THE EFFECTS OF FOREST POLICY CHANGE ON FOREST MANAGEMENT PRACTICES AND FORESTATION IN THE U.S. PACIFIC NORTHWEST AND BRITISH COLUMBIA, CANADA

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ABSTRACT

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Earth's forests provide many benefits and services to people and yet human land-use patterns have greatly altered the forest landscape on a global scale, reducing the quantity and quality of forest resources. Land-use patterns and processes in forested environments are the byproduct of people's perceptions of the forest and its values, human behaviors that modify the forest, and policies that regulate these behaviors. In the Pacific Northwest, USA, and British Columbia, Canada, differences in people's perceptions of the forest and it's values has resulted in changes to forest management policies in both regions.

This dissertation examines the relationships between changing policies in the PNW and BC and changes in management practices and forest manager perceptions of forest resource management, and it will examine and compare how these changes contribute to forest distribution patterns in different ecological settings utilizing observations of natural resource management conferences, content analysis of semi-structured interviews with forestry professionals, and analyses of forest canopy cover change in sample regions of Oregon, Washington, and British Columbia utilizing ERDAS Imagine and ArcGIS technologies.

The observations of conferences provide a general indication of three recurring topics of importance to forest management in both regions: management techniques and approaches, stakeholder relationships, and ecosystem protection. Content analysis revealed changing perspectives and practices amongst forest managers, though the changes observed depended to some extent on whether the professional worked within a public agency or with private industry. The analyses of canopy cover changes revealed a loss of forest canopy over the course of the study time frame, but the losses were not equally distributed between owner and tenure classes. Policy implementation did seem to affect changes to canopy cover for the policy's targeted owner or tenure class. This research contributes to a better understanding of the interactions between human systems and ecosystems.

CHAPTER ONE

INTRODUCTION

Earth's forests provide many benefits and services to people and yet human land-use patterns have greatly altered the forest landscape on a global scale, reducing the quantity and quality of forest resources. Land-use patterns and processes in forested environments are the byproduct of people's perceptions of the forest and its values, human behaviors that modify the forest, and policies that regulate these behaviors. In recent decades, deforestation and forest over-use have depleted forest resources and degraded environments. The impacts have caused a wider range of stakeholders to pressure governments to modify forest policies and the forest industry to change their practices to reverse these trends. By the end of the 20th century, this disagreement over forest use has resulted in new forest policies for sections of the U.S. Pacific Northwest (PNW) and British Columbia (BC), Canada.

This dissertation will examine the relationships between changing policies in the PNW and BC and changes in management practices and forest manager perceptions of forest resource management, and it will examine and compare how these changes contribute to forest distribution patterns in different ecological settings. This research will help to better understand the interactions between human systems and ecosystems, an important endeavor to reverse the trends of forest degradation and deforestation, as humans will continue to rely on forest resources and manipulate forest ecosystems. Understanding these relationships can improve forest management and lead to more resilient forest ecosystems.

In this first chapter, I will provide general background information on the PNW and BC. I will briefly explain some of the events that led to forest policy changes in both regions and describe the framework and implementation of the three relevant policies. The purpose of this chapter is to provide the reader with a basic understanding of the major policies that form the backdrop for this dissertation project. The chapter will close with a description of what follows in the remainder of this dissertation.

Background

The coastal regions of the PNW in the United States and BC, Canada, contain temperate rainforest ecosystems that provide numerous services to many stakeholders that operate from local to global scales. The region has supplied substantial amounts of timber to global markets since the end of WWII. Forest management policy in the region historically reflected the priority of timber value over other forest values until the late 1980s. At that time, however, public pressure to protect old-growth forests and their associated species—especially endangered species like the northern spotted owl (*Strix occidentailis caurina*)—resulted in shifts in policies for portions of northern California, Oregon, Washington, and British Columbia. In the U.S., the Northwest Forest Plan (NWFP) has regulated federally owned forests in northern California, Oregon, and Washington since its implementation in 1994. In Canada, the Forest Practices Code (FPC) regulated the majority of forests in BC from 1995 until 2004, when the Forest and Range Practices Act (FRPA) replaced it. Both regions' policies have stressed ecosystem and biodiversity conservation, focusing on old-growth forests and associated species (USDA 1994; Ministry of Forests and Ranges 2002).

The policy shifts in both regions affect, both positively and negatively, many stakeholders, including citizens in communities that rely upon the forest industry, private woodlot owners, First Nations people, Non-governmental Organizations (NGOs), local, regional, and national governments, industrial timber corporations, real estate investment trusts (REITs), and timber-investment management organizations (TIMOs). This study will answer the following question: How have changes in public forest policies affected forest managers' perceptions, forest management practices, and the patterns of forest distribution across owner and tenure designations within the temperate rainforest regions of the U.S. Pacific Northwest and British Columbia, Canada?

Forest Policy Background

Changes in public perceptions of the value of forests and the U.S.'s listing of the northern spotted owl as an endangered species gave rise to concerns about forest management practices in the PNW of the U.S. and BC, Canada. These concerns generated conflicts among the array of stakeholders with interests in forest management. Environmental activists, rural and urban citizens, Native Americans (or First Nations), forest workers, forest industrial companies, and private landowners were engaged in reshaping the framework of forest policy in the bi-national region. Out of these conflicts came the NWFP in the PNW and the FPC (which was eventually replaced by FRPA) in BC.

The Northwest Forest Plan

Primarily because of the addition of the northern spotted owl to the list of endangered species, growing concerns regarding the marbled murrelet, increased awareness of diminishing old growth forests, and a barrage of court cases that essentially shut down operations in the federal forests of the PNW, President Clinton convened a summit in 1993 to address the situation. Clinton called for a team of scientists—The Forest Ecosystem Management Assessment Team (FEMAT)—to assess policy options for meeting both conservation goals and desired harvest levels. Clinton required that the following guidelines be addressed in drafting scientifically-based federal forest policy in the range of the northern spotted owl. FEMAT was to consider:

- "Never forget the human and the economic dimensions of these problems. Where sound management policies can preserve the health of the forest lands, sales should go forward. Where this requirement cannot be met, we need to do our best to offer new economic opportunities for year-round high wage, high skill jobs.

- As we craft a plan, we need to protect the long-term health of our forests, our wildlife, and our waterways. They are a…gift from God; and we hold them in trust for future generations.
- Our efforts must be, insofar as we are wise enough to know it, scientifically sound, ecologically credible, and legally responsible.
- The plan should produce a predictable and sustainable level of timber sales and non-timber resources that will not degrade or destroy the environment.
- To achieve these goals, we will do our best, as I said, to make the federal government work together and work for you. We may make mistakes, but we will try to end the gridlock within the federal government and we will insist on collaboration, not confrontations." (USDA 1994; Haynes et al. 2006).

After conducting their assessment, the FEMAT team settled on ten alternatives for forest management within the range of the northern spotted owl. They are described in the USDA's 1994 Record of Decision. The alternative selected was to meet ecological, social, and economic needs through an ecosystem-based approach to forest management. The end result of FEMAT's work was the NWFP. In addition to the NWFP, five other primary federal forest policies in the region are reflected in the NWFP: the National Environmental Policy Act, the Endangered Species Act, National Forest Management Act, Federal Land Policy and Management Act, and the Oregon and California Lands Act (USDA 1994).

Framework of the NWFP

The NWFP is a collection of policies, decisions, standards, and guidelines that provide a framework for the management of federal forests in the range of the northern spotted owl and the marbled murrelet in northern California, Oregon, and Washington. The 24 million acres of federal forestland in the region are divided into 12 ecological provinces based on their climates, vegetation, geology, and landforms (USDA 1994; Haynes et al. 2006). The administrative boundaries provide for five primary land-use allocations: late successional reserves, congressionally reserved, managed late-successional reserves, adaptive management areas, and matrix areas (USDA 1994; Haynes et al. 2006).

The 7,430,800 acres of late successional reserves are 30% of the federal land base managed under the NWFP and provide important habitat for species that prefer old growth forests, including the northern spotted owl, while another 30% of the region's federal land is designated "congressional reserve" which is comprised of National Parks and other federally protected areas (USDA 1994). The designation "managed late successional areas" includes 102,000 acres, or 1% of the northwest's federal lands. These are buffer zones within managed areas known to either have resident northern spotted owls or are associated with other rare endemic species (USDA 1994).

Under the NWFP, the two designations for actively managed forests are either "adaptive management areas" or "matrix." There are 1,521,800 acres of adaptive management areas, 6% of the region's federal forestlands. These areas are set aside to be used for research on management approaches that might fulfill the forest management goals of ecosystem protection, enhancement of society, and timber production (USDA 1994). The matrix, however, is primarily intended to provide most of the timber produced in the region. The matrix is the remaining 16% of the forestland not otherwise designated. Although these lands are allocated to timber production, not all are suitable for harvest (USDA 1994). "Riparian reserves" found within the matrix serve as buffers for aquatic systems and protect water resources and water-dependent species.

The Record of Decision (USDA 1994) laid the foundation for a set of standards and guidelines for the NWFP. The NWFP negates pre-existing management plans for federal forests, unless those plans implement management strategies that strengthen habitat protection and provide more ecosystem benefits beyond those provided for in the NWFP. Each land use allocation has associated standards and guidelines. The Aquatic Conservation Strategy includes standards and guidelines that reach beyond the riparian reserves to encompass key watersheds and guide watershed analysis and restoration (USDA 1994).

