al. 2006). The final portion of the survey collected demographic information about the respondents such as their age, gender, and education.

Many of the questions used in the survey instrument are intended to measure attitudes, behavior, and demographic characteristics of the adult population in the communities of Kelowna and Prince George. As such, these questions are meant to serve as social indicators, as counterparts to the economic indicators most often used in forest/ community assessments. The survey was designed to measure individuals' perceptions, values, understanding, and support for mountain pine beetle management strategies. In

this survey, respondents were asked questions on issues such as their level of trust in information sources, economic impacts of MPB, ecological value orientations, and their preferences for forest policy tradeoffs, questions that provide data for testing the hypotheses. Data from this survey are particularly useful for examining the correlates of support for mountain pine beetle management tradeoffs because they include a broad range of attitudinal indicators in addition to standard demographic variables.

As this research is focused on exploring issues related to support for mountain pine beetle management strategies, a survey is an appropriate instrument for gathering data to address the main research questions regarding differential factors or dimensions on the issue. The survey contains a set of attitudinal statements related to forest management goals that were designed to elicit attitudes relating to trade-offs between economic and ecological outcomes of responses to mountain pine beetle management. Other attitude statements were designed to gauge participants' level of trust of different actors.

The objective of the larger research project is to investigate the public acceptability of possible management alternatives for the mountain pine beetle epidemic. To measure public opinion, I developed a structured questionnaire. The study uses a 71-item self-administered questionnaire (see Appendix A) to collect data on a range of values, knowledge, and perceptions related to mountain pine beetle management strategies. This thesis, however, is primarily concerned with a subset of questions aimed at delineating preferences for mountain pine beetle management alternatives. A five-point Likert scale

was used to elicit responses to attitudinal statements ranging from ‘strongly agree’ to ‘strongly disagree’.

The survey measures attitudes about the current mountain pine beetle epidemic, social actors, wider environmental and economic interests, and demographic information. This survey also addresses individual beliefs about the possible causal factors behind the MPB outbreak and how people understand the role of humans in contributing to them. Near the end of the instrument, participants are again asked to indicate the degree to which they support harvesting ‘damaged wood’ to check whether their support for this strategy may have changed as a result of participating in the research project. This thesis draws upon some of these data to test the six hypotheses.

3.3 Operationalization

Questionnaire development was guided by causal models being discussed by the public and forestry professionals as well as by the existing research on environmental attitudes. The following section identifies the key concepts that the survey instrument was used to measure. For further information on the operationalization of concepts found in the survey, please refer to the instrument in Appendix A.

3.3.3 Support for Harvesting

The primary dependent variable measured in this study is the support for increased harvesting to manage the mountain pine beetle outbreak. Considering the nature of the forest disturbance, the primary response to the outbreak advocated by the forest industry as well as policy makers is to increase harvesting levels so as to mitigate the spread of the mountain pine beetle as well as to salvage remaining economic value. To test for internal

consistency, several similarly worded questions about harvesting were placed throughout the survey instrument for analysis. The following five harvesting questions were incorporated into the survey:

1. Some experts argue that a necessary response to the mountain pine beetle (MPB) outbreak is to increase harvesting levels of all standing pine (including unaffected trees). Do you generally support more or less harvesting?

1	2	3	4	5
Less Harvesting		No Change		More Harvesting

2. It has been argued that salvaging more pine now will allow the forest to recover faster, get the most value from the timber resource, and employ more people in the short term. However, increased salvaging now will likely result in the elimination of many jobs in the future (15-20 years) after all of the affected pine has been cut and there is no more available mature pine to harvest. Additionally, unless other techniques can create diversity in the ages of the trees planted after salvaging, another MPB epidemic may occur. Would you support policies to increase the degree of salvaging timber now to remove more affected trees?
    a. Less salvaging
    b. No change in current level
    c. More salvaging
    d. Can't make an informed decision

3. Harvesting should be increased in infected areas to salvage larger volumes of timber.

1	2	3	4	5
Strongly Disagree		Neither		Strongly Agree

4. Timber extraction should be reduced to ensure a sustainable level of harvesting.

1	2	3	4	5
Strongly Disagree		Neither		Strongly Agree

5. Should forest companies be harvesting more or less of the damaged wood than they currently plan to do?

1	2	3	4	5
Less Harvesting		Neither		More Harvesting

These five questions range from simple and straightforward (Q3 and 4 with neither actually mentioning the MPB) to more elaborate ones which present the point of view of anonymous experts (Q1 and 2). The fifth question is embedded in the visual experiment.

3.3.4 Environmental Value Orientations

As the body of research on socio-cultural factors associated with pro-environmental attitudes, behavior, and policy has expanded, researchers have come to rely on the NEP and its variants as a base for measuring an individual's place on the ecocentric-anthropocentric worldview continuum. Dunlap and Van Liere's New Environmental Paradigm (NEP) Scale (1978) is a standard measure of environmental attitudes. Environmental attitudes are based on an ecological worldview as first conceptualized in terms of research on the New Ecological Paradigm (NEP) scale which identified three dimensions of the NEP: limits to growth, balance of nature, and dominion over nature. The original scale consisted of 12 environmental attitude statements on a 6-point Likert scale (very strongly agree to very strongly disagree), which comprise three (and in some cases four) dimensions.

Based on Blocker and Eckberg (1997), to operationalize an environmental attitudes scale Weaver argued that three variables from the GSS measure Human Actions Have Environmental Consequences (HAHEC), one of the components of the NEP. Following the work of Dunlap and Van Liere (1978), Weaver (2002) constructed an index "HAHEC": (1) Limits to growth is operationalized with the question, "Economic growth always harms the environment." (2) Balance of nature is operationalized with the

question, "Any change humans cause in nature – no matter how scientific – is likely to make things worse." (3) Human dominion is operationalized with the question, "Almost everything we do in modern life harms the environment" (see Figure 1). The more strongly the respondent agreed with these statements the more she exhibited pro-environmental attitudes and assumed an ecological worldview akin to the NEP.

Steil's recent research (2008) also used the 2000 GSS to operationalize environmental attitudes by capturing the dimensions of the NEP. Rather than use the NEP itself, I followed Weaver's (2002) approach and adapted questions from the ISSP and GSS (see Figure 1). Of these questions, three operationalize "limits to growth," two represent the dimension "balance of nature," and the third dimension, "dominion over nature," is captured by one question. Culled from the General Social Survey, the following series of questions are in some cases edited to tailor them for this survey.

1. (Q3-7) How much trust do you have in each of the following groups to give you correct information about the MPB?
    a. Forest industry ____
    b. Environmental groups _____
    c. Local and Provincial government_____
    d. Media (Newspapers, TV, Radio, etc.) _____
    e. University research centres _____
2. (Q34) Modern science will solve our environmental problems with little change to our way of life.
3. (Q35) We worry too much about the future of the environment and not enough about prices and jobs today.
4. (Q36) To protect the environment, British Columbia needs a strong economy.
5. (Q37) Economic growth always harms the environment.
6. (Q38) It is just too difficult for someone like me to do much about the environment.
7. (Q39) Many of the claims about environmental threats are exaggerated.

Operationalizing the New Ecological Paradigm			
NEP	HAHEC Weaver (ISSP)	Steil (GSS)	Berheide
Limits to growth	Economic growth always harms the environment	We worry too much about the future of the environment and not enough about prices and jobs today	Economic growth always harms the environment; We worry too much about the future of the environment and not enough about prices and jobs today; To protect the environment, British Columbia needs a strong economy
Balance of nature	Any change humans cause in nature – no matter how scientific – is likely to make things worse	People worry too much about human progress harming the environment	Many of the claims about environmental threats are exaggerated; It is just too difficult for someone like me to do much about the environment.
Dominion over nature	Almost everything we do in modern life harms the environment	There are more important things to do in life than protect the environment	Modern science will solve our environmental problems with little change to our way of life

Figure 1: Operationalizing the New Ecological Paradigm
Note: some of the items are stated so that agreeing is ecocentric while others are stated so agreement is anthrocentric (or the inverse is ecocentric).

3.3.5 Economic Impacts

Frequently the debate over environmental problems and issues centres around the potential costs and benefits environmental policies would have on the economy, especially on jobs. The calculus of economic effects often emphasizes immediate human quality of life concerns (i.e. anthropocentrism) over long-term environmental consequences (i.e. ecologism). Given the way the MPB management solutions are presented to the public, economic interests cannot be divorced from defining the problem

or the means available to people combating the outbreak in forest-dependent communities.

Weaver's conceptualization, Environmental Problems Have Human Consequences, is based on Schwartz's Awareness of Consequences index, which "assumes that altruistic behavior stems from the activation of personal norms" (Weaver 2000:79). The "implied value orientations [the index of variables comprising her EPHHC construct] are described as social-altrusitic, biospheric, and egoistic" (Weaver 2000:79). Instead of using the six questionnaire items that ask respondents to rank how dangerous a variety of environmental problems are for themselves and families as Weaver did, I ask individuals to respond to questions about how shifts in economic activity due to environmental changes would affect them, their locality, the province, and the nation to construct an index that measures the value orientation which I am calling, Economic Impact. Each of the following statements is constructed on a 5 point Likert scale from strongly disagree to strongly agree. The statements are as follows:

1. The local economy is strong enough to hold out through a shortage of logging activity.
2. Due to the MPB, the wood products currently coming out of BC onto the global market will decrease in value.
3. If the market value of wood products coming out of BC decreases in value, I will feel the economic impact as a result.
4. Special assistance grants to my community to mitigate the environmental and economic consequences of the MPB are necessary.
5. Economic progress in Canada will slow down unless we look after the environment better.
6. Historically the surrounding forests were of greater importance to the local economy than they are today.
7. The MPB outbreak is being used by the forest industry to justify clear-cut logging.
8. I would support the development of a biofuel processing plant in the local area.

This question also uses a five-point scale from not at all to absolutely all;

9. Do you think that the job growth in other industries will replace possible future job losses in the forest industry?
    a. Not at all
    b. Only a small portion
    c. A small majority
    d. Almost completely
    e. Absolutely all

3.3.6 Knowledge

Hypothetically, individuals who do not possess at least a fair degree of knowledge related to the origin or management of the mountain pine beetle would have to resort to other means of establishing a stance on the issue. Measuring how much an individual reports knowing about the mountain pine beetle outbreak in the local area and province will help to distinguish the importance of rational considerations compared to value belief systems in determining support for management policies. In contrast to Value Belief Norm (VBN) theories (Stern et al., 1999) that argue that active support for movements or policies comes from one's values, this index tests whether support for an environmental policy arises out of knowledge about its merits for accomplishing its goal and alleviating stress on affected stakeholders. Knowledge is therefore operationalized by the following questions:

1. How much would you say you know about the mountain pine beetle (MPB) outbreak in the province?
    a. Nothing
    b. A little
    c. A fair amount
    d. A good deal

2. How much do you know about how the mountain pine beetle (MPB) outbreak is currently being managed in your area?
    a. Nothing
    b. A little
    c. A fair amount
    d. A good deal

3.3.7 Trust

To understand the stance of the respondent within the larger environmental debate and the success of institutions in constructing their narratives, I identify five separate large social institutions (i.e. the forest industry, environmental groups, local and provincial government, media, and university research centres) to gauge the respondent's level of trust in these institutions as information sources. The wording of the question is as follows:

How much trust do you have in each of the following groups to give you correct information about the MPB? 1 hardly any, 2 not much, 3 some trust, 4 quite a lot, 5 great deal, 9 no answer

1. Forest industry ____
2. Environmental groups _____
3. Local and Provincial government_____
4. Media (Newspapers, TV, Radio, etc.) _____
5. University research centres _____

3.3.8 Demographic Characteristics

Other survey questions elicited information about socioeconomic characteristics such as age, education, income, marital status, and location. The survey measures the respondent's self-reported gender as a dichotomous variable as being either male or female. Though gender studies scholars would argue people today identify with other categories including transgender, this survey takes the conventional approach to the operationalization of gender.

3.4 Data Collection and Sample

This research focuses on two communities in British Columbia currently affected by the MPB: Kelowna and Prince George. To ensure the quality of the design and the validity and reliability of the questionnaire items, the survey was piloted on a sample of approximately 50 Kelowna residents shopping at Wal-Mart on Wednesday, December 6,

2006. Ethical considerations in the design of the survey are guided by the principle that participation in the study should be both voluntary and cause no harm to its subjects. Following ethical guidelines, both comprehensive liability insurance and honorariums, along with guarantees of anonymity and confidentiality, were used. All subjects have provided informed consent.

The pilot test demonstrated that a 'convenience' sampling method produces a diverse cross-section of public opinion. For practical reasons, a convenience sample was determined the best approach for gathering data quickly and inexpensively in the two target communities. This sampling method captures people out in public both to gather data and to increase awareness of the MPB issue. Although a convenience sampling method constrains our ability to generalize the results, if statistically significant differences exist, they can be retested on a random sample.

The survey was administered to a non-probability convenience sample of English speaking individuals over the age of 18 self-selected from communities in Prince George and Kelowna. The data were collected 19-21 January 2007 at the Capri Centre Mall in Kelowna and 10-11 February 2007 at Wal-Mart in Prince George. To produce a more diversified sample, a survey administrator approached potential respondents at the two sites who appeared as if they were members of different demographic groups, according to age, sex, marital status, and parental status. The original sampling design called for 150 respondents from each community.

The benefit of a convenience sampling procedure is it allows researchers with limited resources to obtain information in an efficient manner. Furthermore, the process promoted awareness about the mountain pine beetle and helped to reveal the familiarity of the public in a somewhat casual environment.

Over 300 questionnaires were completed yielding 312 usable surveys. The sample consists of 159 respondents in Prince George and 153 in Kelowna for a total of 312 cases (see Table 1). The population is the adult citizens of these two communities.

Table 1: Location (in percentages)

Location	Percent
Kelowna	49
Prince George	51
Total	100
(N)	(312)

3.5 Procedures

Data obtained from individuals in Prince George and Kelowna were analyzed using the most recent versions of SPSS (versions 13-18) first to produce frequency distributions and cross tabulations by location. I employed chi-square tests to identify significant relationships among categorical variables. Given the small sample size, I set alpha = 0.05 as the significance threshold.