Implementation of the NWFP

The NWFP mandates that all federal agencies that operate within northern spotted owl range use the same sets of standards and guidelines for managing forests. The agencies included are the United States Forest Service (USFS), the Bureau of Land Management (BLM), and the United States Fish and Wildlife Service

(USFWS). The NWFP changed the processes and procedures by which each agency operated, required all federal lands to be managed similarly, and required management to be guided by the land use designation rather than by an agency's mission or goals. The NWFP also required that agencies work collaboratively to iteratively plan, analyze, monitor, and modify management techniques and approaches.

Forestlands designated late successional reserves are managed for preservation rather than for exploitation. Management of these lands is to strive for improvement of species' habitats and old-growth protection. Timber harvests are not allowed although thinning and silvicultural treatments that encourage or improve old-growth development in stands younger than 80 years old are permitted(USDA 1994). Managed late successional areas were established to protect active owl habitats. Such sites are not permanently designated as such, because owls will occasionally vacate some areas. Therefore, the areas included in this designation can change over time (USDA 1994).

Adaptive management areas are designated for scientific research, however, if late successional reserves are established within adaptive management areas, the late successional reserve standards apply for that portion of the adaptive management area (USDA 1994). On matrix lands where timber is to be harvested, management should ensure ecosystem conservation and protection of rare species (USDA 1994).

Regardless of the land-use assignment, federal forest managers are required to determine the status of other rare species not specifically named in the NWFP. Managers are required to manage for known rare species, survey to determine the presence of rare species before permitting disturbances, survey for rare species habitats, and conduct regional surveys for rare species (USDA 1994). This part of the NWFP is called “survey and manage,” and is considered to be a cumbersome and expensive component of the plan that is viewed as impeding other activities.

The Forest Practices Code

The policy that set the regulations for forest management in BC from 1995-2004 was the Forest Practices Code (FPC). Prior to the implementation of the FPC, the primary goal of forest practices in BC was to harvest timber. The harvesting of timber provided a substantial source of income for the Crown. With the implementation of the FPC, the Crown’s goals for its forest resources changed substantially. Leading up to the change in forest policy was a significant effort by environmental organizations to hamper sales of BC timber (most notably that harvested from Clayoquot Sound) on the global market. Groups successfully campaigned for a boycott on BC timber to protest the prevalence of clear-cut harvesting (Cashore et al. 2001).

In 1991, a new administration came into power under Premier Mike Harcourt. This administration proceeded with a plan begun by the previous administration to consolidate forest regulations into a single legislative code

(Cashore et al. 2001). According to Cashore et al. (2001, 67), guiding the development of this new legislation was a set of government-defined problems:

- "Insufficient legal powers—the lack of a single, consistently applied forest practices act.
- Lack of strong, up-to-date rules governing all areas of forest and range practices.
- Occurrences of poor and inconsistent industry performance.
- Inadequate monitoring and enforcement.
- Weak penalties.
- Insufficient auditing."

The Forest Resources Commission, which had been formed by the previous administration, engaged in consultations with stakeholders and developed a framework for what would become the Forest Practices Code (Cashore et al. 2001).

Framework of the FPC

The FPC sets out operational guidelines for four primary land-use zones: wilderness areas, resource management zones, landscape units, and sensitive areas (Ministry of Forests 1995). The Crown has the authority to assign and to change the boundaries of each land-use zone type. The FPC authorizes the chief forester to establish standards for forestry practices respecting multiple forest values; biological diversity, for instance, is listed aside timber extraction (Ministry of

Forests 1995). Biodiversity conservation is emphasized in the Old Growth Order, in which old-growth protection standards are set for landscape units in each "biogeoclimatic" zone (Ministry of Forests and Range 2005). Further, the Old Growth Order sets guidelines for old-growth recruitment and clarifies the amount of forest available for timber harvest (Ministry of Forests and Range 2005). The ministry, however, established a 6% cap on the economic impacts to the annual allowable cuts from the implementation of biodiversity standards in the FPC (Cashore et al. 2001). In other words, the implementation of standards for biodiversity conservation could not impose more than a 6% decrease in the allowable timber extraction rates, which immediately places limitations on the management actions that can be taken to protect forestlands, especially late serral forests.

To ensure that managers could meet the objectives of the FPC, a set of guidebooks was published to provide prescriptions for operations in diverse forest conditions to meet specific goals. There are more than 30 guidebooks that cover an array of topics from biodiversity, fish stream identification, and wildlife management to road engineering, stand management, and public consultation (Ministry of Forests 1995). The Ministry of Forests also published a classification of "biogeoclimatic" ecosystems within the province. In this text, each ecosystem is defined and described, and a means to assess site locations to determine the correct biogeoclimatic ecosystem classification is provided. Ecoregions within the province are also described to provide a broader perspective on the distribution of the province's ecosystems (Ministry of Forests 1991).

The FPC established a new role for the Ministry of Forests. One issue that led to changes in regulation of forest management was a criticism that the Crown (i.e. the Canadian government) did not oversee management practices on provincial land (Cashore et al. 2001). The FPC established an enforcement and compliance component that would be administered by the Ministry of Forests. Under the FPC, managers would be required to submit Forest Development Plans to the Ministry of Forests prior to beginning any on-the-ground operations. Those plans would have to be approved by the Ministry of Forests before operations could proceed. Tenure-holders found to be out-of-compliance with the FPC could be fined by the Ministry of Forests. The FPC also creates an independent entity called the Forest Practices Board to evaluate the overall effectiveness of the code (Cashore et al. 2001).

Implementation of the FPC

The FPC was implemented in 1995 and applied to all Crown lands and tenure holders harvesting timber off of those lands. The implementation of the FPC fostered new relationships between the Ministry of Forests and its tenure holders and substantially changed forest management within the province. The FPC remained in effect until 2004, when the Forests and Range Practices Act (FRPA) took effect. The first years of enactment of the FRPA were a period of transition from old policies (and associated regulations) to new policies. During this time, some of the FPC regulatory structure remained in place. Today, little of the FPC remains apparent. An exploration of the Ministry of Forests website reveals very little about the FPC except its basic structure and the definitions it established.

The Forests and Range Practices Act

Recently, perhaps to reflect changes in function, the name of the Ministry of Forests as changed to the Ministry of Forests, Lands and Natural Resource Operations, but, for consistency, I will continue to refer to this department simply as The Ministry of Forests. As noted above, the process of implementing FRPA began in 2004, and it is at this time fully operational. One of the biggest changes in FRPA was to the procedural guidelines. No longer is it necessary for manager's to follow prescriptions in the guidebooks published under the FPC, though those guidebooks do still exist for reference. Instead, the Ministry of Forests relies on manager professionalism to meet FRPA goals and objectives. According to the Ministry of Forests' homepage for FRPA:

> "The *Forest and Range Practices Act* and its regulations govern the activities of forest and range licensees in B.C. The statute sets the requirements for planning, road building, logging, reforestation, and grazing.
>
> FRPA maintains high levels of protection for forest values including watersheds and wildlife habitat, and creates efficiencies for both government and industry through streamlined planning processes.
>
> FRPA encourages innovation by skilled resource professionals and holds industry responsible for outcomes. Combined with rigorous compliance and enforcement, the *Act* and regulations will contribute to high quality forest management and sustainable environmental values for future generations." (Ministry of Forests, Lands and Natural Resource Operations n/d)

Thus, according to the above introduction to FRPA, the changes to the policy in BC do not necessarily mean a change in the Crown's goal to manage the forests for multiple values.

Framework of FRPA

Under the FPC, managers were required to submit Forest Development Plans to the Ministry of Forests prior to harvest activities. In the FRPA, tenure holders are required to submit Forest Stewardship Plans prior to harvest or road-building on Crown lands. FRPA requires that Forest Stewardship Plans describe how tenure-holders intend to meet the objectives outlined in FRPA for Crown lands: do no harm to the environment and protect the environment (such as soil and wildlife) (Ministry of Forests 2004b). Forest Stewardship Plans provide the boundaries (i.e. limitations) within which roads are to be built or harvests conducted, though details as to specific locations are not required (Ministry of Forests and Range 2005). Forest Stewardship Plans are in effect for five-year periods, rather than the two-year terms of Forest Development Plans under the FPC (Ministry of Forests 2004b).

Under FRPA tenure-holders are expected to protect key environmental values, as was the case in the FPC, but the process is streamlined and the number of comprehensive plans submitted by managers has been reduced (Ministry of Forests 2004c). Furthermore, FRPA strives to allow operators greater flexibility to meet timber extraction goals and environmental protection needs at the same time it increases operator accountability (Ministry of Forests 2004c). The Old Growth Order established under the FPC still stands.

The Ministry of Forests continues its compliance and enforcement roles under FRPA. Instead of approving each intended activity, the Ministry of Forests approves the comprehensive Forest Stewardship Plans and monitors the results to determine whether the intended outcomes and FRPA goals are achieved (Ministry of Forests 2004). Though the emphasis is on the end results, FRPA does allow for intervention into operations at earlier stages to prevent environmental damage (Ministry of Forests 2004). Fines are still levied for infractions, but the upper limits of those fines have increased (Ministry of Forests 2004). The Forest Practice Board is still an independent oversight body (Ministry of Forests 2004).

Implementation of FRPA

As with the FPC, FRPA applies to all tenure-holders operating on Crown lands. FRPA has established a Provincial FRPA Implementation Team (PFIT). The objectives of the PFIT are twofold: to promote consistency throughout the province in the interpretation and implementation of FRPA and to serve a leadership role in determining and solving issues in the implementation of FRPA (Ministry of Forests and Range 2005).

Differences between Pacific Northwest and British Columbia Policies

There are two key differences between the PNW and BC policies. The first is that different amounts of forestland are affected due to differences in land ownership structures in the two countries. The second difference is in the policies' priorities. The NWFP applies only to federally managed lands within the range of the northern spotted owl; federally owned forests comprise 41% of forestlands in the PNW (Haynes et al. 2006). However, according to Pinkerton (1998) the changes in forest policy at the federal level in the U.S. have caused modifications of state policies and new cooperative efforts between the USFS, state forest agencies, and private forest owners. The Oregon Department of Forestry examined early NWFP guidelines and utilized information from those guidelines in revising Forest for structure-based management (Oregon Department of Forestry professional, personal communication). Though, as noted in Spies et al. (2007), management for old growth forests is not a stated goal for State of Oregon forestlands. Under the NWFP, regulation guidelines and management practices differ between land-use designation types (i.e. riparian, matrix, reserve, or adaptive management area). In BC, by contrast, nearly all (more than 90%) forestland belongs to the BC government and is leased to tenants (Pinkerton 1998). BC's policy is applied differently across tenure types, which vary according to lease and license designation. There are differences in regulation and management of forests under woodlot licenses, timber supply area licenses, community forest agreements, tree farm licenses, and pulpwood licenses.

In the U.S., ecosystem management and biodiversity conservation management are the foci of the NWFP, and this has led to a sharp decline in timber harvests from federal forests in the PNW (USDA 1994; Haynes et al. 2006). While BC's policy changes have increased the importance of ecosystem and biodiversity conservation in forest management and though the policy is to balance multiple values, timber sales are still the first priority (Howlett 2001b). In addition, forest regulation in BC has changed over the last 16 years from the FPC to the FRPA, while in the U.S. the NWFP has remained in-place since 1994.

Much research has been conducted in the PNW and BC to understand forest structure, function, and management across ownership and tenure types, and there are many studies that compare the two regions' policies. To date, however, there has been no examination of the effects of forest policy on the relationships between changes in management practices, ownership and tenure, and forest land-cover change across the region. This study undertakes a two-scaled approach to reveal how trends in management perspectives and practices primarily operating at the local level are linked to the patterns observed at the regional level.

Organization

In this first chapter, I have described the purpose of this research project and the question I have sought to answer in the undertaking of this particular study. I have also provided background information on the events that led up to policy changes in the PNW of the U.S. and BC, Canada. I have also given an overview of the relevant policies—the NWFP, the FPC, and the FRPA—describing the framework and implementation of each.

The chapters that follow provide the details of this study, beginning with background information that lays the foundation for the project. In Chapter Two, I provide a review of relevant literature for the various components of this project. I include information on current understandings of issues of scale in land-cover change analysis, assessments of forest-cover change, forest management, tenure effects on landcover change in the PNW and BC, and issues of governance. Chapter Two also includes the conceptual framework and the objectives of the study. A description of my study area follows in Chapter Three. The chapter includes explanations of ownership and institutional structures and well descriptions of the physical environment.

The next four chapters detail the processes for meeting the objectives of this research. In Chapter Four, I lay out the methods used in the three components of the project: observations of meetings and conferences, semi-structured interviews, and forest-cover change analysis. The results from each component are revealed in three separate chapters. In Chapter Five, I provide my analysis of the meetings and conferences, followed by the content analysis of the semi-structured interviews in Chapter Six. The final analysis on forest-cover change is revealed in Chapter Seven. Chapter Seven also includes an explanation of the constraints and possibility for error in the methods and data analyses.

The remainder of the dissertation offers a discussion of findings and suggestions for future study. The discussion of my findings is contained in Chapter 8. The chapter consists of findings from all three components as well as an assessment of the potential relationship between managers' perceptions and practices and the patterns of forest-cover change in the PNW and BC. The final chapter, Chapter 9, offers suggestions for potential research directions that have arisen from this project.

CHAPTER TWO

LITERATURE REVIEW, CONCEPTUAL FRAMEWORK, AND RESEARCH OBJECTIVES

Human land use influences the patterns of natural processes across landscapes. The effects of land-use and land-cover changes negatively impact Earth's net primary production (Haberl et al. 2007) and have global consequences for both social systems and the biosphere (Foley et al. 2005). Global population increases and the ensuing rise in resource demands will further strain ecological and sociological systems. Along with the concomitant reduction in natural resource availability, there has been an increase in stakeholder interest and the recognition of a broader range of resource values. Furthermore, the impacts of climate change on environmental and human systems are largely uncertain, though they will potentially exacerbate the systemic pressures, and are expected to significantly affect forest systems (IPCC 2007). Taken together, these issues demonstrate the imperative need to understand the manner in which land use policy and management practices are adapting to changing values, increasing demands and uncertainties, and a declining resource base—and the impact these have on the landscape—so that we may strive for ecological, social, and coupled system resilience across scales.

The resilience of a system depends on functional redundancy (meaning multiple system components have overlapping functions within the system) at multiple scales (Holling 1973; Holling 2001; Gunderson et al. 2002), yet human land-use patterns reduce this redundancy across scales, thus leaving systems vulnerable to disturbances. Disturbances, in a resilient system, can result in system reorganization, renewal, and redevelopment from existing functional components in the system (Holling and Meffe 1996; Holling 2001; Gunderson et al. 2002; Folke 2006); however, if functional redundancy across scales is lacking, the system is at higher risk of reaching a threshold, beyond which it will not recover previous functional capacities and will convert to a distinctively new system with different functions. Productive ecosystems frequently encounter higher levels of human disturbance, which result in decreased functional redundancy, and thus reduced resilience, over time (Holling and Meffe 1996; Lindenmayer and Fischer 2006). Lands that are intensively managed under a command-and-control paradigm for humans' needs for resources especially run the risk of eventually crossing a threshold and converting to a new system following a disturbance event (Holling and Meffe 1996). The real issue for humans is not that the system changes but that the new system may no longer provide the ecosystem services humans need or desire.

Issues of Scale

It is now widely recognized that issues of scale confound the complexity of the problems land-use and land-cover changes cause. Land-use planners and managers typically consider local and immediate issues in their decision-making processes, with little consideration of the effects of local land-use on the regional, national, or global systems. The consequences of local land-use decisions can, however, have implications for both natural and human systems at broader scales and even on processes spatially and temporally distant from activities (Cash and Moser 2000; Lamdin et al. 2001; GLP 2005; Turner II et al. 2007). While land-use and land-cover change patterns are the result of decisions made primarily from the bottom at the local and regional scales, the institutional and policy structures that govern these decisions often originate at the top (Berkes 2002; Young 2002). In addition, land-use planning has historically focused on the management of primary resources for human consumption, rather than managing ecosystem processes for biodiversity and resilience (Foley et al. 2005).

Land Use/Land-cover Change

Research on land-use and land-cover change ought to consider that processes at one scale influence and are influenced by processes at larger and smaller scales (Allen and Hoekstra 1990; Peterson et al. 1998; Global Land Project 2005; Lindenmayer and Fischer 2006). Lindenmayer and Fischer (2006) stress that it is imperative we investigate the effects of land use and land-cover change at multiple scales to better understand the consequences of human land-use patterns. A systemic approach recognizes humans as part of the system, rather than as an external factor (Berkes and Folke 1998; National Research Council 2000). The effects of land-use and land-cover change can thus best be understood within the context of dynamic and coupled human–ecological systems, with linkages occurring between components of the systems at varying scales (Levin 1992; National Research Council 2000; Turner II et al. 2007). However, one of the biggest challenges in landscape research is determining the effects of change at multiple scales, and particularly in scaling up from local-level impacts to global impacts (Global Land Project 2005). The Global Land Project (2005) suggests a framework for assessing changes in the coupled system through the use of case studies and experimental studies for fine-scale analysis, along with remote sensing and GIS techniques for coarse-scale analysis, to attain insight into the relationships between components at varying scales.

The natural systems upon which we rely are affected by human uses. Over time, human land-use patterns have generally become more intense and more diverse, especially as technology has developed, depleting natural systems and reducing resource availability (Forman 1995; Global Land Project 2005; Lindenmayer and Fischer 2006). Cumming and Barnes (2007) have found positive feedbacks between changes in land tenure and land-use and land-cover change; fragmentation is more likely as ownership diversity increases. Furthermore, according to the authors, the correlation of tenure to land-use and land-cover change threatens the sustainability of social-ecological systems and complicates ecosystem and landscape management (Cumming and Barnes 2007). In some circumstances, however, changes in technology have led to increases in vegetation cover, as reliance on local resources to meet local needs has declined (Hutchinson et al. 2000). While under these particular types of conditions land cover can potentially change in the direction of increasing vegetation cover rather than decreasing vegetation cover, it is important to recognize that though the changes at the local level indicate less local resource extraction, there are potential implications at the global scale, as local resource needs are met through (perhaps less sustainable) extraction of resources from other locations.

Forest-cover Change

Accurate detection of forest-cover change over large areas (i.e. regionally or nationally) requires contemporaneous hierarchical analyses at several scales (small to large) (Fraser et al. 2005). Forest-cover change researchers have tended to investigate forest cover at a single (frequently arbitrarily chosen) scale (Turner et al. 1996), yet the generalization of findings requires analyses of change at several spatial scales (Wimberly and Ohmann 2004). Bettinger et al. (2005) offer a hierarchical framework that allows modelers to construct models built from individual units based on harvest or habitat block reflecting diverse land ownership types, several vegetation-cover categories, and different management practices. Simulations of the impacts of different policies can be applied concurrently to numerous units, and the results at one scale can be linked to other larger or smaller scales to predict the impacts of management actions at the scale of either the landscape or the land parcel (Bettinger et al. 2005). This model has potential for use in forest policy development and in forest management decision-making processes, and the technology should improve as understanding of the linkages between coupled-system components improve. Furthermore, the ability to predict the impacts of policy and management on the forests will enable effective socio-ecosystem management.