I conducted principal components exploratory factor analysis as the first step in constructing indexes to measure environmental attitudes, trust in sources of information, and economic impact of the MPB as well as support for harvesting. Survey items were considered to "load" on a factor if their loading coefficient on that factor was .35 or greater. Thus I used a minimum loading of .35 to determine the items belonging to a

factor. The final indexes were created as sums of unstandardized scores on the individual items. Factor analysis is a multivariate statistical technique used to reduce a large number of variables into a smaller, usable group of factors which can then be subjected to further analysis.

A reliability analysis was performed after conducting a factor analysis to assure internal reliability of the indexes. The internal consistency of the summative scales created based on the factor analysis was assessed using Cronbach's alpha coefficient. Factor analysis loadings and Cronbach's test of reliability demonstrate that the survey and concepts within the questionnaire contain internal conceptual consistency.

I used t-tests to examine the differences between residents of the two communities. A t-test is customary when comparing only two groups (Morgan et al. 2011). An independent-means t-test is used when there are two experimental conditions and different participants take part in one or the other condition (Field 2009). In this case, there are two different locations (Prince George and Kelowna) and different participants completed the survey in those different locations.

Exploratory factor analysis reveals the dimensionality of the mountain pine beetle issue. The indexes were created to determine whether they were associated with public support for mountain pine beetle forestry related operations, as similar measures have been found to predict individuals' intention to take environmental action. The set of indexes measuring trust, economic impacts, knowledge, and environmental worldview were used

in correlational analyses to determine whether these concepts were associated with public support for harvesting.

3.6 Limitations

One limitation of this study is that it is a cross-sectional, observational study, which limits the interpretation of direction of effect in most cases. Because hypotheses about relationships between observed variables were tested using correlational analysis, it is not possible to know the causal direction of the significant relationships. While it seems reasonable to assume that location affected economic impact, trust, and knowledge (rather than the other way around), it is unclear whether knowledge and ecological modernization attitudes affected support for harvesting MPB infected trees or whether support for harvesting affected knowledge about the MPB outbreak and ecological modernization attitudes.

A second limitation may have arisen from the construction of questions on harvesting. The uninformed respondent may not have accurate information about the scope or level of harvesting referred to by the measures. For example, one of the responses in question two was “no change in current level” which might have been interpreted differently by respondents who did not have accurate information about the current level of harvesting. Similarly, interpretations may have varied for questions five where respondents are asked, “should forest companies be harvesting more or less of the damaged wood than they currently plan to do,” depending on what they believed the plans of forest companies to be.

Finally, there are limitations to convenience sampling. There is a risk of sampling bias given our reliance on available subjects. The convenience sampling method requires participants to have the means and a motive to go to either Wal-Mart or the Capri Centre Mall on the days the questionnaire was administered. Those who completed the survey may represent people who shop at the mall or Wal-Mart with greater frequency than others. In particular, it may not represent the full range of socioeconomic status in these two communities. As a result, the data may not be entirely representative of the views of the public at large.

Therefore, we should be cautious about generalizing the results of this survey to the British Columbia as a whole. While the modal BC resident is between the ages of 20 and 44, and previously married, the modal respondent in this study is younger (between the ages of 18 and 29, see Table 8), married (see Table 9). Although limitations to this survey design preclude us from being able to generalize to adults in British Columbia, we are able to provide some empirical evidence assessing public perceptions of alternative options for addressing the mountain pine beetle outbreak. Additional research is needed to test these measures on random samples.

4 Results

This chapter presents the results from the statistical analysis using SPSS to test the hypotheses that the more forest dependent community, Prince George, differs from the less forest dependent community, Kelowna, with regard to environmental attitudes (H1), trust in sources of information about the MPB (H2), knowledge about the MPB (H3), economic impact of the MPB (H4), and support for harvesting (H5) as well as strategies to speed regrowth, such as fertilization to manage the MPB epidemic (H6). To reject the null hypothesis, probabilities are considered significant if the result is less than the conventional alpha level of .05 ($p < .05$). Results greater than .05 are reported as non-significant (*n.s.*).

4.1 Indexes Measuring Environmental Attitudes, Trust, Knowledge, Economic Impact, and Support for Harvesting

The survey instrument contained multiple questions measuring the same constructs. For example, the questionnaire included five different items asking about harvesting as a strategy for managing the mountain pine beetle outbreak. Correlation coefficients shown in Table 2 reveal significant relationships between each pair of harvesting variables ($p < .01$), indicating that the five items are weakly to moderately correlated.

I conducted a factor analysis followed by reliability analyses to test whether the items in the survey instrument measure the underlying constructs, such as support for harvesting, the dependent variable, or economic consequences of the MPB, one of the intervening variables. With 312 respondents, the sample contained enough cases to conduct an exploratory factor analysis on 30 questions from the survey: five Harvest items, five

Trust items, thirteen Consequences of the MPB items, and seven Environmental Attitude items. Twenty of the 30 questions included in the factor analysis were measured on a Likert scale with 1 indicating strongly disagree and 5 strongly agree (see Table 3). Of the 30 questions, 29 were measured on a 5-point scale. One harvesting item (question 13) was measured on a 3-point scale with 1 indicating the respondent preferred less salvaging, 2 indicating a preference for no change in the current level, and 3 indicating preference for more salvaging. To be consistent with the other four harvesting questions, this item was recoded with more salvaging becoming a 5, no change a 3, and less salvaging remaining a 1. Another harvesting question (Reduce Timber Extraction) was reverse coded so a strongly agree response for reduction in timber extraction becomes 1 and 5 indicates strongly disagree. Missing data was replaced with the mean on that item so the number of cases would not fall below the 300 threshold that is appropriate for conducting a factor analysis on 30 questions.

Table 2: Correlation Coefficients of Harvesting Items (Pooled Prince George and Kelowna Samples)

	Support More or Less Harvesting	Support Increase in Salvaging	Increase Harvesting	Reduce Timber Extraction	Harvest More or Less Damaged Wood
Support More or Less Harvesting	1.000	.283**	.360**	-.228**	.300**
Support Increase in Salvaging		1.000	.462**	-.228**	.446**
Increase Harvesting			1.000	-.284**	.438**
Reduce Timber Extraction				1.000	-.269**
Harvest More or Less Damaged					1.000

** $p < .01$

The coefficient of determination for the correlation matrix of the 30 items in Table 4 is .006 indicating that there is no multicollinearity. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for analysis, KMO = .657, which is acceptable, further indicating that there is no multicollinearity and that a factor analysis should yield distinct and reliable factors. Bartlett's Test of Sphericity X^2 (435) = 1017.73, p = .000, is significant indicating that the relationships between variables were sufficiently large for a principal components analysis. Therefore the data obtained from these questions are suitable for factor analysis.

Table 3: Environmental and Economic Items Used in the Factor Analysis (in percentages) (Pooled Prince George and Kelowna Samples)

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Total
HARVESTING						
Increase Harvesting	4.2	10.7	13.1	52.2	19.7	289
Reduce Timber Extraction	7.4	27.0	24.1	34.4	7.0	270
CONSEQUENCES OF MPB						
Local Economy Strong Enough	5.7	35.2	17.8	36.7	4.6	281
MPB Decreases Value in Wood	4.0	25.3	19.8	44.0	7.0	273
Wood Value Personally Impacts	3.1	18.7	11.8	52.2	14.2	289
Community Grants Are Necessary	1.7	10.1	17.5	49.0	21.7	286
CA Econ Progress Will Slow	2.7	9.7	8.4	48.0	31.2	298
MPB Natural Part of Forest Ecology	6.5	16.8	12.7	51.0	13.0	292
Forest Will Never Recover Fully	16.9	44.4	14.1	17.6	7.0	284
Forests Will Adapt to MPB	20.9	35.2	14.3	25.6	4.0	273
Forest Industry Previously Important	7.3	26.3	12.5	41.2	12.8	289
Industry Use MPB to Justify Clearcut	10.5	29.6	17.1	30.7	12.2	287
Support Biofuel Processing Plant	3.1	12.4	16.3	51.9	16.3	258
ENVIRONMENTAL ATTITUDES						
Biodiversity Benefits Locally Only	13.5	45.5	17.1	19.3	4.7	275
Science Will Solve Problems	19.9	41.5	20.9	14.3	3.5	287
Worry Too Much about Env. and Not Jobs	35.3	38.6	7.6	11.9	6.6	303
Env. Protection Requires Strong Econ.	7.1	14.5	13.2	41.2	24.0	296
Econ. Growth Always Harms Env.	6.0	36.1	23.7	26.4	7.7	299
Too Difficult to Help Environment	18.9	56.3	10.3	11.6	3.0	302
Environmental Threats Are Exaggerated	22.6	42.4	14.6	16.3	4.2	288

The initial factor analysis, using principal components extraction and varimax factor rotation, produced nine factors with eigenvalues greater than 1.0 and together explained

54 percent of the variance. Only five of the factors explained more than five percent of the variance at the initial stage. Table 4 displays the items and factor loadings for the first four rotated factors, with loadings less than .35omitted to improve clarity.

Even though the fifth component has an eigenvalue greater than one, the fifth factor was excluded because two of the three variables with the strongest loadings on it had already loaded highly on one of the first four factors. Those two variables were trust in the forest industry and "Economic progress in Canada will slow down unless we look after the environment better." The third variable, forest industry uses the MPB to justify clearcutting, had the highest loading on this fifth factor (.74). Therefore, only four components were retained in the final analysis: harvest, environmental attitudes, trust, and economic consequences.

The first factor was distinguished by strong factor loadings for all five of the Harvest questions and none of the others. This factor explained eight percent of the total variance in the items. The second factor had high factor loadings for one of the items measuring possible consequences of the MPB epidemic ("Greater biodiversity in the forest increases benefits only to communities adjacent to the forest") and four of the seven more general environmental attitude questions and none of the other 25 items. These five items appear to form an anthropocentric value orientation ("Environmental threats are exaggerated") consistent with an ecological modernization point of view ("To protect the environment, British Columbia needs a strong economy"). This factor explained an additional seven (7.4) percent of the variance.

The third factor loads on all five Trust items and one environmental attitude question, specifically the respondent's agreement with the statement, "It is just too difficult for someone like me to do much about the environment." It explained an additional seven percent of the variance. The fourth factor loads on four of the thirteen questions related to the consequences of the MPB and one of the economically-related more general environmental attitude items ("Economic progress in Canada will slow down unless we look after the environment better") and none of the other items. The other four items also deal with economic consequences of the MPB at the local or regional level. This factor represents the economic consequences of the MPB. It explained an additional seven percent of the variance.

The results of the factor analysis indicated that the items that loaded on the first four factors could be used to create indexes to measure the underlying constructs. The four constructs are support for harvesting as a strategy for managing the mountain pine beetle outbreak, ecological modernization attitudes, trust in social institutions to provide correct information, and economic consequences of the MPB epidemic respectively. The results of the factor analysis were consistent with those presented in Table 2; both sets of results indicate that participants interpreted the five harvesting items in the same way. The final harvesting question on the survey instrument loads most highly on the first factor with a factor loading of .747. Though each harvesting question was written to reveal nuanced reasons to support or oppose harvesting as a MPB management strategy, ultimately the

five questions all load on the same factor and a test for reliability provides statistical evidence that the questions measure the same underlying concept (Cronbach's $\alpha = .70$).

Table 4: Factor Loadings (over .35) for Exploratory Factor Analysis with Varimax Rotation of Mountain Pine Beetle Items (N = 312) (Pooled Prince George and Kelowna Samples)

	Rotated Factor Loadings			
Item	Harvesting	Ecological Modernization	Trust	Economic Impact
HARVESTING				
Support More Harvesting	.58			
Increase Salvaging	.71			
Increase Harvesting	.70			
Reduce Timber Extraction (R)	.38			
Harvest More Damaged Wood	.75			
ENVIRONMENTAL ATTITUDES				
Biodiversity Benefits Locally Only		.43		
Science Will Solve Problems		.66		
Worry Too Much about Envm Not Jobs		.66		
Env. Protection Requires Strong Econ		.51		
Econ. Growth Always Harms Env.				
Too Difficult to Help Environment (R)			.42	
Environmental Threats Are Exaggerated		.45		
TRUST				
Trust in Forest Industry			.45	
Trust in Environmental Groups			.78	
Trust in Government			.47	
Trust in Media			.54	
Trust in University Research Ctr.			.67	
CONSEQUENCES OF MPB				
Local Economy Strong Enough (R)				.53
MPB Decreases Value in Wood				.47
Wood Value Personally Impacts				.71
Community Grants Are Necessary				.56
CA Econ Progress Will Slow				.38
Other Industries Replace Forest Jobs				
MPB Outbreak Natural Anomaly				
MPB Natural Part of Forest Ecology				
Forest Will Never Recover Fully				
Forests Will Adapt to MPB				
Forest Industry Previously Important				
Industry Use MPB to Justify Clearcut				
Support Biofuel Processing Plant				
Eigenvalues	2.392	2.215	2.121	2.039
% of variance	8.0	7.4	7.1	6.8
α	.70	.60	.61[a]	.58

Note: Loadings < .35 are omitted.
[a]Index excludes "Too Difficult to Help Environment"
R indicates an item has been reverse coded

The item measuring agreement with the statement that "Modern science will solve our environmental problems with little change to our way of life" had the highest factor loading (.663) on the ecological modernization factor with the one measuring agreement with the statement that "We worry too much about the future of the environment and not enough about prices and jobs today" a close second (.658). Three of the items loading on this index measure an anthropocentric point of view that is skeptical about the value of the environmental particularly relative to economic concerns ("Greater biodiversity in the forest increases benefits only to communities adjacent to the forest" and "We worry too much about the future of the environment and not enough about prices and jobs today") and about the validity of claims made about environmental problems ("Many of te claims about environmental threats are exaggerated"). The other two ("Modern science will solve our environmental problems with little change to our way of life" and "To protect the environment, British Columbia needs a strong economy") suggest a belief in the power of modern science and economic growth to solve whatever environmental problems do exist that is consistent with ecological modernization theory (York and Rosa 2003; York, Rosa, and Dietz 2003). Therefore, it seems to be an index that measures environmental skepticism and a belief in ecological modernization.