Both management activities for, and scholarly research on, biodiversity (e.g. Brosofske et al. 1999; Bunnell and Huggard 1999; Wimberly and Ohmann 2004; McAlpine et al. 2007) and natural disturbance regimes (e.g. Andison and Marshall 1999; Elkie and Rempel 2001; Taylor and Skinner 2003; Allen 2007; Falk et al. 2007) have increasingly led to cross-scale analyses of forest-cover change. Much of the research on biodiversity and natural disturbance regimes stems from an attempt to understand natural forest ecosystem structures and disturbances to manage forests as ecosystems and in a manner that mirrors natural structures and disturbances. When viewed from the landscape scale, management activities can be seen to both decrease and increase the extent of forest cover.

Assessing Forest Cover Change

Changes in forest cover that occur either from deforestation or afforestation have implications for ecosystem health and ecosystem services globally (Rudel et al. 2005). Measurement of forest-cover change is more accurate at the landscape scale with the continuing improvements in remote sensing and GIS technologies, though many studies are using mixed-method approaches to gain a deeper understanding of forest cover change across scales. Examples of mixed-method approaches on forest cover change, which generally combine remote sensing/GIS analysis with one or two other quantitative or qualitative methods, have been conducted in Pakistan (Ali 2005), in the Sudano-Sahelian zone in northern Ghana (Wardell et al. 2003), in Malaysia (McMorrow and Talip 2001), in Burkino Faso, in Nairobi (Rasmussen et al. 2001), in Panama (Sloan 2008; Oestreicher et al. 2009), in Canada (Chen et al. 2002), and in the PNW of the United States (e.g. Wimberly and Ohmann 2004).

Remote sensing and GIS technologies are widely used in the PNW and to some extent in BC to assess landscape and regional level changes in forest cover and the drivers of change. Using remote sensing and GIS technologies, researchers have detected changes in forest cover patterns in the PNW that can be attributed to, for example, differences in harvest across ownership categories and changing fire regimes (Healey et al. 2008), to land quality (Alig et al. 2005), to ownership, topography and forest structure (eg. Spies et al. 1994; Kennedy and Spies 2004), and to socio-economic attributes as well as physical system attributes (Butler et al. 2004). In BC, changes in the patterns of forest cover have been found to result from forest harvesting (Sachs et al. 1998), human-induced climate change, which has increased the extent of forest fires (Gillett et al. 2004), and to beetle infestations (Goodwin et al. 2008). Evidence of the linkages between multiple components of a coupled system is the finding that land cover changes due primarily to human manipulation of the vegetated landscape have had an effect on stream flow in the Columbia River Basin of the PNW and BC (Matheussen et al. 2000).

Land Use Decisions

Institutional and social system linkages across scales are important factors in land-use decisions and the resultant land-cover changes (National Research Council 2000; Berkes 2002; Young 2002). Local land-use decisions often have unforeseen consequences at landscape, regional, and even global scales, and therefore attempts to predict the consequences of land-use and land-cover changes need to incorporate research on institutional dynamics and policy structure at multiple scales (Berkes 2002; Verburg et al. 2002; Young 2002; Wimberly and Ohmann 2004; Global Land Project 2005; Lindenmayer and Fischer 2006). Through a better understanding of the cross-scalar linkages between natural processes and management decisions across scales, we will be able to more effectively inform policy in order to address important environmental and resource issues (Cash and Moser 2000).

There is growing awareness and recognition from multiple stakeholders of the multiple values of natural systems. This recognition should lend itself to the argument for the holistic management of diverse and resilient ecosystems. Nonetheless, resource management frequently continues to operate in the paradigm of intensive management primarily for human consumption. The institutional structure is such that regulation is most often generated at an institutional scale that is different from both the scale of management actions and the scale of the resulting environmental and social issues (Cash and Moser 2000). Furthermore, given that local actions have natural, social, and economic impacts that extend beyond the local arena, it is often difficult to trace these impacts to their origins and thus to hold accountable the responsible institutions (Satake et al. 2008). There is a mismatch between the regulatory structure, the decision-making process, and the impacts of decisions to natural systems and there is a need to understand where and why mismatches occur in order to correct them (McDaniels et al. 2005).

Forest Resources and Forest Management

Forest resource managers have traditionally managed to enhance the supply of extractible resources as well as manage for multiple uses. Traditionally, managers have viewed conservation of resources as a way to provide an unlimited (and sustained) supply of natural resources for people. While Gifford Pinchot established this paradigm of forest management in the United States, it is by no means unique to the United States, and is in fact evident worldwide. In recent decades, however, the management of forests has begun to shift from management for resource production to ecosystem management. Ecosystem management, paradigmatically, is based on the notion that the resilience and function of an ecosystem depends upon the interdependence of many system components. Ecosystem management depends upon hierarchy theory to monitor stressors of both biodiversity and the ecosystem across spatial and temporal scales (Noss 1990; National Research Council 2000).

Ecosystem Management

Ecosystem management is a more holistic approach to forest management than the traditional approaches of either overt exploitation or conservation. Forest ecosystem management is, at least to some extent, employed around the globe in places such as Australia (McAlpine et al. 2007), Canada (Johnson et al. 1998; Seely et al. 2004; Bouchard et al. 2008; Klenk et al. 2008), Sweden (Olsson and Folke 2001), and the U.S. (USDA 1994; Fule et al. 1997; Rauscher 1999; Pavlikakis and Tsihrintzis 2000; Gram et al. 2001). Public land management in the United States (Rauscher 1999; Bailey 2009) and in Canada (Klenk et al. 2008) has been moving toward the ecosystem-management approach over the past couple of decades. Ecosystem management inherently assumes that there is interdependence between ecosystem components and feedbacks at many scales, rather than operating on the more traditional approach that manages one component of the system and often regards attention to other components as detrimental to efficient management.

In employing ecosystem management methods, it is frequently suggested that management approaches reflecting natural disturbance regimes will result in forest patterns more closely resembling historical patterns of natural variation (e.g. Swanson et al. 1994; Lertzman et al. 1996; Franklin et al. 2002). Human disturbance of the forest thus aims to reflect as closely as possible the natural disturbance regimes for a particular forest ecosystem. Utilizing management strategies that reflect natural disturbance regimes provides a means by which human forest values can be met simultaneously with the attempt to sustain forests within a range of historical natural variability and thus maintain forest system resilience, diversity, and health (Swanson et al. 1994). Stand-replacing fires, which create large canopy gaps, occur on a time-scale of approximately once every 150 years or more in the southern range of the coastal forests of the PNW to greater than 400 years in the northern range (Hansen et al. 1991). In the southern range of the BC coastal forests, stand-replacing fires occur on the order of once every 250 years or more, though these intervals reflect regional fire occurrences and not single-stand, repeated occurrences (which have fire returns into the thousands of years)(Lertzman et al. 2002; Daniels and Gray 2006). In addition, traditional clear-cuts would not be employed, as fires do not destroy all the trees within the stand (Franklin et al. 2002). Low severity and higher frequency small fires, as well as, infrequently, windthrow from storms and insect outbreaks, are natural disturbance regimes that also exist in the coastal forests of the PNW and BC and create smaller canopy gaps than those seen from larger fires (Spies and Franklin 1989; Spies et al. 1990; Hansen et al. 1991; Franklin et al. 2002). Management techniques based on disturbance regimes would aim to create canopy gaps of variable sizes across the landscape at intervals reflecting fire and windthrow returns.

Cissel et al. (1999) used current forest conditions in the Blue River, OR, forests to model outcomes from static NWFP land-use designations and prescriptions and from a landscape disturbance regime approach, and found that the disturbance regime increased the occurrence of late-successional forests, larger patch sizes, and fewer edge effects that would the current practices stipulated in the NWFP. Under a landscape disturbance regime, late-successional forests would be distributed across 71% of the landbase in a 200 year time frame, rather than the 59% predicted under non-disturbance management plans in the NWFP, and younger forests would exhibit more complex structure provided by increased overstory (Cissel et al. 1999).

In ecosystem management, there is recognition of the human component within the system. Forest ecosystems provide us with goods and services, yet we still find it challenging to understand and balance the need, or desire, for these products in the short term with the need to encourage resilience for the long term in order to ensure that the system will continue to function in the future (Kaufmann et al. 1994; Rauscher 1999; Pavlikakis and Tsihrintzis 2000). The movement to ecosystem management has thus far been tenuous. The paradigm of ecosystem management is to manage forest systems in a manner that maintains ecological integrity and sustainability, recognizes social values and meets social approval, and is economically viable (Bengston 1994; Kaufmann et al. 1994; Rausher 1999; National Research Council 2000; Pavlikakis and Tsihrintzis 2000). There are, however, hurdles to implementing ecosystem management.

The problems that are causing distress in forest systems are complex and cross many scales globally, yet they are frequently unknown or even invisible to the population at large (Likens and Franklin 2009). Conflicting social values and goals for management exacerbate the distress in forest ecosystems, and to date processes for resolving these conflicts have not been successful on a broad scale. In addition, ecosystem management is not implemented across ownership and tenures, as the political structure, especially in the United States, leads to a spatially shifting, complex array of regulations for forest management. Further constraining the successful implementation of ecosystem management is that policies and regulations are susceptible to pressure from powerful stakeholders and tend to change with each change in political administration (Rausher 1999).

Tenure Effects

Tenure in the Pacific Northwest, USA

Forest ownership in Oregon and Washington is a complex matrix of public and private ownership. Much of the research on the effects of tenure on forest cover in the PNW reflects the differences in policy and management practices across the matrix. Prior to the implementation of the NWFP, several multi-temporal studies were conducted on changes in forest cover across ownership types (Wimberly and Ohmann 2004; Kennedy and Spies 2004; Kennedy and Spies 2005). These studies find that ownership is a significant indicator of changes in forest cover patterns over time. Furthermore, Nonaka and Spies (2005) and Johnson et al. (2007a) find that under current management policies, ownership will continue to be a strong predictor of land cover patterns in Oregon and land cover will continue to diverge from historical ranges of variation due in large part to the differences in policy guidelines and management techniques across ownership types.

Bolsinger et al. (1997) reviewed the effects of ownership on forest growth and timber harvest in Washington for a four-year period prior to the implementation of the NWFP, and found that while forest growth rates approximately equaled forest harvest rates, timber harvests were proportionately higher than forest growth on industrial lands and forest growth was higher than cut rates on public lands. However, it is important to note that since industrial ownership is higher than public ownership west of the Cascades (Bolsinger et al. 1997), harvest rates of the western forests would be higher overall than forest growth for the same area.

While patterns of forest cover will continue to diverge from historical ranges under the current policy structure in the PNW, there is potential to alter these projections. Should policies and management become more aligned across ownerships and move towards management techniques that reflect disturbance regimes, landscape patterns of forest cover and forest structure would more closely emulate historical ranges of variation (Thompson et al. 2006; Spies et al. 2007). In addition, coarse filter management and planning strategies that encompass all ownerships would be better suited for considering the current diversity in forest structure exhibited across ownerships at the landscape or regional scale (Ohmann et al. 2007; Spies et al. 2007). There is some promise for a more inclusive approach to forest management, at least with non-industrial forest owners. Johnson et al. (1999) have assessed management practices and perceptions of non-industrial private forest owners in western Oregon and Washington and find that though non-industrial forest owners practice a range of management methods, from clear-cut extraction to conservation, the majority claims they would change their management methods if it resulted in a healthier ecosystem. None of these managers, however, would give up their rights to harvest timber altogether (Johnson et al. 1999).

The shift to disturbance-regime management on a broad scale and across ownerships would come with an initial cost burden and with reduced harvest rates for private landowners, but would bring the forests of the PNW closer to historical patterns of variation, though the effects of climate changes on these patterns are still unclear (Nonaka and Spies 2005; Thompson et al. 2006). In BC, where forest management regulations apply to approximately 95% of forestlands, the FPC-mandated forest management aims for increased biodiversity through management techniques that mirrored natural disturbance regimes and the Biodiversity Guidebook prescribes specific techniques for meeting biodiversity goals (Parminter 1995; Andison and Marshall 1999). Though the FRPA (Ministry of Forests and Range 2005) maintained biodiversity goals, it did away with prescriptive management guidelines. It is useful therefore, to examine the different effects of forest policy and management in the PNW and BC across ownerships and tenures. It is interesting to note, however, that research on tenure effects on forest cover in BC reflect an overall desire to move away from the current tenure and policy structure in the province.

Tenure in British Columbia, Canada

In BC, land leases allocate land use rights to the lessees. Variations in land use lead to variations in management, which in turn result in variations in forest cover. Forest management tenures run the gamut between privately managed land to community forest management, with community, company, and individual goals ranging from profit mandates to ecological conservation (M'Gonigle 1998). M'Gonigle (1998) suggests that BC has the potential to move toward a more sustainable forest management system through a structure of ecosystem management under local community governance. BC has a model in place for such a structure through, in part, the community forest licenses, and also through the First Nations forestry rights and management practices (M'Gonigle 1998). However, the effectiveness and feasibility of community forest licenses, or CFAs, have not been assessed on a systemic basis (Nelson 2008). First Nations co-management agreements are a relatively new development, and thus have also not been fully evaluated. In addition, the absence of a political will to revamp current tenure, governance, and management structures and the unwillingness to cede power to local governance generally hinders policy restructuring unless there is a crisis or a shift in governmental party control (Nelson 2008).

There are those (e.g. Binkley 1997, 1999; Zhang and Pearse 1997; Sahajananthan et al. 1998; Haley and Nelson 2007) who argue that ecologically and economically sustainable forest management requires the restructuring of tenure and licensing, and, by proxy, of forest management practices in BC, and in Canada as a whole. Binkley (1997, 1999) and Sahajananthan et al. (1998) challenge the carte blanche shift to ecosystem management, and defend the limited use of intensive forest management plantation zones, positing that offering limited intensive management through zoning allocations would actually create more resilient ecosystems overall due to a subsequent increase in conservation management for the remaining forests. Zhang and Pearse (1997) find that tenure type affects reforestation rates in BC, with private forest owners investing more in reforestation than timber or forest license holders. The authors attribute this finding to differences in the levels of security between tenure designations (Zhang and Pearse 1997). The authors do not, however, address the scarcity of private land in BC versus the abundance of Crown land. It is possible that private forest owners spend more on reforestation due to an inability to buy new tracts of land to shift their operations when current lands are depleted, while lessees do have the opportunity to lease new tracts of forest, or shift extraction areas under current leases, once the current harvest area has been depleted.

Forest management in BC is further constrained by varying expectations outside of tenure and policy constraints (Reader 2006). The tenure and licensing system, policy, and the legal framework provided within policy, certainly affect forest management practices across tenure types; however, a strengthening environmental movement and increased scientific knowledge are also playing a vital role in shaping management practices on leased lands and likely on private lands as well (Reader 2006). In BC, as in the United States, stakeholder involvement and scientific knowledge are both playing significant roles in changing the paradigm of forest policy and forest management.

Forest Policy and Governance

Effective governance of forest systems is no longer possible under the sole purveyance of few actors from the top levels of the institutional structure (Ostrom 1990; Holling and Meffe 1996; Brunner et al. 2002). Globalization and an increase in the expected ecosystem services delivered have resulted in increased pressure for sustainable forest and ecosystem management (Young et al. 2006; Haynes 2007). Timber, however, remains the prevalent commodified product, and much conflict arises from expressed stakeholder desires for a wider range of ecosystem services to which no monetary value can be accurately (or indisputably) attached (Siry et al. 2005; Haynes 2007). A majority (approximately 87%) of the world's forests are under public ownership, though within the U.S., the opposite is true, where private ownership sums to approximately 73% of forestlands (Siry et al. 2005; Haynes 2007). Nevertheless, conflict over forest management for multiple values frequently occurs regardless of ownership or tenure, as numerous stakeholders—such timber product consumers, environmental non-governmental organizations (ENGOs), local citizens, aboriginal groups, tourists, and public institutions—perceive personal interest in the outcomes of forest management.

The complexity of forest policy and management for multiple values is leading to a restructuring of governance. There is a movement toward decentralization of governance, with more local and regional control over forest and ecosystem management regulations and planning. Science and stakeholders are now more likely to inform forest management policies and practices than they were prior to the 1990s. In recent decades, collaborative, co-management efforts for forest ecosystems—where multiple stakeholders are to some degree involved in the decision-making process, in policy development, in management plan development, and in resolving issues in forest system management—have begun to surface (Lee 1993; Folke et al. 1998; Gregory 2000; Bodin and Crona 2009). These collaborations generally involve citizens, various levels of government, aboriginal groups, scientists, and managers. Efforts to manage forest ecosystems for multiple values demonstrate a wide degree of variability in the scope of the projects, the levels of stakeholder involvement, and the degree to which those involved, and indeed those observing the process, consider the process and the outcomes successful.

Science, Policy, and Management

In a command-and-control paradigm, the science in forest management often leads to degraded systems vulnerable to perturbations both natural and human. This approach creates the illusion of stability while it reduces the variability, functional capacity, and resilience of the system, often leading to long-term consequences that were neither intended nor expected (Holling and Meffe 1996). The complexities and uncertainties in present-day ecosystem management require policies that use a flexible, innovative, learning-adaptive, and publicly responsible scientific approach (Holling 1978; Walters 1986; Lee 1993; Folke et al. 1998; Gunderson 1999; Johnson 1999). The role of science in natural resources policy development and implementation can either directly inform the decision-making process (as occurred with the development of the NWFP) or it can alter accepted truths, which then affect policy outcomes (Spilsbury and Nasi 2006). In collaborative, adaptive management approaches it, optimally, does both.

The concept of adaptive management is intended to address the uncertainties of ecosystem management through approaching management as a scientific experiment, where uncertainties are expected and lessons learned are incorporated in future management techniques (Holling 1978; Walters 1986; Lee 1993; Folke et al. 1998; Gunderson 1999; Johnson 1999). In the U.S. PNW, the notion has, too some degree, been incorporated into federal forest and other natural resources management (e.g. Bormann et al. 1999; Johnson 1999; Kiker et al. 2001; Graham and Kruger 2002; Stankey et al. 2006). Adaptive management efforts have emerged as well in BC, Canada (e.g. Bunnel and Dunsworth 2004; Grainger et al. 2006; Beese and Deal 2010). At the core of adaptive management is the concept of social learning, which necessitates social participation in the process. Adaptive management is perceived to be a process of collaboration that includes actively engaged stakeholders in the goal setting, learning, and adaptation processes of forest management (Lee 1993; Bormann et al. 1999). The success of these programs is repeatedly impeded by conflicts arising between stakeholders.