Trust in environmental groups has the highest factor loading on the Trust factor (.775). All five trust questions loaded on this factor suggesting that they form a single scale. The item that loads most strongly on the Economic Impact factor is "if the market value of wood products coming out of BC decreases in value, I will feel the economic impact as a result." (.710). The other items loading on this factor measure economic impact on a

local ("The local economy is strong enough to hold out through a shortage of logging activity" and "Special assistance grants to my community to mitigate the environmental and economic consequences of the MPB are necessary"), provincial ("Due to the MPB, the wood products currently coming out of BC onto the global market will decrease in value"), or national scale (Economic progress in Canada will slow down unless we look after the environment better"). These results suggest that the harvesting, ecological modernization attitudes, trust, and economic consequences questions are distinct from each other and can meaningfully be combined into four separate indexes. Reliability analysis was used to determine whether the individual items that loaded on each factor could be combined into an index.

4.1.2 Reliability Analysis

A reliability analysis was performed to examine the internal consistency of the first four factors produced by the exploratory factor analysis. These reliability analyses revealed that the Harvesting items formed a highly reliable scale (Cronbach's $\alpha = .704$) and the alpha would not be improved with the removal of any of the items. The five Ecological Modernization Attitude items in Table 4 that loaded on the second factor of the factor analysis produced a moderately reliable scale (Cronbach's $\alpha = .600$) and the alpha would not be improved with the removal of any single item. The reliability analysis for the five Trust items in Table 4 plus the one question on being too difficult for someone like the respondent to do something about the environment indicated that the alpha would improve with the removal of the too difficult question. Once that item was removed the five remaining trust questions produced a scale with an acceptable level of internal consistency (Cronbach's $\alpha = .610$). Therefore the Trust index includes only the five

questions that operationalized trust in social institutions as sources of accurate information. The reliability analysis performed on the five Economic Impact items in Table 4 that loaded on the fourth factor of the factor analysis also revealed a moderately reliable scale (Cronbach's $\alpha = .581$) and the alpha would not be improved if any of the items were removed. I also performed a reliability analysis of the two Knowledge items in Table 5 which indicated that they produced a scale with a high level of internal consistency (Cronbach's $\alpha = .718$).

Table 5: Knowledge about MPB Index (in percentages) (Pooled Prince George and Kelowna Samples)

	Nothing	A Little	A Fair Amount	A Good Deal	Total	N
Know about MPB in BC	5.5	55.0	30.2	9.3	100.0	(311)
Know about MPB in Area	21.3	56.1	17.1	5.5	100.0	(310)

As a result of the factor and the reliability analysis, five indexes were created. When creating the indexes, missing data on an individual item was replaced with the mean. The ecological modernization index is comprised of five questions on the same five point Likert scale. Responses ranged from 5 to 25 with a 25 indicating that an individual strongly agreed with all five statements ("Greater biodiversity in the forest increases benefits only to communities adjacent to the forest," "Modern science will solve our environmental problems with little change to our way of life," "We worry too much about the future of the environment and not enough about prices and jobs today," "To protect the environment, British Columbia needs a strong economy," and "Many of the claims about environmental threats are exaggerated").

Potential responses on the Trust index also ranged from 5 to 25. The higher the score on the index, the more trust the individual had in the following institutions to provide accurate information about the MPB: forest industry, environmental groups, local and provincial government, media sources, and university research centres. Knowledge as an index containing two questions has a potential range of responses from 2 to 8, such that a higher score indicates the respondent has more knowledge about the MPB in both their locale and the Province (see Table 6). Responses to five statements "If the market value of wood products coming out of BC decreases in value, I will feel the economic impact as a result," "Special assistance grants to my community to mitigate the environmental and economic consequences of the MPB are necessary," "The local economy is strong enough to hold out through a shortage of logging activity (reverse coded)," "Due to the MPB, the wood products currently coming out of BC onto the global market will decrease in value," and "Economic progress in Canada will slow down unless we look after the environment better," were added together to create the Economic Impact index. Potential responses range from 5 to 25 so that the higher the score the more the respondent strongly agreed that the MPB would have economic consequences. Finally, the Harvesting index is a summation of responses about support for an increase "in the degree of salvaging" (recoded from a scale of 1to 3 to a scale of 1 to 5), "harvesting all standing pine," "harvesting more … damaged wood," "in infected areas to salvage," and the reverse coded "timber extraction should be reduced." This index also ranges from 5 to 25 with a higher response indicating greater support for increases in harvesting to manage the MPB.

4.2 Does the Forest Dependent Community Differ from the Non-Forest Dependent One? Differences between the Prince George and Kelowna Samples

The essential question in this study is whether there is a difference between the Prince George and Kelowna samples, that is between the more forest-dependent community and the less forest dependent community, in support for MPB management strategies. Do they differ in their demographic characteristics, ecological modernization attitudes, trust in institutions to provide accurate MPB information, knowledge about the MPB, economic impact of the MPB, and especially in their support for harvesting as a MPB management strategy? This section examines whether the two samples differed in any of these ways. A Pearson chi-square statistic was conducted on categorical variables and a t-test was conducted on the indexes. Assumptions were checked and met.

4.2.1 Demographic Characteristics.

The first question investigated is whether the Prince George and Kelowna samples differ demographically. Table 6 shows the Pearson chi-square results indicating that the two locations do differ significantly by gender ($X^2 = 13.39$, $df = 1$, $N = 306$, $p = .000$). The Kelowna sample was 60 percent male whereas Prince George was 60 percent female.

Table 7 presents the Pearson chi-square results for age. It shows a significant difference in age between the two samples ($X^2 = 27.10$, $df = 4$, $N = 308$, $p = .000$). The sample from Prince George was younger on the average than the Kelowna sample. Almost a third of the Prince George sample (32 percent) was 18-29 years old while only one-fifth of the sample from Kelowna (20 percent) was that young.

Table 6: Gender by Location (in percentages)

	Location		
Gender	Kelowna	Prince George	Total
Male	60.5	39.6	50.0
Female	39.5	60.4	50.0
Total	100.0	100.0	100.0
(N)	(152)	(154)	(306)

$X^2 = 13.386$; $df = 1$; $p = .000$

Table 7: Age by Location (in percentages)

	Location		
Age	Kelowna	Prince George	Total
18-29	19.6	32.3	26.0
30-39	12.4	26.5	19.5
40-49	24.8	12.3	18.5
50-59	19.6	18.7	19.2
60 and older	23.5	10.3	16.9
Total	100.0	100.0	100.0
(N)	(153)	(155)	(308)

$X^2 = 27.097$; $df = 4$; $p = .000$

The marital statuses of the respondents in the two samples were also significantly different ($X^2 = 32.55$, $df = 2$, $N = 305$, $p = .000$). The Pearson chi-square results in Table 8 reveal that over half the residents of Prince George were married (57 percent) whereas only 30 percent of the residents of Kelowna were married. The residents of Kelowna were more likely to be divorced, separated, or widowed (31 percent) compared to the residents of Prince George (9 percent).

Table 8: Marital Status by Location (in percentages)

Marital Status	Location: Kelowna	Location: Prince George	Total
Single	38.7	33.5	36.1
Married	30.0	57.4	43.9
Divorced +	31.3	9.0	20.0
Total	100.0	100.0	100.0
(N)	(150)	(155)	(305)

$X^2 = 32.554$; $df = 2$; $p = .000$

Finally, according to the Pearson chi-square results in Table 9, the two samples differed significantly in the number of children the respondents had living at home ($X^2 = 12.74$, $df = 3$, $N = 306$, $p = .005$). Over a third of the participants in Prince George (37 percent) had one or more children under the age of 18 living at home compared to only one-quarter (24 percent) of the Kelowna sample. In contrast, the Pearson chi-square results in Tables 10 and 11 reveal that the two samples did not differ significantly in educational levels ($X^2 = 5.80$, $df = 5$, $N = 307$, $p = .326$) nor in income ($X^2 = 7.42$, $df = 5$, $N = 283$, $p = .191$). Thus, the two samples differed in some important respects, including sex, age, marital status, and number of children living at home, but not in others, including education and income.

Table 9: Number of Children at Home by Location (in percentages)

Number of Children at Home	Location: Kelowna	Location: Prince George	Total
0	75.7	62.6	69.1
1	13.8	11.6	12.7
2	7.2	14.2	10.7
3+	3.3	11.6	7.5
Total	100.0	100.0	100.0
(N)	(152)	(155)	(306)

$X^2 = 12.745$; $df = 3$; $p = .005$

Table 10: Highest Education Level by Location (in percentages)

Highest Education Level Completed	Location		
	Kelowna	Prince George	Total
Less than High School	18.4	9.7	14.0
Completed High School	21.7	20.6	21.2
Some College	19.1	21.3	20.2
Received Certificate	21.7	23.9	22.8
Received Bachelor's	10.5	14.8	12.7
Some Post-Grad	8.6	9.7	9.1
Total	100.0	100.0	100.0
(N)	(120)	(119)	(239)

$X^2 = 5.803$; $df = 5$; $p = .326$

Table 11: Income by Location (in percentages)

Respondent's Income	Location		
	Kelowna	Prince George	Total
0 - 9,999	14.6	15.1	14.8
10,000 - 19,999	22.6	13.0	17.7
20,000 - 29,999	16.1	15.1	15.5
30,000 - 39,999	19.7	17.1	18.4
40,000 - 59.999	14.6	21.2	18.0
60,000 and above	12.4	18.5	15.5
Total	100.0	100.0	100.0
(N)	(137)	(146)	(283)

$X^2 = 7.419$; $df = 5$; $p = .191$

4.2.2 Environmental Attitudes

The factor analysis and reliability analysis reduced seven environmental attitude variables down to a single summative scale composed of the five items in Table 12. A high score on this set of five items represents an environmental value orientation that follows an ecological modernization approach believing that science and economic growth can solve environmental problems (York and Rosa 2003). The majority of respondents in both communities disagreed or strongly disagreed with all the items except the statement that

"To protect the environment, British Columbia needs a strong economy," where the majority (65 percent) agreed or strongly agreed. Fifty-nine percent disagreed or strongly disagreed that biodiversity only increases benefits to forest communities; 61 percent disagreed to strongly disagreed that "modern science will solve our environmental problems with little change to our way of life;" 74 percent disagreed or strong disagreed that we worry too much about the environment and not enough about jobs; and 65 percent disagreed or strongly disagreed that environmental threats are exaggerated. In short, the majority of respondents rejected all the straightforward anthropocentric items and one of the two ecological modernization ones, accepting only that environmental protection requires a strong provincial economy.

Table 12: Ecological Modernization Index Items (in percentages) (Pooled Prince George and Kelowna Samples)

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	(N)
Biodiversity Benefits Locally Only	13.5	45.5	17.1	19.3	4.7	(275)
Science Will Solve Problems	19.9	41.5	20.9	14.3	3.5	(287)
Worry Too Much about Environment and Not Jobs	35.3	38.6	7.6	11.9	6.6	(303)
Environmental Protection Requires Strong Econ.	7.1	14.5	13.2	41.2	24.0	(296)
Environmental Threats Are Exaggerated	22.6	42.4	14.6	16.3	4.2	(288)

To test whether the mean scores of the Kelowna and Prince George samples differed on the four scales derived from the factor analysis as well as on the mountain pine beetle knowledge index, I performed independent samples *t* tests. The Levene's test for equality of variances showed that the variances were equal for all five variables. While

the *t* values were significant for three out of the five indexes presented in Table 13, the *t*-test was not significant for ecological modernization attitudes ($t(240) = -1.206$, $p = .229$). The mean score for Kelowna residents on the Ecological Modernization Index ($M = 12.70$, $SD = 3.59$) was not significantly different from the mean score for Prince George residents ($M = 13.25$, $SD = 3.48$).

Table 13: Comparison of Kelowna and Prince George Residents on Five Indices

Index	*M*	*SD*	*t*	*df*	*p*
Ecological Modernization Attitudes			-1.21	240	.229
Kelowna	12.70	3.59			
Prince George	13.25	3.48			
Trust			2.42*	310	.016
Kelowna	16.25	3.24			
Prince George	15.33	3.43			
Mountain Pine Beetle Knowledge			-2.72**	310	.007
Kelowna	2.29	1.30			
Prince George	2.70	1.31			
Economic Impact			-3.50***	236	.001
Kelowna	16.76	3.21			
Prince George	18.17	3.00			
Harvesting			0.10	229	.923
Kelowna	18.37	4.07			
Prince George	18.32	4.01			

* $p < .05$, ** $p < .01$,*** $p < .001$

There were two environmental attitude items that did not load on the ecological modernization factor. The first was the statement, "It's personally too difficult to help the environment." Table 14 shows the Pearson chi-square results indicating that the two locations did differ significantly on this measure of environmental attitudes ($X^2 = 9.74$, $df = 4$, $N = 302$, $p = .045$). While the difference between the percent of Kelowna respondents who disagreed or strongly disagreed that it is too difficult for an individual to help the environment (77 percent) and the percent of Prince George respondents (74 percent) who felt that way is relatively small, the difference between the two sets of

respondents in the percent who strongly disagreed is much larger (24 percent compared to 14 percent).

The second environmental attitude item that did not load on the ecological modernization factor was "economic growth always harms the environment." According to Table 15, the two locations also differed significantly on this measure of environmental attitudes ($X^2 = 10.586$, $df = 4$, $N = 299$, $p = .032$). The distribution of responses to the statement that economic growth always harms the environment was bimodal for Kelowna where 43 percent agreed or strong agreed and 37 percent disagreed or strongly disagreed. In contrast, the respondents from Prince George were much more likely to disagree or strongly disagree (47 percent) than to agree or strongly agree (26 percent).

Table 14: Personally Too Difficult to Help the Environment by Location (in percentages)

Personally Too Difficult to Help the Environment	Location		
	Kelowna	Prince George	Total
Strongly Disagree	24.5	13.5	18.9
Disagree	52.4	60.0	56.3
Neither	10.9	9.7	10.3
Agree	8.2	14.8	11.6
Strongly Agree	4.1	1.9	3.0
Total	100.0	100.0	100.0
(N)	(147)	(155)	(302)

$X^2 = 9.738$; $df = 4$; $p = .045$

Table 15: Economic Growth Always Harms Environment by Location (in percentages)

	Location		
Growth Harms Environment	Kelowna	Prince George	Total
Strongly Disagree	5.4	6.6	6.0
Disagree	31.3	40.8	36.1
Neither	20.4	27.0	23.7
Agree	32.0	21.1	26.4
Strongly Agree	10.9	4.6	7.7
Total	100.0	100.0	100.0
(N)	(147)	(152)	(299)

$X^2 = 10.586$; $df = 4$; $p = .032$

4.2.3 Trust in Social Institutions to Provide Correct MPB Information

The factor analysis and reliability analysis led to the creation of a summative trust index consisting of the five items in Table 16. The pooled respondents had the most trust (70 percent had quite a lot or a great deal of trust) in university research centres to give them correct information about the MPB. Almost half (49 percent) had this high level of trust in environmental groups, while only 39 percent had this level of trust in the forest industry, 27 percent in the media, and only 15 percent in the government to provide accurate information about the MPB.

Table 16: Trust in Institutions Index Items (in percentages) (Pooled Prince George and Kelowna Samples)

People having … trust in…	Hardly Any	Not Much	Some Trust	Quite A Lot	Great Deal	Total
Forest Industry	11.5	18.6	30.7	23.6	15.5	(296)
Environmental Groups	6.4	10.1	34.8	25.7	23.0	(296)
Government	19.4	35.3	30.8	11.1	3.5	(289)
Media	11.6	31.4	30.4	19.5	7.2	(293)
University Research Centres	4.8	2.8	22.8	33.8	35.9	(290)

According to Table 17, residents of Kelowna were significantly different from residents of Prince George on the Trust Index ($t(310) = 2.415$, $p = .016$). Inspection of the two

group means indicates that the average trust score (M = 16.25, SD = 3.24) for Kelowna's citizens is significantly higher than the average score (M = 15.33, SD = 3.43) for Prince George's citizens. While statistically significant, the difference between the means is not quite one point (.91) on a scale ranging from 5 to 25.

Table 17 presents independent samples t tests for each of the five social institutions separately to explore whether the difference in trust scores existed across all five or whether it was limited to specific social institutions. The Levene's test for equality of variances showed that the variances were equal for all five variables. Table 17 indicates that the respondents reported more trust in university research centres (M=3.93) to give correct information about the mountain pine beetle than environmental groups (M=3.49), the forest industry (M=3.13), media (M=2.79), and the government (M=2.44). There was no statistically significant difference between subjects from Kelowna and Prince George in their levels of trust in universities, environmental groups, the media, and the government. In contrast, there was a statistically significant difference in trust in the forest industry by location. Residents of the more forest dependent community, Prince George, reported lower levels of trust in the forest industry to give correct information about the MPB (M=2.96, SD=1.209) than those in Kelowna, the less forest-dependent community (M=3.33, SD=1.208), (t(294) = 2.654, p = .008).

Table 17: Comparison of Kelowna and Prince George Respondents on Level of Trust in Institutions

	Location					
Institution	Kelowna (*M*)	Prince George (*M*)	Total	*t*	*p*	*df*
Forest Industry	3.33	2.96	3.13	2.65**	.008	294
	(140)	(156)	(296)			
Environmental Groups	3.61	3.37	3.49	1.83	.068	294
	(142)	(154)	(296)			
Government	2.50	2.38	2.44	1.03	.304	287
	(141)	(148)	(289)			
Media	2.79	2.80	2.79	-0.09	.928	291
	(140)	(153)	(293)			
University Research Centres	4.06	3.82	3.93	1.94	.053	288
	(138)	(152)	(290)			

$p < .01$ **

4.2.4 Knowledge and Beliefs about MPB Ecology and MPB Management Alternatives

The two knowledge questions, as discussed earlier in section 4.1.2, formed a reliable scale. In 2007, the mountain pine beetle was destroying huge tracts of BC forests, including areas around Kelowna and especially Prince George, and yet a majority of the respondents (60 percent) from both communities indicated that they knew little or nothing about the MPB outbreak in the province (see Table 6). According to Table 6, residents of both communities reported knowing even less about the management of the mountain pine beetle in their area; 21 percent reported knowing nothing about how the mountain pine beetle outbreak was being managed in the area. As Table 13 indicates, they differed significantly with regard to their knowledge of the mountain pine beetle problem ($t(310) = -2.72$, $p = .000$). Residents of the more forest dependent community, Prince George, reported having more knowledge about the outbreak and about what is

being done to manage it (M = 2.70, SD = 1.31) than those in Kelowna (M = 2.29, SD = 1.30). The difference between the means is slightly less than half a point (.41) on a scale that ranges from 2 to 8.

4.2.5 Ecological Consequences of the MPB Epidemic

The survey not only asked respondents about how much they knew, it also asked them about their knowledge and beliefs about the origins and nature of the MPB outbreak. Over one-third (38 percent) believed the outbreak is a combination of an anomaly in the natural cycle of disturbance ecology and the resulting effects of human induced temperature increases; while over 43 percent believed people are largely to blame (see Table 18). There was no difference between the two locations in their beliefs about the origin of the MPB outbreak (X^2 = 2.523, df = 2, N = 292, p = .283).

Table 18: Belief about MPB Outbreak Origin by Location (in percentages)

	Location		
MPB Outbreak Natural Anomaly	Kelowna	Prince George	Total
MPB is a Natural Anomaly	16.4	21.1	18.8
Both	42.9	34.2	38.4
People Are Largely to Blame	40.7	44.7	42.8
Total	100.0	100.0	100.0
(N)	(140)	(152)	(292)

X^2 = 2.523; df = 2; p = .283

In contrast to the less than one-fifth (19 percent) who believed the outbreak is a natural anomaly, two thirds (64 percent) agreed to strongly agreed that the beetle itself is a natural part of forest ecology (see Table 3). Almost as many (61 percent) disagreed to strongly disagreed with the statement that "The level of disturbance caused by the MPB

is irreversible and the forest will never recover fully" (see Table 3). Half that many (30 percent) agreed or strongly agreed that forests will adapt to the MPB suggesting that the recovery, like the outbreak itself, will require human intervention (see Table 3). In short, over 60 percent disagreed with the statement that the forests will never fully recover and nearly 60 percent disagreed with the statement that if left alone the forests will adapt to the mountain pine beetle (see Table 3). These three items were included in the factor analysis, but they did not load on the same factor or, indeed, on any factor. The two samples did not differ on any of these three other variables measuring beliefs about the ecological consequences of the Mountain Pine Beetle for the forests (X^2 = 2.116, df = 4, N = 292, p = .714; X^2 = 0.490, df = 4, N = 284, p = .974; X^2 = 6.878, df = 4, N = 273, p = .142, respectively). These four ecological consequences of the MPB outbreak did not load on the economic consequences factor either.

4.2.6 Economic Impact of the MPB Epidemic

The factor analysis and reliability analysis reduced 13 items measuring consequences of the MPB, both economic and ecological, to a single summative scale composed of the five economic questions in Table 19. A high score on this set of five items represents more concern for the economic consequences of the MPB (as opposed to the environmental consequences that were discussed in the previous section). The Economic Impact Index examines the scaled economic effects from the individual level up to the national level with the effects on the individual having the highest factor loading and the effects on the country having the lowest.

Table 19: Economic Impact Index Items (in percentages) (Pooled Prince George and Kelowna Samples)

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	(N)
Wood Value Personally Impacts	3.1	18.7	11.8	52.2	14.2	(289)
Local Economy Strong Enough	5.7	35.2	17.8	36.7	4.6	(281)
Community Grants Are Necessary	1.7	10.1	17.5	49.0	21.7	(285)
MPB Decreases Value in Wood	4.0	25.3	19.8	44.0	7.0	(273)
CA Econ Progress Will Slow	2.7	9.7	8.4	48.0	31.2	(296)

At the individual-level, two-thirds of the respondents agreed or strongly agreed that "if the market value of wood products coming out of BC decreases in value, I will feel the economic impact as a result." At the local level, the respondents were split over whether "the local economy is strong enough to hold out through a shortage of logging activity" with 41 percent agreeing or strongly agreeing and the same percent disagreeing or strongly disagreeing. The other 18 percent responded neither. On the second local-level measure, 71 percent agreed or strongly agreed that "special assistance grants to my community to mitigate the environmental and economic consequences of the MPB are necessary." At the provincial level, just over half (51 percent) agreed or strongly agreed that "due to the MPB, the wood products currently coming out of BC onto the global market will decrease in value." Finally at the national level, 79 percent agreed or strongly agreed that "economic progress in Canada will slow down unless we look after the environment better."

As Table 13 indicates, the respondents from the two communities differed significantly in the degree to which they felt the mountain pine beetle in particular and environmental problems more generally have economic consequences ($t(236) = -3.497$, $p = .001$). An examination of the means revealed that respondents living in Kelowna, the less forest-dependent community, had lower average economic impact scores ($M = 16.76$, $SD = 3.20$) than those living in Prince George, the more forest dependent community ($M = 18.17$, $SD = 3.00$). The difference between the means is over one point (1.41) on a scale from 5 to 25. Respondents from Prince George were more likely than their counterparts in Kelowna to agree that the mountain pine beetle would affect them personally as well as their community, the province, and the country.

The survey included four other questions asking about the economic consequences of the MPB epidemic that did not load on the economic impact factor, only one of which differs between the two samples. Residents of Prince George, the more forest-dependent community, were more likely to disagree or strongly disagree (38 percent) that "historically the surrounding forests were of greater importance to the local economy than they are today" than those of Kelowna (29 percent), the less forest-dependent community (see Table 20). The Pearson chi-square results indicate that this difference is statistically significant ($X^2 = 11.610$, $df = 4$, $N = 289$, $p = .020$). There is no difference between the responses of the Prince George and Kelowna samples on whether growth in other industries will replace possible future job losses in the forest industry ($X^2 = 4.814$, $df = 4$, $N = 283$, $p = .307$) as well as in their responses to the statements that "the MPB outbreak is being used by the forest industry to justify clear-cut logging" ($X^2 = 0.500$, *df*

= 4, N = 287, p = .973) and that "I would support the development of a biofuel processing plant in the local area" (X^2 = 8.215, df = 4, N = 258, p = .084).

Table 20: Forest Industry Previously Important by Location (in percentages)

Forest Industry Was Previously More Important	Location		
	Kelowna	Prince George	Total
Strongly Disagree	5.8	8.6	7.3
Disagree	23.4	28.9	26.3
Neither	11.7	13.2	12.5
Agree	39.4	42.8	41.2
Strongly Agree	19.7	6.6	12.8
Total	100.0	100.0	100.0
(N)	(137)	(152)	(289)

X^2 = 11.610; df = 4; p = .020

4.2.7 Managing the Mountain Pine Beetle Epidemic

The factor analysis and reliability analysis led to the creation of a summative harvesting index consisting of five different questions measuring support for harvesting as a strategy for managing the MPB outbreak. This first question measuring the respondent's support for harvesting indicates that 32 percent would support less harvesting while about 50 percent would support more harvesting of all standing pine (see Table 21). There is no difference between the two samples in support for harvesting all standing pine (X^2 = 1.314, df = 4, N = 308, p = .859). The question in Table 22 elicited even more support for harvesting with over 60 percent of the sample supporting policies to increase salvaging to remove more affected trees. Responses to this measure do not vary by location (X^2 = 3.685, df = 2, N = 249, p = .158).

Table 21: Support More or Less Harvesting by Location (in percentages)

	Location		
Support More or Less Harvesting	Kelowna	Prince George	Total
1 – Less Harvesting	17.9	15.3	16.6
2	15.9	14.0	14.9
3 - No Change	19.2	17.2	18.2
4	27.2	31.2	29.2
5 – More Harvesting	19.9	22.3	21.1
Total	100.0	100.0	100.0
(N)	(151)	(157)	(308)

$X^2 = 1.314$; $df = 4$; $p = .859$

Table 22: Support Increase in Salvaging by Location (in percentages)

	Location		
Support Increase in Salvaging	Kelowna	Prince George	Total
Less Salvaging	10.2	13.0	11.6
No Change	19.5	28.2	24.1
More Salvaging	70.3	58.8	64.3
Total	100.0	100.0	100.0
(N)	(118)	(131)	(249)

$X^2 = 3.685$; $df = 2$; $p = .158$

In contrast to the previous two harvesting measures (and the next two), the Pearson chi-square results in Table 23 indicate that the two locations did differ significantly in their level of agreement with the statement "harvesting should be increased in infected areas to salvage larger volumes of timber" ($X^2 = 9.593$, $df = 4$, $N = 298$, $p = .048$). More residents of Prince George, the more forest-dependent community, agreed or strongly agreed that harvesting should be increased (75 percent) than residents of Kelowna, the less forest-dependent community (69 percent). In addition, support for harvesting was higher (72 percent for the entire sample) on this item than on the previous two (50 percent on the first and 64 percent on the second).

The next item in the harvesting index does not specifically mention the MPB and had to be reverse coded because it is stated in the opposite direction. According to Table 24, 41 percent agreed or strongly agreed that "Timber extraction should be reduced to ensure a sustainable level of harvesting." There was no difference between the two samples in support for reducing timber extraction ($X^2 = 0.740$, $df = 4$, $N = 270$, $p = .946$). The last item measuring support for harvesting on the survey instrument is presented in Table 25. On this measure, 70 percent supported forest companies harvesting more damaged wood than they currently plan to. Once again the two samples did not differ ($X^2 = 2.381$, $df = 4$, $N = 304$, $p = .666$).