Stakeholder Participation

The degree to which stakeholders participate in implementation, planning, and problem solving varies considerably, as does the scale of projects in which they are involved. In Europe, countries began developing national forest programs following the UN Conference on Environment and Development in Rio in 1992, whereby each country is expected to bring together stakeholders to develop policies and management strategies with the goal of sustainable forest management (USDA 1994; Liss 1999; Ollonqvist 2006). In the U.S. a few ecosystem restoration efforts (e.g. the Tillamook Bay Estuary Project, Gregory 2000; the Florida Everglades Restoration Project, Kiker et al. 2001) have involved stakeholders in the decision-making process beyond the standard public-hearing sessions. The intent of the NWFP, especially in the adaptive management areas, is to use a collaborative learning process between citizens, scientists, and managers to sustainably manage the forests (Bormann et al. 1999; Stankey et al. 2006). In BC, forest licensees are required to hold public-hearing and comment sessions on stewardship plans prior to approval and implementation (Ministry of Forests and Range 2005). Efforts such as these are not without their challenges, and success has thus far been untenable.

Institutional and power structures have a strong influence on stakeholder involvement. There are often disconnections between the perceptions of citizens and those of scientists and managers. Stankey et al. (2006) demonstrate that managers and scientists might be under the impression that they have included citizens and other stakeholders in the process, and provided them with opportunities for participation and engagement, while those very same citizens and stakeholders report that their ideas are not incorporated and that they do not have the opportunity to participate. As such, though the idea of adaptive management seems a good solution for resolving forest management issues, successful implementation is, in reality, problematic. While there are suggestions for improving the process through structured decision analysis (Gregory 2000; Gregory and Keeney 2002; Kiker et al. 2005), a true adaptive management approach to forest management policies and practices still seems elusive, and may continue to be until the gap in perceptions between the range of stakeholders decreases.

The composition of stakeholders invested in land use affects the policies governing land use (Cumming and Barnes 2007). It is important to consider the stakeholders' perspectives during policy development for ecosystem management, as stakeholder involvement is vital for successful implementation of policies. Policies can compel changes in stakeholder behavior; however, policies regulating resource management tend to be influenced by the political landscape within which they are applied. Thus, without a change in stakeholder perception, and without stakeholder collaboration and cooperation across the range of owner and tenure structures, the success of ecosystem management is jeopardized. Collaborative efforts, such as those between the USFS, the Washington State Forest Service, and private forest owners in Washington (Pinkerton 1998) are essential for successful ecosystem management as they create venues for communication, understanding, and learning.

Conceptual Framework and Research Objectives

The management and modification of forest systems affect system resilience by changing the extent and patterns of forest cover across a landscape. In turn, this affects forest biodiversity and ecosystem health. Increased forest fragmentation—as traditionally occurs with intensive forest management practices—threatens ecosystems by decreasing forest cover and connectivity and by increasing edge effects that occur when patch sizes decrease and patch numbers increase (Franklin and Forman 1987; Forman 1995; Lindenmayer and Fischer 2006). The potential for ecosystem restoration, conservation of managed lands (including commodified forests), and increases of long-term resilience rely on the provision (or allowance) of adequate contiguous forest cover and for large forest patches that are linked to other large forest patches in matrix landscapes. Large patches can be linked using corridors or stepping-stones to smaller forest patches. In other words, they can be spatially separated and still be linked by creating pathways that provide access to different patches for many species. Forest management plans can be designed to establish and encourage these patterns across the landscape (Fischer et al. 2006). Furthermore, management techniques that simulate natural disturbance patterns are more likely to create conditions that achieve resilience (Kaufman et al. 1994; Pavlikakis and Tsihrintzis 2000).

Forest management policy can compel forest managers to adapt management techniques to focus upon ecosystem management and conservation, as is the case with the NWFP for the USFS- and BLM-managed forests. However, policies are temporary measures that can, and often do, change with changing administrations. Policies are not necessarily stable, and are even less likely to be so in a politically volatile and conflict-rich atmosphere such as is often found in the United States or Canada. Changes are more likely to endure when managers adapt management practices to changing personal and societal perspectives, rather than adapting solely because policy requires it. Policy can also influence forest managers' perspectives on best practices, not only because it can compel managers to act in a particular manner, but also because it can influence managers through exposure to different ways of managing forests. This goal, to better understand the relationships that exist in the coupled forest system between policy, perspectives, practices, and landscape patterns, provides the foundation for the following objectives for this study:

- Objective 1: Determine how changes in federal forest policy in the PNW and Crown forest policy in BC have affected management practices across ownership groups in the coastal forests of both regions.
- Objective 2: Determine how changing policies affect forest managers' decisions and perceptions about ecosystem management and resilience.
- Objective 3: Determine how changing policies affect other stakeholder (i.e. non-owner and non-manager) perspectives about ecosystem management and resilience.

- Objective 4: Evaluate a comparison of forest cover change across ownership groups before and after policy changes for sample multi-owner/tenure areas within the coastal forests of the PNW and BC.

- Objective 5: Evaluate the manners in which the management approaches of diverse ownership groups in the coastal forests of the PNW, as well as the tenure types in the coastal forests of BC, contribute to the changing forest cover observed at the landscape scale.

The objectives of this study require the use of a mixture of methods: in-depth interviews to achieve the objectives 1 and 2, observations at meetings and workshops to achieve objective 3, and forest-cover change analysis using remotely sensed data to achieve objectives 4 and 5. In-depth interviews will help to establish whether or not forest managers' perspectives are changing. Given that the NWFP regulates federal land management, and that this policy is more stringent than state policies for either state or private lands, interviews with state and private forest managers will reveal the current trends in forest management practices across ownership levels and the links between these trends as well as forest managers' perceptions of best practices in forestry. State and private managers implementing forestry practices that resemble those in the NWFP, rather than state policies, are doing so by choice. It is also possible that state and private managers may be increasing the intensity of forest management due to real or perceived pressures to meet the timber extraction demands that was once met by extraction from federal forests. Forest policy in BC has changed to the ecosystem-management focus, but their tenure system blurs lines between public and private ownership (Prudham 2007). In-depth interviews with BC's forest managers will illuminate the differences in managers' perceptions and practices when operating under the variety of tenure-lease agreement types.

Observations at open meetings and workshops and forest-cover change analysis using remotely sensed data are methods that are intended to clarify and enhance the outcomes of the in-depth interviews. Observation will provide the opportunity to evaluate context (broader current trends in management perceptions and practices) through interactions between and presentations from various stakeholders at meetings and workshops. These observations will not provide information about changing attitudes over time, but they will provide a clear picture of current collaborative efforts, stakeholder involvement, and institutional support systems. Analysis of forest-cover change across ownership and tenure types for a sample of the multi-owner/multi-tenure landscape will provide insights into how changes in perceptions and practices apparently affect landscape patterns. Furthermore, the results will be analyzed to determine whether ownership type or tenure type is a more significant determinant of forest-cover changes.

Though a higher percentage of coastal forests in BC are public forests compared to the coastal forests of the PNW, the NWFP will be expected to have had a larger impact on the management perspectives and practices in the PNW across ownerships than either the FPC or the FRPA in BC. The NWFP has placed priority importance on ecosystem conservation and provides opportunities for collaboration and education for multiple stakeholders. Furthermore, the structure and regulation of land ownership in the PNW, in concert with the activities of the courts, allow for a greater bottom-up influence from stakeholders in the region. Citizens, NGOs, and industry can own property and manage it according to regulations set by the state, allowing for greater flexibility in management, including management for protection rather than extraction. However, the court system in the U. S. also provides venues for challenges to those management practices, especially under the Endangered Species Act. Though BC's forests are primarily publically owned, it is expected that the top-down influence from government and industry outweighs the bottom-up influences of other stakeholders, as lease agreements proffer a significant financial benefit to the government and to industry, function similarly to private land ownership in the U.S., and are not challenged in courts to the extent they are in the PNW. Additionally, the benefits to the government and to industry are maintained in the current policy. The differences between the two regions in management trends should be evident in overall landscape patterns. In the PNW, it is expected that forest cut rates have decreased across ownerships since the implementation of the NWFP, though the decrease should be seen to be much greater on public lands than on private lands. In BC, the differences in forest cut-rates across tenure types are likely to have decreased, but the rate of decrease is significantly less than in the PNW. The shift to ecosystem management should also have noticeably reduced the amount and frequency of clear-cutting and increased forest density across owner/tenure types in both regions.

The Global Land Project (GLP) (2005) recommends a framework of cross-scalar studies on coupled systems using both quantitative and qualitative measures to understand component relationships and the consequences to global systems due to human manipulation of land systems. This research project has been conducted with the GLP (2005) recommendations in mind. Much work has been, and continues to be, conducted on forest policies in the PNW and in BC. Likewise research in the two regions on forest conditions and landscape change has been abundant and much cross-scale research has also been undertaken. However, this project is novel in two particular ways. First, to my knowledge, there has been no work conducted comparing the PNW and BC policies and landscape change simultaneously, though the two regions have both shifted policy goals during approximately the same time period—with the policies in both regions stating similar goals—and even though the ecosystems across both regions are similar. The second novel aspect of this study, and perhaps the one that is more important to the aim of understanding the relationships between coupled system components across scales, is the assessment of the manner in which trends in manager perspectives correlate to trends in forest cover change. The intent of this dissertation is to contribute to work that is in its infancy in cross-scalar coupled systems research so that we may begin to understand the connections between human system components and ecological system components across scales.

Summary

Human land-use patterns reduce the functional redundancy across scales and thus reduce the resilience of the system. In managed systems, human actions can degrade systems to the point that the system tips over into a new system that no longer provides the expected or desired services. In order to better understand forest systems and manage these systems in a manner that reduces the threat to ecosystem resilience, it is necessary to better understand the relationship between system components across scales and to understand how management decisions and actions at one scale affect system components at different scales. Increasing demands, changing societal values, and stakeholder involvement in issues of forest management are leading to changes in forest management policies and approaches in the PNW and BC.