Not surprisingly given the lack of difference on four of the five individual harvesting items, as Table 13 shows, the respondents from the two communities did not differ significantly from each other in their scores on the harvesting index ($t(229) = .097$, $p = .923$). The mean score on the harvesting index for Kelowna residents ($M = 18.37$, $SD = 4.07$) was virtually identical with the mean score for Prince George residents ($M = 18.32$, $SD = 4.01$). Whether to harvest infected trees is not the only issue that confronts policy makers who are dealing with the MPB epidemic. They also need to decide what to plant in the areas that have been harvested. Over three-quarters (78 percent) said they "would rather replant using a mix of forest species" (see Table 26). This result varied by location with twice as many residents of Prince George indicating a preference for replanting with pine trees (22 percent) as residents of Kelowna (11 percent); ($X^2 = 6.509$, $df = 2$, $N = 277$, $p = .039$).

Table 23: Support for Increased Harvesting of Infected Timber by Location (in percentages)

	Location		
Increase Harvesting	Kelowna	Prince George	Total
Strongly Disagree	7.9	.7	4.2
Disagree	10.0	11.4	10.7
Neither	13.6	12.8	13.1
Agree	50.0	54.4	52.2
Strongly Agree	18.6	20.8	19.7
Total	100.0	100.0	100.0
(N)	(140)	(149)	(289)

$X^2 = 9.593$; $df = 4$; $p = .048$

Table 24: Reduce Timber Extraction by Location (in percentages)

	Location		
Reduce Extraction	Kelowna	Prince George	Total
Strongly Disagree	7.6	7.2	7.4
Disagree	25.0	29.0	27.0
Neither	25.8	22.5	24.1
Agree	34.8	34.1	34.4
Strongly Agree	6.8	7.2	7.0
Total	100.0	100.0	100.0
(N)	(132)	(138)	(270)

$X^2 = 0.740$; $df = 4$; $p = .946$

Table 25: Harvest More or Less Damaged Wood by Location (in percentages)

	Location		
Harvest More or Less Damaged Wood	Kelowna	Prince George	Total
1 - Less	4.1	5.7	4.9
2	6.1	5.1	5.6
3 - Neither	19.7	19.1	19.4
4	22.4	28.7	25.7
5 - More	47.6	41.4	44.4
Total	100.0	100.0	100.0
(N)	(147)	(157)	(304)

$X^2 = 2.381$; $df = 4$; $p = .666$.

Table 26: Replant Pine or Other Species by Location (in percentages)

Replant Pine or Other Species		Location: Kelowna	Location: Prince George	Total
Replant Pine		11.1	21.8	16.6
Diversify		81.5	73.9	77.6
Replant non-pine		7.4	4.2	5.8
	Total	100.0	100.0	100.0
	(N)	(135)	(142)	(277)

$X^2 = 6.509$; $df = 2$; $p = .039$

In contrast to the difference in the two samples with regard to what kind of trees should be planted in the areas that have been harvested to manage the MPB epidemic, according to Tables 28 and 29 respectively there was no difference between them with regard to the use of fertilizer ($X^2 = .197$, $df = 1$, $N = 190$, $p = .657$) and replanting with genetically modified trees ($X^2 = 1.385$; $df = 2$; $N = 254$, $p = .500$). According to Table 27, almost two-thirds would support the use of fertilization to assist the faster regrowth of trees. Over one-third (35 percent) of the respondents opposed genetic engineering in general (see Table 28). Almost an equal proportion (34 percent) approved of its use in general and one-third (30 percent) approved of its use in this instance, resulting in a substantial majority favoring its use to spur faster regrowth.

Table 27: Support the Use of Fertilization by Location (in percentages)

Support the Use of Fertilization		Location: Kelowna	Location: Prince George	Total
No		38.5	35.4	36.8
Yes		61.5	64.6	63.2
	Total	100.0	100.0	100.0
	(N)	(91)	(99)	(190)

$X^2 = .197$; $df = 1$; $p = .657$

Table 28: Support Genetically Engineered Reforestation by Location (in percentages)

Support Genetically Engineered Reforestation	Location		
	Kelowna	Prince George	Total
Distrust	38.8	32.0	35.4
Only this instance	27.9	32.8	30.3
Whenever	33.3	35.4	34.3
Total	100.0	100.0	100.0
(N)	(129)	(125)	(254)

$X^2 = 1.385$; $df = 2$; $p = .500$

4.3 Correlations of Indexes with Support for Harvesting

To investigate whether there were statistically significant associations between support for harvesting and the indexes measuring trust for sources of accurate MPB information, knowledge about the MPB, economic impact of the MPB, and ecological modernization attitudes, Pearson correlations were computed to examine the intercorrelations of the variables. Table 29 shows that 8 of the 15 pairs of variables were significantly correlated. The harvesting index was correlated with knowledge of the MPB ($r = .126$, $p = .013$) and ecological modernization ($r = .183$, $p = .001$) but not with location, trust, or economic impact. The variables that had significant associations with support for harvesting were not the same as those that were correlated with location. The correlation between the Harvest and Ecological Modernization index scores was positive, indicating that the more strongly a respondent held an ecological modernization point of view, the greater his or her support for harvesting as the strategy for managing the MPB epidemic. The correlation between the Harvest and Knowledge Indexes was also positive, albeit smaller than the one between harvesting and ecological modernization. It indicates that the higher the score on the MPB knowledge index, the higher the score on the harvesting index.

Table 29: Correlations for Five Indexes and Location (Pooled Prince George and Kelowna Samples)

	Harvest	Location	Trust	Knowledge	Economic Impact	Ecological Modernization
Harvest	1.000	-0.006	0.081	0.126*	0.030	0.183***
Location		1.000	-0.136**	0.153**	0.194***	0.068
Trust			1.000	0.151**	-0.110*	-0.026
Knowledge				1.000	-0.029	0.142**
Economic Impact					1.000	0.075
Ecological Modernization						1.000

*$p < .05$, **$p < .01$, ***$p < .001$

The results of the correlation analysis were consistent with those of the independent samples t-tests: location was related to trust ($r = -0.136$, $p = .008$), knowledge ($r = 0.153$, $p = .003$), and economic impact ($r = .194$, $p = .000$). The negative correlation between location and trust indicates that respondents from Prince George had lower scores on trusting the five sources to give correct information about the MPB than those from Kelowna. The positive correlation between location and knowledge indicates that the residents of Prince George were more likely to score higher on the MPB knowledge scale than the residents of Kelowna. The positive correlation between location and economic impact indicates that the residents of Prince George were more likely to report higher levels of economic impact from the MPB epidemic than those living in Kelowna.

The trust index was also correlated with the knowledge index ($r = .151$, $p = .004$) and the economic impact index ($r = -.110$, $p = .027$). The higher the respondent's score on the trust index, the higher his or her score on the knowledge index. In contrast, the higher the respondent's score on the trust index, the lower his or her score on the economic impact

of the MPB. Lastly, the knowledge index was also positively correlated with the ecological modernization index (r = .142, p = .006), suggesting that the stronger a respondent's ecological modernization point of view, the higher his or her score on the MPB knowledge scale (or vice versa). These results suggest that support for harvesting to manage the mountain pine beetle was not related to dependence on forestry but rather may have been a function of an individual's knowledge of the problem or his or her acceptance of the principles of ecological modernization, that economic and scientific progress will produce a technological solution to this environmental problem. This insight is the focus of the discussion and conclusions in the next chapters.

5 Discussion

Both researchers in the field of natural disturbances and experts in community assessments can find valuable information in these statistical analyses. The factor analysis indicates that most items load onto expected dimensions such as trust, knowledge, and attitudes toward harvesting. It reveals dimensions that could be incorporated into future research on the MPB; ranging from a generic environmental worldview to mountain pine beetle specific measures, including knowledge about the issue, trust in the sources of information, and its economic impact.

According to social psychologists, such as Stern et al. 1995, the mountain pine beetle epidemic would be considered an emergent attitude object. As Stern et al. (1995:1612) observed, when communities are confronted with problems such as the mountain pine beetle outbreak, "it is not easy to predict what form they will take, what attitudes will form about them, or whether 'public opinion' will be of one mind or be fragmented with regard to a particular new social entity." While it was not what I hypothesized, these data indicate that public opinion was largely of one mind about the mountain pine beetle outbreak.

The public appears to have accepted the position of the Council of Forest Industries and the government that increased harvesting is the appropriate approach to managing the outbreak. Whether the respondent lived in a more forest-dependent community or not, he or she was equally likely to support harvesting. The discussion begins with the results from the analysis of demographics, followed by an examination of the coherence of

environmental attitudes, then a look at the MPB specific issues of the degree of trust in social institutions as sources of accurate information, the level of individual knowledge, the ecological consequences, and its perceived economic impacts. The chapter ends with a discussion of public support for MPB management strategies.

5.1 Demographic Characteristics

The Kelowna sample was significantly older than the Prince George sample and included more widows and widowers while the Prince George sample contained more married people and people with children living at home. In short, as Tables 8, 11, and 12 demonstrate, the age, education, and income distributions of the samples from the two communities indicate that there was a difference between a younger working-class Prince George and an older "pensioner's" Kelowna.

5.2 Environmental Attitudes

Two of the seven environmental attitudes questions did not load on the environmental attitude factor, including the only one of the three questions that formed Weaver's (2002) Human Actions Have Environmental Consequences index that was included in the survey: "Economic growth always harms the environment." The residents of the less forest dependent community, Kelowna, expressed significantly higher levels of concern on this measure of human actions have environmental consequences than the residents of the more forest dependent community, Prince George. This result is consistent with the expectation that residents of the more forest dependent community would value economic growth over environmental protection.

The other environmental attitude that did not load on the attitude factor measured personal efficacy around environmental issues: "It is just too difficult for someone like me to do much about the environment." Although the variable did not load onto a factor, the significant difference by location shows residents of Kelowna seemed slightly more optimistic about an individual's ability to help the environment. The residents of Kelowna were more likely to reject the notion that an individual cannot help. Interestingly, this item loaded on the same factor as the trust in social institutions to provide correct information variables, although it did not form a reliable scale with them. Respondents who felt that they could do little to help the environment might believe that it requires social organizations, such as environmental groups, university research centres, and similar groups to make a difference. On this item, the more forest dependent community residents were significantly more likely to express personal efficacy with regard to the environment than were the residents of the less forest dependent community. It may be that more of the people living in a forest dependent community work in jobs or knew people who worked in jobs that involved efforts to improve the environment and therefore saw more ways that individuals could make a difference.

The five environmental attitude items loaded on a factor that reflects an ecological modernization point of view. Ecological modernization theory argues "that continued industrial development, rather than inevitably continuing to degrade the environment, offers the best option for escaping from the global ecological challenge" (York and Rosa 2003:273). The respondents who scored high on this index believed that science would solve environmental problems and that environmental threats are exaggerated.

Furthermore they believed that a strong economy is necessary to protect the environment and that we worry too much about the future of the economy and not enough about prices and jobs today. They also believed that greater biodiversity in the forest increases benefits only to communities adjacent to the forest. In short, they downplayed the importance of environmental concerns and relied on economic and scientific progress to solve environmental problems.

Another important factor that might affect value orientations is an individual's position within the productive arrangements of society, which could be as simple as social class differences or could be a more specific distinction between those who work in forestry and those who work in other industries. As Steel et al. (1995:141) observed, "Persons who rely on the timber industry for their economic well-being, for example, are more likely to look at commodity interests as most beneficial." The mean scores for both the Kelowna (M = 12.70) and Prince George (M = 13.25) samples indicated that the respondents from the more forest dependent community were no more likely to hold an ecological modernization point of view than those from the less forest dependent community. Thus living in a forest dependent community did not appear to be associated with whether an individual held an ecological modernization perspective on environmental problems. Therefore, the first hypothesis is rejected. On the average, the respondents in both samples disagreed with the ecological modernization point of view. Public opinion in these two communities was tilted toward an ecocentric set of values and away from an anthropocentric set. Even in forest dependent communities, citizens of BC (and perhaps beyond) may no longer trust economic growth and scientific advances to

solve environmental problems, particularly with the MPB epidemic serving as a dramatic object lesson of the limits of their ability to do so.

5.3 Trust in Social Institutions to Provide Correct MPB Information

Perceived past mismanagement may explain the low levels of trust in the forest industry, the media, and especially in the government reflected in the results. Interestingly, although the difference between the two means is small, the two communities did differ significantly in their trust of basic social institutions to provide accurate information about the MPB. An examination of five items reveals that the two communities differed specifically in their level of trust of the forest industry rather than in their trust of the government, the media, university research centres, or environmental groups (see Table 17). The more forest-dependent community had less trust in the forest industry (M = 15.33) than the less forest dependent community (M = 16.25). Therefore, the second hypothesis is rejected. The difference in mean scores between Kelowna and Prince George was almost one point (.92) on a scale ranging from 5 to 25. The proximity to the forest industry and forest operations may have exposed residents of Prince George to poor past performance or mismanagement experiences that Kelowna was otherwise shielded from.

5.4 Knowledge and Beliefs about MPB Ecology and MPB Management Alternatives

Emerging social objects, such as the mountain pine beetle epidemic, activate environmental norms. Public concerns may, therefore, be shaped by information that links the issue to held values. I have argued that when confronted with an ecological disaster, such as the MPB, residents of Western capitalist countries, such as Canada, will frame the problem in terms of its economic impact. Therefore I hypothesized that there

would be greater support for salvaging timber within regions affected by the mountain pine beetle. Individuals who hold a biocentric worldview, however, may understand the mountain pine beetle epidemic not in economic terms but in ecological ones and therefore support alternative approaches to managing the mountain pine beetle. The question of interest remains what factors were associated with public support for alternatives to harvesting as a mountain pine beetle management approach. One factor might be more knowledge about the issue. Lack of knowledge may hamper the public's ability to make choices concerning which management alternatives to support.

The two communities did differ significantly in their knowledge about the MPB outbreak and about management strategies with residents of Prince George reporting more knowledge (M = 2.70) than the residents of Kelowna (M = 2.29). The mean scores indicate that the average resident of Prince George knew a fair amount about the MPB outbreak in the province and about how it was being managed in the local area whereas the average resident of Kelowna only knew a little. They differed by .41 of a point on a scale ranging from 2 to 8. Knowledge about the mountain pine beetle was less than I expected among the general population. Over the last five years since the survey was administered, significant media attention has been given to the issue, which may have increased knowledge about mountain pine beetle outbreak in both communities, but especially in Kelowna, which was less affected by the MPB outbreak in 2007. It was expected that residents of Prince George would be more knowledgeable about mountain pine beetle management since at the time of the data collection in 2006 the intensity and

duration of the outbreak had reached a peak in the region surrounding Prince George. Therefore, the third hypothesis cannot be rejected.

5.5 Ecological Consequences of the MPB Epidemic

While the focus of the study is to understand public support for harvesting, especially any differences in support between a non-resource dependent and a forest-dependent community, depending on how the question was phrased between one-quarter and one-half of the respondents did not support an increase in harvesting (see Tables 22-26). The correlation between the harvesting index and the ecological modernization one suggests that these same respondents may also disagree with the ecological modernist approach that modern science and economic growth will solve environmental problems (r = .18, see Table 29). They may have been taking a leave-it-alone position (over one-quarter of the respondents agreed or strongly agreed that "if left alone, the forest will adapt to the MPB" in Table 3), perhaps because they acknowledged the role or at least possibility of humans in exacerbating natural disturbances, particularly this one.

Although most scientists agree that global warming is both real and a major contributing factor to the mountain pine beetle epidemic, almost 20 percent of the respondents believed the outbreak was a natural anomaly. A fifth of respondents seemed to deny human involvement in it. There was, however, considerable support for the idea that the mountain pine beetle outbreak resulted from human mismanagement. As Table 18 shows over one-third (38 percent) believed the outbreak was the result both of an anomaly in the natural cycle of disturbance ecology and of the effects of human induced temperature increases while even more (43 percent) believe people were largely to blame. Thus, most

respondents (81 percent) believed that humans were at least partly to blame for the MPB outbreak. These findings suggest that there may be a consensus in these two communities, and perhaps in the rest of BC, that the current mountain pine beetle epidemic was a result of human induced ecological change.

5.6 Economic Consequences of the MPB Epidemic

The factor analysis identified five of the 13 questions measuring the consequences of the MPB epidemic as loading on a single factor. All five measured economic rather than environmental consequences. These five items measure the economic effects on the individual ("If the market value of wood products coming out of BC decreases in value, I will feel the economic impact"), local ("The local economy is strong enough to hold out through a shortage of logging activity;" "Special assistance grants to my community to mitigate the environmental and economic consequences of the MPB are necessary"), provincial ("Wood products currently coming out of BC onto the global market will decrease in value"), and national ("Economic progress in Canada will slow down unless we look after the environment better") levels. The success of this multi-level approach suggests that the economic consequences of other environmental problems could also be measured using a single index combining the individual, local, provincial, national, and, if appropriate, global levels.

Not surprisingly, the more forest dependent community reported higher levels of economic impact from the MPB as measured by the index of five items (M = 18.17) than the less forest dependent community (M = 16.76). While both mean scores fall between

neither and agree on the economic impact index, the mean for Prince George was closer to agree than the mean for Kelowna. Therefore, the fourth hypothesis is not rejected.

Furthermore, one economic consequence item out of the four that did not load on the economic consequences index also differed by location. Table 20 shows a significant difference in each community's view of the relative importance of the forests and the associated industry. Whereas respondents from Kelowna typically agreed with the statement "Historically the surrounding forests were of greater importance to the local economy than they are today," those from Prince George generally disagreed. The forests were still of greater importance to the economy of the more forest dependent community of Prince George than to the more urban mixed economy of Kelowna. These results would appear to support the characterization of Prince George as a forest-dependent community and Kelowna as a non-forest-dependent community. They revealed the continuing importance of the forest industry to the welfare of Prince George.

5.7 Managing the Mountain Pine Beetle Epidemic

I hypothesized that residents of Prince George, the more forest-dependent community, would be more supportive of harvesting as the method for managing the mountain pine beetle outbreak. The results indicate that there was no difference between Prince George (M = 18.37) and Kelowna (M = 18.32) in support for harvesting on the index as well as on four out of five of its constituent items. Therefore, the fifth hypothesis is rejected. There appeared to be general support for increasing harvesting as the primary means of managing the MPB in both communities, even though they differed in the level of

dependence on the forest industry, as both mean scores indicated agreement with the harvesting items.

Interestingly, a sizable minority favored less harvesting. Although it was the minority position, between 13 percent (Table 23) and 24 percent (Table 24) indicated that they wanted no change in harvesting or salvaging operations. The survey data did not provide any insight into how much harvesting respondents thought was going on at the time they responded to the survey, therefore these results can only be reported to represent the perceptions of individuals based on the assumptions they held about the extent of preexisting forest operations.

The level of agreement ranged from a high of 72 percent of the pooled samples of respondents agreeing or strongly agreeing that "harvesting should be increased in infected areas to salvage larger volumes of timber" to a low of 50 percent who indicated that they generally supported more harvesting after reading the sentence "some experts argue that a necessary response to the mountain pine beetle (MPB) outbreak is to increase harvesting levels of all standing pine (including unaffected trees)." This question with the lowest level of agreement was the first one of the harvesting items in the questionnaire. The last harvesting item produced almost the same level of support for more harvesting (70 percent indicated more harvesting in response to the question "should forest companies be harvesting more or less of the damaged wood than they currently plan to do?") as the middle one which produced the 72 percent agreement referred to at the beginning of this paragraph. The second question produced more

support for harvesting (64 percent favored more salvaging when asked "would you support policies to increase the degree of salvaging timber now to remove more affected trees") than the first (50 percent) but less than the third (72 percent) and the fifth (70 percent). The higher level of agreement on items occurring later in the questionnaire suggests that the act of completing the survey may have influenced people's opinions, perhaps by providing them with more information about the mountain pine beetle outbreak, including visual information at the end of the survey. This result is consistent with Kearney's (2001) study that found that describing the benefits of a management strategy and providing visualizations significantly increased support for clear-cutting.

The fourth question was posed in the opposite direction. It asked the respondent's level of agreement with the statement, "timber extraction should be reduced to ensure a sustainable level of harvesting." It was also a generic question that did not mention the MPB specifically. Looking at it from the opposite point of view, this question garnered the most support for reducing harvesting, with 41 percent agreeing or strongly agreeing that timber extraction should be reduced. In contrast, only 32 percent supported less harvesting on the first question, 12 percent supported less salvaging on the second, 15 percent on the third, and 10 percent on the last. While a substantial minority of the public in these two communities may support less harvesting in general, that support fell off when the issue was what to do with damaged wood or affected trees. The lack of a statistically significant relationship with living in a forest dependent community is surprising given previous studies demonstrating the importance of this variable. McFarlane and Boxall (2000), for example, found that living in a forest-dependent

community led to more support for current forest management, economic development, and timber-oriented management.

5.7.1 Other Mountain Pine Beetle Management Alternatives

Managing the mountain pine beetle entails more than simply whether to harvest infected trees. Another key question is what should replace the infested trees after they have been harvested. While the vast majority of respondents from both communities supported replanting using a mix of forest species, residents of the more forest dependent community, Prince George, were twice as likely to support replanting pine trees (22 percent) than residents of the less forest dependent community (11 percent). This difference as well as the other observed differences between the two communities, such as the difference in knowledge of the MPB, trust in social institutions as sources of information about the MPB, and ecological modernization attitudes, may be the result of drivers other than forest dependence. It is possible that the slight larger number of Prince George respondents who wanted to replant with pine was a reflection of the existing differences in forest diversity between the two locations and preferences were to replace the harvested trees with trees similar to those in stock in those areas. Kelowna has a more mixed forest landscape while in Prince George pine forest predominate. In addition, the epidemic was peaking around Prince George at the time of the survey in 2007 but it was just beginning to reach Kelowna. In short, these large landscape level differences may be explain both observed and unobserved differences in concerns of the citizens of the two communities rather than the difference in their on the forest industry as the community's economic engine. It seems likely that variation in the relative attributes of forest

composition at the time of this survey would have an effect on the respondent's perception of the MPB problem and related forest issues.

In contrast, there was no difference between the two samples in support for the use of fertilization to assist faster regrowth of stands nor in support for using genetically engineered species to regenerate the forest more rapidly. Almost two-thirds approved of using both fertilization and genetically engineered species to speed regrowth. Therefore, the sixth hypothesis is rejected for fertilization and genetic modification, but it cannot be rejected for replanting with pine.

In a similar study, respondents to the Canadian National Parks survey agreed that "no intervention" was not an option (McFarlane et al. 2006). Preferred management options were "sanitation cutting to remove infested trees from small areas," and "the use of pheromones to attract beetles to one area." Although local residents shared the view of park managers that allowing the MPB to go unchecked was unacceptable, survey results showed preferences for "removing infested trees over small areas using the least invasive means possible" (McFarlane et al. 2006:346). Generally unsupported options included the use of chemical controls and other control methods in uninfected areas. McFarlane et al.'s study was consistent with previous studies that found that chemical controls and burning were contentious and generally less acceptable.

Similarly, the residents of British Columbia surveyed in this project also did not support a non-intervention policy. The frequencies in Tables 21-25 suggest public consensus in

favor of managing the outbreak by harvesting MPB infected trees. Unlike McFarlane et al.'s research that found little support for chemical agents and prescribed fire, the majority of respondents supported both fertilization and the use of genetically modified species to speed regrowth.

McFarlane et al. (2006:347) argued that "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." They cautioned that given the issue salience of the MPB, their findings may not be typical of public perceptions toward natural disturbance agents of other sorts, especially those with a low incidence or with few social or economic impacts. The results from my question asking whether the MPB epidemic was a result of an anomaly, human induced changes to the environment, or both seemed to show that the more respondents viewed the effects of the outbreak as a result of human mismanagement and not a normal natural phenomenon, the more likely they were to support greater intervention to correct past mismanagement even though this logic may seem counterintuitive.

McFarlane et al. (2006:345) also found that pro-environmental attitudes were positively correlated with "support for no intervention in MPB outbreak in national parks." I found the obverse, that anthropocentric attitudes, specifically an ecological modernization orientation, were positively correlated with support for harvesting to manage the MPB. McFarlane et al. concluded that public education outreach and policy should concentrate on providing factual information not only about the MPB but also about ecosystem

health. This information, they argued, would serve to educate the public about the role of natural disturbance and perhaps garner support for less interventionist policies. The conclusions of this analysis support their findings and their recommendation.

5.8 Correlations of Indexes with Support for Harvesting

Figure 2 illustrates the significant correlations among the variables. Support for harvesting was associated with holding an ecological modernization point of view and knowledge of the MPB problem. It was not associated with living in a forest dependent community, trusting social institutions to provide accurate knowledge about the MPB, nor economic impact of the MPB.

Living in a forest dependent community is associated, however, with greater knowledge of the MPB outbreak. It could be, as the relationships outlined in Figure 2 depict, that location had an indirect association with support for harvesting. Living in a forest dependent community was correlated with greater knowledge about the MPB problem which in turn was correlated with support for harvesting to manage the problem. While location was associated with both economic impact and trust in social institutions as sources of correct information about the MPB, neither was associated with support for harvesting.

Even though the public debate and policies often emphasize the economic consequences of natural disturbance events, it is knowledge and environmental value orientation (in this case, and ecological modernization perspective) not economic impact that was associated

with public support for harvesting. A respondent's knowledge about forest management efforts as well as value orientation influenced his or her opinions about the MPB epidemic. An individual's cognizance of environmental conditions and the things they value may propel them towards a willingness to take a stance on a public policy issue such as the MPB.

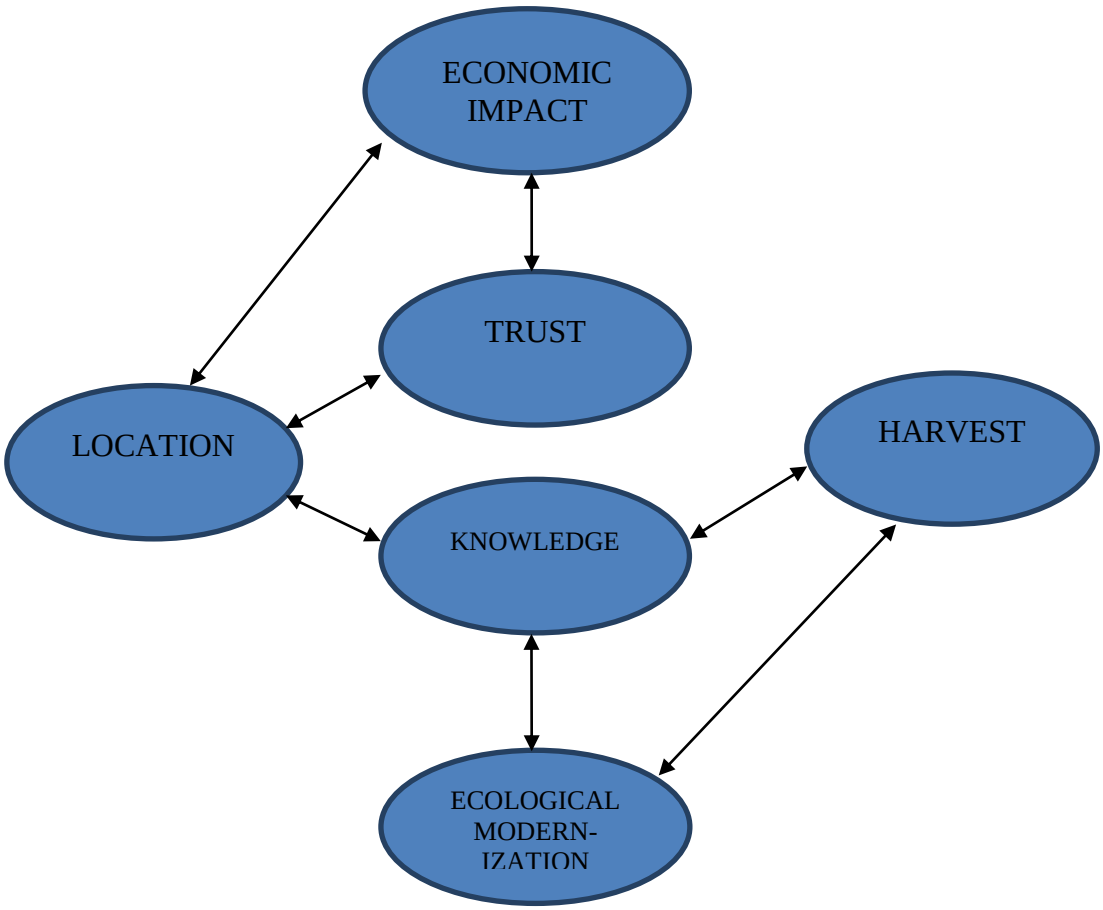

Figure 2: Conceptual Representation of Factors Correlated with Public Support for Harvesting

These findings seem to support the decades of research in norm-activation theory that argue environmental concern is the result of a process of activating personal moral norms based on the confluence of value orientations, social interactions, and information about

attitude objects that influence beliefs. They provide evidence supporting the theory that a preference towards a social attitude object, such as harvesting the mountain pine beetle impacted forests, is guided by value orientations. They are consistent with the theory that value orientations (whether measured by the NEP or AC) are stable predictors of emerging social-environmental attitude objects. In this particular case, the findings indicate that a distinctly anthropocentric value orientation, specifically an ecological modernization worldview, was associated with greater support for increased harvesting as the policy response to the MPB outbreak.