In the past few decades, there has been a shift from traditional command-and-control forest management to ecosystem management. This shift is occurring in the PNW and BC; however, because of differences in the institutional and tenure structures of the two regions, ecosystem management is not applied equally across the landscape, leading to different and complex patterns of forest cover across the two regions. Changes in stakeholder involvement, coupled with changes in the scientific understanding of forested systems, has led to policy changes and new approaches to forest management in the PNW and BC. Science has been used to inform policy, and has led to attempts to incorporate an adaptive management approach to ecosystem management. Conflict between stakeholders impedes progress in new approaches to management.

This project attempts to improve our understanding of the relationships that exist in the coupled forest system between policy, perspectives, practices, and landscape patterns through observations of meetings and conferences, semi-structured interviews with forestry professionals, and analysis of forest-cover change preceding and following policy changes in the PNW and BC. The next chapter provides an overview of my study area, which includes background on ownership and institutional structure as well as descriptions of the physical environment for the coastal forests of the PNW and BC.

CHAPTER THREE

STUDY AREA

During the close of the 19th Century, the Pacific Northwest (PNW) gained prominence in the United States' timber industry, and by the middle of the 1900s, provided approximately half of the nation's timber supply (Williams 1989). Concurrent to the rise of the timber industry in the region was the area's development of and experimentation with strategies for sustainability and conservation. These new concepts and practices were of equal importance to the region's social and economic identity as the enormous contribution of PNW wood from public lands (today managed by the U.S. National Forest Service (NFS) and Bureau of Land Management (BLM)) to the timber markets was its primary lifeblood (Williams 1989). The apparent contradiction (most private profits stemming largely from exploitation of public property) exists even today and is the basis for both the ongoing conflicts between forest-industry interests and environmentalist's interests and the development of the Northwest Forest Plan (NWFP), a process intended to balance of the public and private interests focused on federal lands.

The history of the forests of British Columbia (BC) is similar to the US's PNW. Timber increased in economic importance during the 19th Century as export demand grew around the globe. Timber extraction continued to climb substantially into the 20th Century (Hagerman et al. 2010). Calls for conservation and sustainable forestry in BC's forestlands began during the late 1800s, with conservationists pressuring the government to inventory the province's forests (Hagerman et al. 2010). Prior to the mid-20th Century, there was little regulation of extraction practices, and the few regulations in place primarily outlined tenure licenses and terms and stumpage fees to be paid to the provincial government for harvesting on public land. The timber industry was an important source of revenue for the BC government, though with time conflict between timber interests and environmental interests have changed the forest-extraction regulatory structure and the power of forest industry in the region.

Ownership Structure

Though the NWFP regulates federal forest management in northern California as well as Oregon and Washington, this study only examines the coastal regions of Oregon and Washington because of the dissimilarity in northern California's coastal forest systems to the coastal forest systems of the other two states. Thus, northern California's ownership structure is not discussed here. Land ownership in the coastal ranges of Oregon and Washington is a mosaic of federal, state, and private lands (USDA 1994; Ohmann et al. 2007). Within Oregon, the mosaic often forms a checkerboard pattern, most of which is composed of alternating private and BLM holdings. Federal lands not classified as BLM lands are either national forest land or Bureau of Indian Affairs (BIA) land, the latter are lands designated for Native American access. There are no national parks within the coastal range of Oregon. However, in Washington, Olympic National Park occupies much of the peninsular region. Surrounding the national park are national forests, and to the west and south, private lands (often owned by timber companies) are prevalent. Private non-industrial forests are found in Oregon portion of the study region, but are not in the Washington study area. State-owned lands are present in the study region in both Oregon and Washington.

The Coast Forest Region (CFR) of BC is approximately 75% crown land and 25% privately owned (Bunnell 2008). Within the Crown lands are forestlands provided to the First Nations by treaty. There is some dispute, as revealed in two of the BC conferences attended, regarding the rights to governance, ownership, and management of First Nations' lands. Presently, most believe that the lands are owned by the Crown and that the only rights granted to the First Nations are those conveying free access to the land for traditional uses and for economic activities. Lawsuits are currently moving through the courts over the transfer of title to the First Nations due to the Constitutional claims of ownership of traditional lands believed to have been given to the First Nations. The BC government seems to be trying to develop co-governance with the First Nations on some of the lands at the center of this conflict while the court process works through the conflict.

Institutional Structure

The coastal forests of the PNW and BC are managed not only by a number of agencies and organizations, but also under a complex array of management types. The coastal region of Oregon is approximately 80% forested, much of which has been harvested at least once. Currently, federal public lands managed by the USFS and the BLM are being managed under the NWFP. Forestlands designated Native American lands, under the jurisdiction of the BIA, are not managed under the NWFP, but are treated in ways similar to private land management; management is contextual. The state (Oregon or Washington) sets the policy and regulatory framework for both state-owned lands and private lands. Management practices on non-federal lands can range from intensive timber harvests on large blocks of timber company-owned lands to less intensive timber harvests on private non-industrial forests to multiple-use management, which includes timber extraction, on state-owned lands, and may even be limited to non-consumptive uses (Ohmann et al. 2007). Industry manages the majority, 39%, of Washington's western forests, while the remainder is under federal, state, and non-industrial private management (Bolsinger et al. 1997).

Crown lands in Canada are set aside for multiple purposes including timber extraction, wildlife habitat, and protected park areas. Two and a half million hectares of the 7.6 million hectares of public forests are open to timber harvesting (Ministry of Forests and Range 2007). Crown lands are all regulated by Crown policy, though management of these lands is based on tenure. Private industry operating on Crown lands are regulated by Crown policy, while private industry operating on private lands is less regulated and does not have to adhere to the Forest and Range Practices Act (FRPA) or to the preceding policy, the Forest Practices Code (FPC). Crown tenure is an ever-changing operational framework. Community forest tenure designation is intended to designate proceeds from forest extraction as income for a specific community associated with that land. Woodlot licenses are small operations, and are not intended for industrial-scale timber harvests. Industrial operations operate under either Timber Supply Area (TSA) tenure (in which the tenure-holder competes with other TSA tenure-holders for harvests of pre-determined amounts or areas in designated units) or Tree Forest License (TFL) (in which tenure-holders are given sole operational tenure on a parcel of land). Unlike the national park system in the US, Canada's national parks and other protected areas allow active (though limited) harvests.

The Physical Environment

The coastal forest ranges in the PNW region of the U.S (Figure 3.1) and in BC (Figure 3.2), Canada, were once part of a common ecosystem (coastal temperate rainforest), the system is no longer continuous, however. Furthermore, ownership patterns and land-use activities of the last century and a half, have extensively modified these forests and the outcomes vary quite widely throughout the region.

The coastal region of BC includes Vancouver Island and the Queen Charlotte Mountains can be divided into two regions distinguished by two distinct climates.

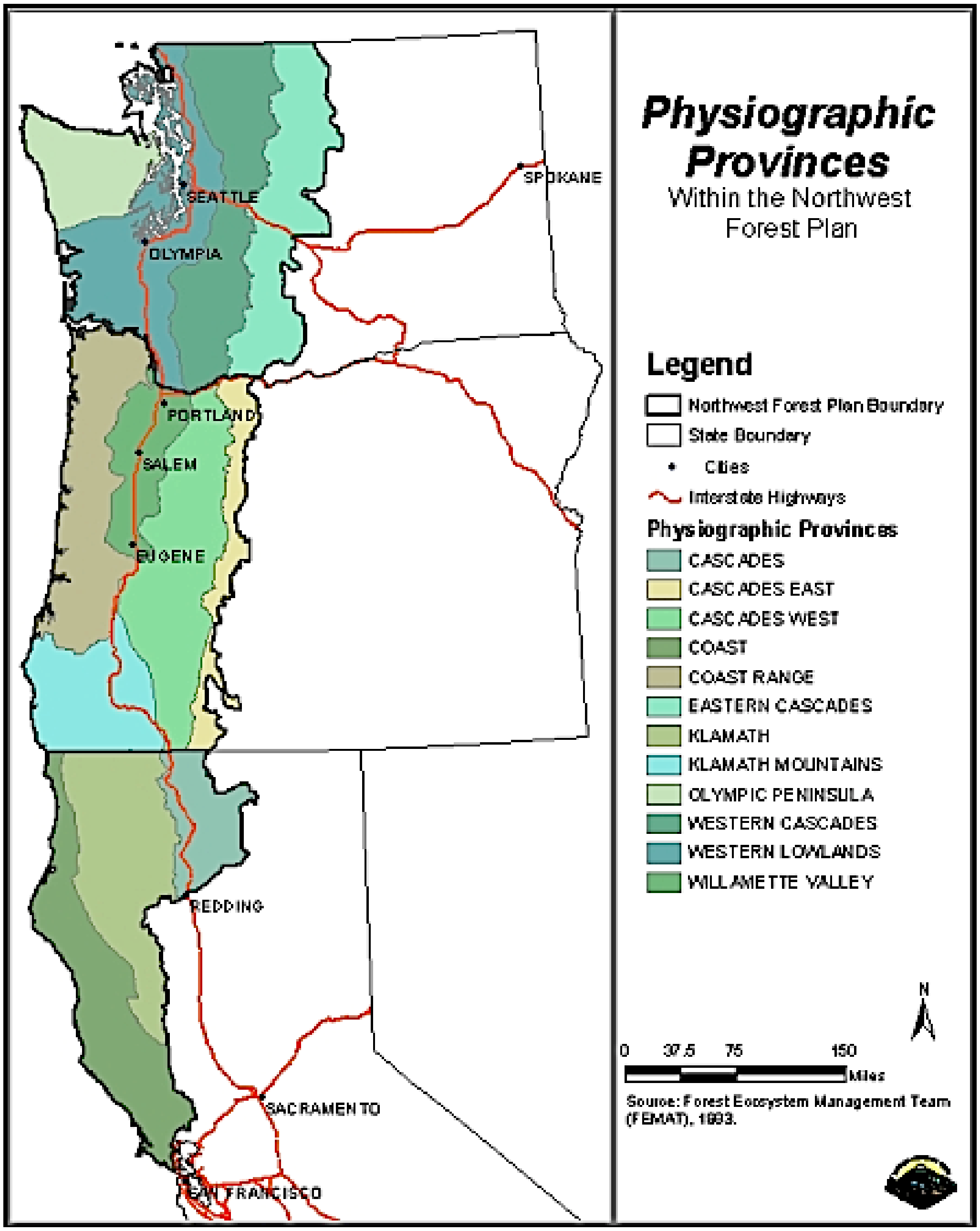


Figure 3.1. Map of Physiographic Provinces within the NWFP. Source: Regional Ecosystem Office.