As Table 29 indicates, ecological modernists were more likely to support harvesting as the MPB management strategy. First, they believed that we worry too much about the environment and not enough about jobs and that environmental threats are exaggerated, but they also believed that modern science will solve our environmental problems and that environmental protection requires a strong economy. In short, those who believed that economic and scientific progress would solve environmental problems supported increased harvesting, which is the human intervention advocated by the Council on Forest Industries and government experts to solve the MPB problem. Individuals who hold this particular type of anthropocentric value orientation towards the environment believed that the best way to protect the environment was to develop the economy and trust that science will develop with technological solutions to any environmental problems that result from that economic development. Thus, these ecological modernists trusted humans to solve environmental problems such as the MPB. While they gave jobs and a strong economy higher priority than the environment, making them

anthropocentric, they also believed that doing so would enable the country to protect the environment. Although people are likely to hold a multidimensional view of the world, their basic environmental attitudes can be situated on a continuum between anthropocentrism and biocentrism. The ecological modernists in these two samples were on the anthropocentric side of the continuum, but were not at the extreme end of it because they believed that prioritizing the economy and science would solve environmental problems too.

Thus, anthropocentric value orientations, such as an ecological modernization worldview, corresponded to public support for harvesting. This result is consistent with McFarlane and Boxall's (2000) finding that respondents with higher anthropocentric values were more supportive of current forest management, economic development, and timber-oriented management. It is also consistent with Ribe's (2002) finding that environmental attitudes towards resource protection affected support for management strategies.

The value orientation measured by the ecological modernization index was correlated with knowledge about mountain pine beetle management. Support for mountain pine beetle harvesting (forest issue support) was correlated with value orientation (ecological modernization) and knowledge. These findings contribute to the conceptual framework for understanding human responses to emerging environmental changes, in particular public support for collective action.

6 Conclusion

This research project was designed to measure public support for MPB management strategies, particularly whether support for harvesting affected trees was stronger in a forest dependent community than in a non-forest dependent community. A survey was administered to 159 residents of Prince George, a forest dependent community, and 153 residents of Kelowna, a community with a mixed economy. The survey results showed no difference between the two communities in public support for harvesting, fertilization, and the use of genetically modified species to speed regrowth after harvesting MPB affected areas, but residents of Prince George were more likely than residents of Kelowna to support replanting affected areas with pine trees. Location, therefore, was unrelated to support for harvesting and to environmental value orientation. Location was, however, associated with an individual's rating of the economic impact of the MPB, knowledge about the MPB, and trust in institutions to provide accurate information about the MPB. These findings suggest that future public communication efforts pertaining to forest policy should reduce its current emphasis on technical and economic reasoning and promote the environmental values the policies seek to address.

6.1 Summary of Findings

This research project was designed to compare Prince George, a more forest dependent community, to Kelowna, a less forest dependent community, on environmental value orientation, trust in social institutions, knowledge about the MPB, economic impact, and support for MPB management strategies.

- Hypothesis 1 that residents of Prince George would score higher on the ecological modernization index than residents of Kelowna was rejected. Only a minority in both communities scored high on this anthropocentric scale.
- Hypothesis 2 that respondents from Prince George would have higher levels of trust in social institutions to provide accurate information about the MPB than those from Kelowna was rejected. The association was in the opposite direction with Kelowna residents scoring higher on the trust index.
- Hypothesis 3 that Prince George residents would have more knowledge about the mountain pine beetle outbreak, including management of it, than Kelowna residents was not rejected. Location was associated with knowledge about the MPB.
- Hypothesis 4 that Prince George residents would be more concerned with the economic impacts of the mountain pine beetle than Kelowna residents was not rejected.
- Hypothesis 5 that Prince George residents would be more supportive of harvesting as a MPB management strategy than Kelowna residents was rejected: The degree of forest dependence was not associated with public perceptions of harvesting as a MPB management strategy. Both locations were generally supportive of harvesting.
- Hypothesis 6 that Prince George residents would show greater support for fertilization and genetic modification than Kelowna residents was rejected. Approximately two-thirds of each sample supported both strategies for speeding regrowth of the forests. In contrast, the hypothesis that Prince George residents

would show greater support than Kelowna residents for replanting affected areas with pine was not rejected.

Although there was broad public support for harvesting policies, that support was less associated with location and more associated with knowledge and value orientation. As hypothesized, public support for harvesting as a forest management strategy for the mountain pine beetle outbreak was associated with both environmental value orientation and knowledge about the MPB. My expectation was that the mountain pine beetle issue would be judged primarily based on its economic consequences, which would differ across individuals and locations, and only secondarily based on value orientation. Instead, I found that value orientation, specifically holding an ecological modernization point of view had the largest correlation with support for harvesting, while economic impact was not associated with it. The minority of respondents who held an anthropocentric value orientation were more likely to support harvesting suggesting that they may have responded to the issue based on their values. These results are consistent with other studies (McFarlane and Boxall 2000; Ribe 2002) and provide further evidence supporting the theory that value orientation leads to specific positions on environmental issues. McFarlane and Boxall (2000) would regard support for harvesting as a specific attitude and ecological modernization as a general belief. It may be that general beliefs have stronger effects on specific attitudes such as forest management preferences than do economic interests.

6.2 Limitations

This research had several limitations. First, it used cross-sectional observational research design and correlational analysis. This design does not allow conclusions to be drawn about whether the relationships were causal nor about the causal direct of the relationships. Second, the convenience sample design does not allow generalizations to be made to the populations of these two communities nor to the rest of British Columbia or other MPB areas. Despite the study's limitations, the information it produced provides researchers with data and measures that can be used in future research on the MPB and other natural disturbance and forest-related issues.

6.3 Implications for Future Research

Given the public consensus in favor of increased harvesting, the more interesting question may be who does not support harvesting as the MPB management approach. The answer may revolve around the 30 percent of respondents who agreed or strongly agreed that if left alone, the forest would adapt to the MPB. Weaver's (2002:85) Human Actions Have Environmental Consequences construct contained two indicators not included in this survey: "(1) any change humans cause in nature – no matter how scientific – is likely to make things worse; (2) almost everything we do in modern life harms the environment." This biocentric value orientation may explain the position of the respondents who opposed increased harvesting to manage the MPB. The opponents of increased harvesting may have believed that human action would make things worse and harm the environment. Future research should include all three of Weaver's indicators as well as the measure of ecological modernization. If 30 percent believed human action harms the environment and a similar number believed that economic and

scientific progress can help the environment, what is the value orientation of the other 40 percent? Are they ecocentrists who believe humans can help the environment? Or anthropocentrics who want to salvage the economic value from the environment? And do these distinct environmental value orientations explain who supports and who opposes increased harvesting as the MPB management strategy?

This study provides support for value orientation–attitude models and demonstrates the connection between individuals' knowledge and their positions on forest management issues. Knowledge of the MPB and how it is being managed locally may produce greater faith in science and economic forces to solve the problem thus leading to a slightly higher score on the ecological modernization index. McFarlane and Boxall (2000) found that knowledge had no effect on support for forest management when controlling for anthropocentric forest values. Future research might include a multivariate analysis controlling for ecological modernization to see if the relationship between knowledge and public support for harvesting disappears. It might also control for age, gender, social class, and other variables that previous research has shown to be related to environmental attitudes.

Much of the recent literature on environmentalism and its effect on behavior has sought to understand the environmental values held by the public. This study contributes to this body of research by identifying an economic-environmental policy issue with broad public support where environmental values may shape support for harvesting. Future studies should continue to measure the various dimensions that may be found along the

anthropocentric – ecocentric continuum and evaluate how their differences may be reflected in support for various forest management regimes. It may be revealed that where broad support for forest management practices exists, there is evidence of a set of environmental values underlying that public support. In other words, public support for harvesting areas impacted by the mountain pine beetle may not only be because individuals see an economic return but because some or most see an environmental benefit. The increased risk of wildfire, the stress placed on other non-timber values such as recreation and wildlife, or simply a perceived decline in forest health as perceived by a reduction in scenic beauty may all be environmental priorities that lead to public support for harvesting. These different orientations should be tested to see whether they influence public response to other forest disturbances as well as other types of natural disturbances and environmental pressures more generally, such as increasing scarcity of petroleum and water.

Nelson (2007) noted an ideological shift in public expectations for forests away from an economic emphasis toward other social and environmental objectives. As impending reductions in the forest related jobs come as a result of the decrease in salvaging operations, pressure may mount to allow access to areas currently managed for non-timber values. A follow-up study examining the effect the increase in jobs, pending reductions, and the pressure to maintain current levels of harvesting in the region may reveal whether individuals' perspectives have changed regarding how communities should prioritize environmental values compared to economic benefits.

Concern about the environment has risen over the past several decades. At times public attention has been captured by writings, such as Carson's *Silent Spring*, or by events such as the conflicts in the forests of the American Pacific Northwest and British Columbia's Clayquot Sound. Public concern has evolved from an awareness of the degradation of environmental quality and services to a desire to be directly involved in decision-making concerning environmental management. Activism directed at forest resource management has been attributed to differences in stakeholder's cognitive value orientations and attitudes. Fundamental understanding of the underlying attitudes and breadth of interests associated with the public's position on forest management issues would help policy-makers address potential conflicts and establish responsive policies that deliver environmental services through adaptive management structures.

6.4 Forest Management as Intervention

The mountain pine beetle is a current example of how a natural disturbance presents huge challenges to traditional systems for managing the environment. Because traditional modes of governance are largely based on models of economic efficiency and a degree of certainty, the uncertainty of natural disturbances and the social and environmental concerns that come with them are formidable tests of the legitimacy of policies and decision-makers. Changes in forest character and timber supply resulting from the mountain pine beetle epidemic will increase potential for political conflict as economic, environmental, and social objectives become more difficult to achieve through the traditional forest tenure system. In BC, the MPB crisis has catalyzed public pressure resulting in small changes in policy. Providing economic relief and increased public

involvement have been enough to assuage public pressure in BC. In addition to differences in employment characteristics and stakeholder involvement, legal constraints on national agencies are more likely to result in outcomes that increase environmental protection while state agencies are more likely to pursue economic development goals in the absence of legal or stakeholder pressure.

Managing a public good such as forests requires establishing the conditions and controls to conserve the value as well as the resource itself for the future and to meet society's changing needs. The scope and origins of the MPB continue to challenge existing forest governance structures. As the MPB spreads over BC, as forest products flood the international market place, and as various scientific and environmental interest groups connect the issue to global climate change, increasing stress is placed on existing political arrangements. This increasing stress may result in one or a combination of new regulations, shifts in authority or responsibilities across agencies or to different levels of government, or increased involvement of other actors including citizens and NGOs in the political arena.

Despite individual or community calls for additional attention to non-economic interests, the major actors represented the concerns of the forest industry, the primary arena of decision making has been at regional or provincial levels of government, and the regulatory mechanism is by design based on economic efficiency. The mountain pine beetle is a great example of how a natural disturbance presents huge challenges to traditional models of environmental governance. Because traditional modes of

governance are largely based on models of economic efficiency and a degree of certainty, the uncertainty of natural disturbances and the social and environmental concerns that come with it are formidable tests of the legitimacy of policies and decision-makers.

As Steel et al. (1994:138) noted, "at the heart of this debate are differing philosophical and normative views about forests and human relationships to forests." Where early foresters such as Gifford Pinchot approached forest management with a distinctly utilitarian philosophy (the wise human use of and development of resources) advocating for the betterment of humankind built on anthropocentric assumptions, others such as Leopold favored extending ethical consideration to all of nature's manifestations promoting a more biocentric orientation to forest management. Findings from this study revealed that while only a minority embraced utilitarian/anthropocentric value orientations with an ecological modernist logic, those who did had a higher likelihood of supporting harvesting as the MPB management strategy than those who did not even though this relationship was relatively weak.

Changes in forest character and available timber from the growing mountain pine beetle epidemic will increase potential for political conflict as economic, environmental and social objectives become more difficult to achieve through the traditional forest tenure system. While decisions may be based on the balance of many factors including on individual's education, faith, previous experience, etc., when confronted with questions about forest management and the mountain pine beetle, people's responses may be made based on their value orientation. Therefore policy-makers should be sure to measure

value orientations, such as the Ecological Modernization, as they seek to understand public opinion on a particular environmental question.

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Appendix A: Survey Instrument

The University of British Columbia
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Consent to Participate in a Research Project

Project Title: *Public Perceptions of Mountain Pine Beetle Management*
Project Funding: This study is funded by Natural Resources Canada.

Project Investigators: Dr. Michael J. Meitner (office: 604-822-0029) and Daniel W. Berheide (office: 604-822-6708)

Consent: By signing this form, you agree to participate in a research project conducted by Dr. Michael J. Meitner and Daniel W. Berheide regardinforestg your perception of forest management in and around the study area in BC, and your opinions relating to those simulated alternatives. First you will be asked to respond to a series of questions about your attitudes towards the Mountain Pine Beetle and related issues. In the second section, you will be asked to view images representing various forest management alternatives and to compare relationships among temporal flow of aesthetic, recreational and economic values associated with alternative management scenarios. Lastly, you will be asked to answer a standard battery of demographic questions.

You will participate in the research project, subject to the following conditions:

- You understand that all information associated with this study will be held in confidence and only the experimenter will have access to the information. Each subject will be assigned a number, and that number will be on all documents rather than his/her name. You have been assured that any data resulting from this experiment will be stored in a password protected computer database and that only a sequential generated ID number will be used to identify your responses.

- You understand that you may refuse to participate or withdraw at any time.

- If you have any questions or concerns about the procedures used in this research, Dr. Meitner or Mr. Berheide has agreed to answer any questions and inquiries that you may have.

If you have any questions or concerns about this research project, you may contact Dr. Mike Meitner (office: 604-822-0029) at the Faculty of Forestry, University of British Columbia. If you have any questions or concerns about your rights or treatment as research subjects, you may contact the UBC Office of Research Services and Administration at 604-822-8598.

This page of the survey will be detached from the questionnaire and the remaining portion of the survey assigned a unique random number to ensure the responses are not associated with any means for identifying its source of origin. (your name or identification).

Remember to please read the instructions carefully and thoroughly, some of the questions require you to circle your answer or check a box representing your choice while other questions ask you rank your preferences with numbers.

Indicate your answer clearly.

Please ask the staff member if you have any questions.

Varying with every individual, the survey should take between 15 and 20 minutes.

Remember all of your responses will be anonymous and answering all of the questions completely assist researchers understand how these complex issues impact individuals and communities.

As you may know, the recent outbreak of the mountain pine beetle (MPB) has raised serious forest management issues in British Columbia. The mountain pine beetle predominantly attacks mature lodgepole pine and approximately 80% of this species of trees in BC is predicted to die in the next 10 years**.** This survey asks your opinions about issues surrounding the current outbreak.

Please clearly circle the response that best represents your view.

1. How much would you say you know about the mountain pine beetle (MPB) outbreak in the province?
    a. Nothing
    b. A little
    c. A fair amount
    d. A good deal

2. How much do you know about how the mountain pine beetle (MPB) outbreak is currently being managed in your area?
    a. Nothing
    b. A little
    c. A fair amount
    d. A good deal

    How much trust do you have in each of the following groups to give you correct information about the MPB? 1 hardly any, 2 not much, 3 some trust, 4 quite a lot, 5 great deal, 9 no answer

3. Forest industry ____
4. Environmental groups _____
5. Local and Provincial government_____
6. Media (Newspapers, TV, Radio, etc.) _____
7. University research centres _____

8. Pick an answer from <u>each</u> column that best describes your view of a healthy forest.

A healthy forest features:

Column I – Density	Column II – Variety	Column III - Openings
a. dense stands of trees	a. mostly the same type of trees	a. large openings among stands
b. sparse stands of trees	b. mixed/different types of trees	b. small openings among stands
c. density does not affect forest health	c. variation does not affect forest health	c. opening size does not affect forest health

9. Some experts argue that a necessary response to the mountain pine beetle (MPB) outbreak is to increase harvesting levels of all standing pine (including unaffected trees). Do you generally support more or less harvesting?

1	2	3	4	5
Less Harvesting		No Change		More Harvesting

10. It has been proposed that fertilizing trees could assist faster regrowth of stands. Would you support the use of fertilization?
    a. No
    b. Yes
    c. Can't make an informed decision

11. Would you support replanting genetically engineered species to regenerate the forest quicker and allow for a quicker return to standard harvesting levels? Or do you prefer reforestation occur without the use of genetically engineered species?
    a. I distrust any genetic engineering
    b. I support using genetically engineered species only in this instance (the MPB outbreak).
    c. I support using genetically engineered species whenever appropriate.
    d. Can't make an informed decision

12. Historically, pine has been the dominant species in areas affected by the MPB outbreak. It has been proposed that replanting mixed species would diversify the forest 'portfolio' therefore reducing further risk of future outbreaks. Would you rather replant the pine, replant with another single species (non-pine) or replant using a mix of forest species?
    a. Replant native pine species
    b. Diversify tree species
    c. Replant non-pine species only (e.g. spruce)
    d. Can't make an informed decision

13. It has been argued that salvaging more pine now will allow the forest to recover faster, get the most value from the timber resource, and employ more people in the short term. However, increased salvaging now will likely result in the elimination of many jobs in the future (15-20years) after all of the affected pine has been cut and there is no more available mature pine to harvest. Additionally, unless other techniques can create diversity in the ages of the trees planted after salvaging, another MPB epidemic may occur. Would you support policies to increase the degree of salvaging timber now to remove more affected trees?
    a. Less salvaging
    b. No change in current level
    c. More salvaging
    d. Can't make an informed decision

14. Do you think that job growth in other industries (tourism, oil, mining, etc.) will replace possible future job losses in the forest industry?
    a. Not at all
    b. Only a small portion
    c. A small majority
    d. Almost completely
    e. Absolutely all
    f. Can't make an informed decision

15. Although the MPB is a part of the natural disturbance cycle of BC forests, some scientists have argued that the current extent of the outbreak is due to effects of temperature increases and global warming. Using a scale of 1 to 5, rate the degree to which humans are to blame where 1 means the extent of the outbreak is an anomaly in the natural cycle of disturbance ecology and 5 means people are largely to blame for the severity of the recent MPB outbreak.

1	2	3	4	5	8
The recent MPB outbreak is a natural anomaly.		Both		People are largely to blame for the recent outbreak of the MPB	Can't make an informed decision.

16. Who should be held <u>primarily</u> accountable for managing the MPB and its consequences for communities and forests?
    a. Government
    b. Private citizens
    c. Industry
    d. None of above

17. In addressing the MPB outbreak, which one of the following do you believe is most important to protect?
    a. All pine species
    b. Local biodiversity
    c. Local business
    d. The forest industry
    e. Outdoor recreation
    f. Can't choose

18. We hear a lot of talk these days about liberals and conservatives. Below is a seven-point scale on which the political views that people might hold are arranged from extremely liberal—point 1—to extremely conservative—point 7. Where would you place yourself on this scale?
    1. Extremely liberal
    2. Liberal
    3. Slightly liberal
    4. Moderate
    5. Slightly conservative
    6. Conservative
    7. Extremely conservative
    8. Can't choose

Please indicate whether you strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree with each of the following statements by placing an (X) underneath the category that best describes your response.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Don't know
19. The MPB is a natural part of forest ecology.						
20. The BC government consulted the community sufficiently in the creation of "British Columbia's Mountain Pine Beetle Action Plan 2005–2010."						
21. The MPB outbreak is being used by the forest industry to justify clear-cut logging.						
22. Harvesting should be increased in infected areas to salvage larger volumes of timber.						
23. The level of disturbance caused by the MPB is irreversible and the forest will never recover fully.						
24. The local economy is strong enough to hold out through a shortage of logging activity.						
25. I would support the development of a biofuel processing plant in the local area.						

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Don't know
26. Due to the MPB, the wood products currently coming out of BC onto the global market will decrease in value.						
27. If the market value of wood products coming out of BC decreases in value, I will feel the economic impact as a result.						
28. Special assistance grants to my community to mitigate the environmental and economic consequences of the MPB are necessary.						
29. First Nations values are being considered in MPB management strategies.						
30. If left alone, the forest will adapt to the MPB.						
31. Timber extraction should be reduced to ensure a sustainable level of harvesting.						
32. Historically the surrounding forests were of greater importance to the local economy than they are today.						

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Don't know
33. Greater biodiversity in the forest increases benefits only to communities adjacent to the forest.						
34. Modern science will solve our environmental problems with little change to our way of life.						
35. We worry too much about the future of the environment and not enough about prices and jobs today.						
36. To protect the environment, British Columbia needs a strong economy.						
37. Economic growth always harms the environment.						
38. It is just too difficult for someone like me to do much about the environment.						
39. Many of the claims about environmental threats are exaggerated.						
40. Economic progress in Canada will slow down unless we look after the environment better.						

Briefly answer the following in the space provided below each question.

41. How do you believe the forest landscape has changed over the past 20 years?

42. How do you perceive the composition of the community has changed over the past 20 years?

43. What do you think contributed the most to the recent outbreak?

44. What will happen to your community if there is a decline in forest revenue?

This page describes the various policy scenarios seen in the associated images. The following page asks you to evaluate the images and should only take another few minutes.

Scenario comparison

In this section we would like you to evaluate 4 scenarios for dealing with the mountain pine beetle problem. In this evaluation we would like you to consider a number of factors simultaneously. These include: 1) how long until the beetle damaged forest has recovered to a harvestable, 2) the risk of the out break happening again, 3) the cost of the scenario, 4) the ecological effects of the scenario, 5) the resulting scenic beauty and 6) the potential of the area to support outdoor recreational activities. In scenarios 2, 3 and 4 the same amount of timber is harvested.

Scenario 1 - Do nothing (*refer to image set 1*)

In this scenario everything regenerates naturally according to whether it is a pure pine stand or a mixed stand. No trees are harvested and no treatments of any kind are applied to the forest. This scenario can be used as a baseline to compare the effects of the other scenarios against. The estimates of recovery time for this scenario range from 75-100 years.

Scenario 2 - Replant with pure pine (*refer to image set 2*)

Timber is harvested in this scenario and each area harvested is replanted. In this scenario pure pine is planted similar to the original composition of the existing forest. The estimates of recovery time for this scenario range from 65-75 years.

Scenario 3 - Replant with mixed species (*refer to image set 3*)

Timber is harvested in this scenario and each area harvested is replanted. In this scenario mixed species of trees are planted in an attempt to reduce the risk of future outbreaks. In this case the trees are fertilized to help them to grow more quickly. The estimates of recovery time for this scenario range from 70-80 years.

Scenario 4 - Replant with pure pine (fertilized) (*refer to image set 4*)

Timber is harvested in this scenario and each area harvested is replanted. In this scenario pure pine is planted similar to the original composition of the existing forest. In this case the trees are fertilized to help them to grow more quickly. The estimates of recovery time for this scenario range from 60-70 years.

A summary of this information is provided in the table below:

	Harvested	**Cost**	**Recovery time**	**Risk of future outbreaks**
Scenario 1 - Do nothing (*refer to image set 1*)	no	none	75-100	moderate
Scenario 2 - Replant with pure pine (*refer to image set 2*)	yes	moderate	65-75	moderate
Scenario 3 - Replant with mixed species (*refer to image set 3*)	yes	moderate	70-80	reduced
Scenario 4 - Replant with pure pine (fertilized) (*refer to image set 4*)	yes	high	60-70	moderate

Please rank order the scenarios in order of preference where 1 equals your most preferred and 4 equals your least preferred. Use each number only once.

	Rank 1 = most preferred 4 = least preferred
Scenario 1 - Do nothing (*refer to image set 1*)	
Scenario 2 - Replant with pure pine (*refer to image set 2*)	
Scenario 3 - Replant with mixed species (*refer to image set 3*)	
Scenario 4 - Replant with pure pine (fertilized) (*refer to image set 4*)	

Please rate which factors were most important to you in determining your scenario preferences. Check only one box on each line.

	Not Important	Somewhat Important	Important	Very Important	Extremely Important
Recovery time					
Cost					
Risk of future outbreaks					
Ecological effects					
Scenic beauty of the area					
Potential for outdoor recreation					

Should forest companies be harvesting more or less of the damaged wood than they currently plan to do?

Less harvesting		Neither		More harvesting

Please rank the scenarios for scenic beauty where 1 equals the most beautiful scenario and 4 equals the least beautiful. Use each number only once.

	Rank
Scenario 1	
Scenario 2	
Scenario 3	
Scenario 4	

Please answer these standard demographic questions. It will only take one minute.

1. In what year were you born? |__|__|__|__| YEAR

2. What is your gender?
   a. Male
   b. Female

3. What is your postal code? |__|__|__|__|__|__|

4. What is your marital status?
   a. Single (never married)
   b. Married
   c. Separated
   d. Divorced
   e. Widowed

5. How many children do you have under the age of 18 and still living at home with you? (If you don't have any children please put 0). _____

6. What is your occupation? (If you are not currently employed, specify whether you are unemployed, retired, homemaker or student). _____

   a. If you are unemployed or retired, what was your most recent job?
      _____

7. Circle the industry or sector you currently work in or worked in before you retired?
   a. Construction
   b. Education and Health Services
   c. Financial Activities
   d. Government
   e. Information
   f. Leisure and Hospitality
   g. Manufacturing
   h. Natural Resources and Mining
   i. Professional and Business Services
   j. Transportation and Utilities
   k. Wholesale and Retail Trade
   l. None

8. What is the highest level of education you have received?
   a. Part of primary school
   b. Completed primary school
   c. Part of high school
   d. Completed high school
   e. Some college or university
   f. Received a college or technical school certificate.
   g. Received a university bachelor's degree.
   h. Some postgraduate training.
   i. Received a postgraduate university degree.

9. Below are listed several categories of income. Please circle the category that gives the best estimate of your *personal income* before taxes last year.
   a. $0 to $9,999
   b. $10,000 to $19,999
   c. $20,000 to $29,999
   d. $30,000 to $39,999
   e. $40,000 to $59,999
   f. $60,000 to $79,999
   g. $80,000 to $99,999
   h. $100,000 and above
   i. Not applicable

10. Using the same categories would you please circle the category that gives the best estimate of your total *household income* before taxes last year.
    a. 0 to $9,999
    b. $10,000 to $19,999
    c. $20,000 to $29,999
    d. $30,000 to $39,999
    e. $40,000 to $59,999
    f. $60,000 to $79,999
    g. $80,000 to $99,999
    h. $100,000 and above
    i. Not applicable

Thank you for your participation in this survey. If you have any questions, please contact:

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