Figure 3.2. BC's Coastal Forest Region (in green). Source: Ministry of Forests and Range.

On the windward side of the coastal mountains (Vancouver Island and Olympic mountains), the climate can be described as "cool mesothermal" and has an average annual temperature of 8˚ C, temperatures above 10˚ C for more than four months per year, and sees an average low of 0.2˚ C for the coldest month of the year (Pojar et al. 1991). Average precipitation amounts range from 1000 mm to 4400 mm within this part of the region. The average for the entire area is 2228 mm (Pojar et al. 1991). On the leeward, or rain shadow, side of the coastal mountains in British Columbia, summers are dry and winters are wet (Nuszdorfer et al. 1991). Average annual temperatures are approximately 10˚ C and the average temperature of coldest month is 0˚ C (Nuszdorfer et al. 1991).

The coastal range of Washington and Oregon has a climate similar to the coastal region of BC. Average annual temperatures range from 0˚ C to 12˚ C (USDA Forest Service n/d). Monthly precipitation averages windward of the Olympic Mountains range from 1,520 mm to 6,100 mm, while the precipitation in the rain shadow averages to 760 mm (USDA Forest Service n/d).

In BC, western hemlock dominates the windward side of the coastal range, with Douglas fir, western white pine, grand fir, big leaf maple, and western red cedar found in the southern latitudes, and with yellow cedar, Amabilis fir, and Sitka spruce in the northern and higher latitudes (Pojar et al. 1991). Very little old-growth remains on the leeward side of the coastal mountains in BC due to intensive logging (Nuszdorfer et al. 1991). Douglas fir is the most prevalent tree species in the region, while red alder, western red cedar, arbutus, grand fir, and Garry oak are also common (Nuszdorfer et al. 1991). The higher elevations of the coastal forests in Oregon and Washington are predominantly composed of cedar, hemlock, and Douglas fir, with western hemlock dominating the lower mountain slopes, western red cedar on lower elevations, and Sitka spruce and western hemlock in the fog belt along the coast (USDA Forest Service n/d).

Summary

The PNW and BC contribute an important supply of timber to the U.S., Canada, and globally. Concurrent to the development of the timber industry in the region was the development of experimental approaches to sustainability and conservation. Much of the forestland in both regions has been harvested at least once, though in the PNW, much of the federally owned forestlands remain uncut. The ownership structure is different within the two regions, with the majority of land under Crown ownership in BC and a mosaic of federal, state, and private ownership in the PNW. The ownership structure differences have also led to differences in the institutional structure of forest management. In the PNW, federal lands are managed by federal agencies, state lands are managed by state agencies, and private industry or non-industrial owners manage private lands. The NWFP only regulates management on federal lands. In BC, on the other hand, private industry manages provincial forests under first the FPC and now under FRPA. The coastal forests used to be one contiguous system, with variations along altitude, north-south gradients, and east-west aspects. The land has been extensively modified over the history of human settlement in the region.

The next chapter consists of the methodology and methods for this study. I first provide a description of conferences and meetings and then describe the methods for assessing current trends in forest management. In Chapter Four, I also reveal information on the methods used for the interview process and include details on ethics and IRB approval. Following the methods for the interview process is the content analysis methods. The final section of the chapter contains the methods for the forest-cover change analysis.

CHAPTER FOUR

METHODOLOGY AND METHODS

Methodology

To reiterate, the purpose of this research is to identify the changes that have occurred in forest manager's perspectives and management practices during the last two decades and to elucidate their implications for the forest landscapes of the PNW and BC. It is presumptive to attribute changes in practices exclusively to changes in policy as there are many potential drivers of forest management practices. Some factors contributing to changes in forestry practices are local economics and supply pressures, international economics and trade demands, social pressure and litigation, technological changes, shifts in forest managers' philosophical perspectives and scientific understanding, and ecological distress and climatic conditions. Indeed, all of these factors have been linked to changing forestry in the PNW (Haynes et al. 2006) and in BC (Pinkerton 1998; Howlett 2001a; Howlett 2001b). Management practices affect ecosystem processes and impact the patterns seen on the landscape. In order to gain both a broader and deeper understanding of management practices and how they are linked to landscape patterns, this study will assess existing drivers of management practices beyond what can be measured exclusively through policy or economic analysis or through analyses of forest-cover change. This chapter elaborates the methodological approaches used to evaluate these relationships in a complex setting at several scales.

Linking processes across scales is a relatively new research approach, and one that requires the use of mixed-methods research design (GLP 2005). Mixed-method approaches use both quantitative and qualitative research methods to collect, analyze, and interpret data within a single study (Greene et al. 1989; Onwuegbuzie and Leech 2006; Johnson et al. 2007b). The use of a *complimentarity* mixed-method approach allows one to enhance the findings of one component of the study with results from another (Rossman and Wilson 1985; Greene et al. 1989). In this particular study, a three-component *complimentarity* approach is used and employs observations made at professional meetings and conferences, in-depth and semi-structured interviews, and land-cover change analyses.

Observations of meetings and workshops provide a foundation for the current trends in forest management perspectives and practices. In-depth interviews provide evidence of the effect of changing policies in the PNW and BC on the philosophical perspectives and ensuing management practices of forest managers across owner/tenure types. Assessment of the changes revealed in forest-cover patterns will illustrate the manner in which forest managers' perspectives and practices contribute to landscape patterns. These three components expose overlapping, as well as unique, aspects of the manners in which changes in policy affect forest manager perspectives and practices and forest distribution patterns across owner/tenure types in the PNW and BC. Together, these techniques provide a deeper understanding of the relationship between the three components (Greene et al. 1985). Ali et al. (2005) used a similar mixed-method approach to assess the causes of forest cover change in Basho Valley, Northern Pakistan.

Methods

Meetings and Conferences

Observation of public meetings and workshops provides information regarding trends in management perceptions and practices for the various owner- and tenure-types. Observations do not provide much in-depth information, nor do they provide much information on paradigm shifts; however, observation offers an indication of current or mainstream management practices across the industry, of the relationships between stakeholders, and of institutional structures and dynamics. Six conferences on forest and forest ecosystem management were attended during the period from October 2009 to October 2010. Notes on interactions, presentations, and proceedings were recorded at each conference. Active participation was avoided. The notes, as well as conference websites and programs, were used to provide evidence of current trends in management practices, stakeholder relationships, and institutional structure and dynamics.

Attended Conferences

To identify relevant conferences and meetings, in-depth Internet searches were conducted from spring through fall 2010, the time at which the researcher resided in the research area. Given the time of year in residence, meeting and conferences were few. Two PNW and three BC/Alberta conferences were attended between June and October 2010. An additional conference was attended in the PNW in October 2009, during which time extensive notes were taken and participation in conference proceedings or discussions was avoided. All conferences met the criteria established for conference observations in that they were relevant to topics and interests in forest management and they were intended for a range of stakeholder audiences. The information gathered from all observations was included in the assessment.

The six meetings and conferences covered a range of topics, goals, and themes. The intended (targeted) audience varied among the conferences. One focused on catering to private landowners, while others were intended for any combination of scientists, academics, students, government organizations, NGOs and private citizens. Meeting and conference duration ranged from one to four days. A brief description of each meeting follows.

Dry Forest Management PNW: Redmond, Oregon, October 2009

The Dry Forest Management PNW conference was an interdisciplinary workshop hosted by U. S. Fish and Wildlife (USFW), USFS, and Oregon State University (OSU). According to the program, the workshop was intended to bring professionals from a wide range of disciplines together to define management objectives in the northern spotted owl dry-forest range, to describe the means by which to meet the objectives, and to discuss long-term plans for manager-and-scientist collaboration on research, monitoring, and evaluation of dry-forest management in the eastern portion of the Cascade Range (U. S. Fish and Wildlife 2009). In addition to professionals and scientists from within the host agencies, workshop participants included scientists and professionals from state organizations and other universities, as well as those representing NGOs.

National Forest Landowners Conference: Stevenson, Oregon, June 2010

Private landowners from across the U. S. assembled for the National Forest Landowners Conference. The presenters included professionals from private industrial-scale timber companies and one state forester from Washington. The audience, however, consisted of owners of non-industrial forestlands as well as people from industry.

Mountain Climate Research Conference: Blue River, Oregon, June 2010

The Consortium for Integrated Climate Research on Western Mountains, along with a number of universities and government agencies and institutes, sponsored a bi-annually held mountain climate conference in Blue River, Oregon, at the HJ Andrews Experimental Forest. Dedicated to unveiling research on climate-change science in the western mountain regions, these conferences are geared toward scientists, policy makers, resource managers, students, and other interested professionals (USDA Forest Service 2011). The goal of the Mountain Climate Research Conference is to enable interdisciplinary research and integration of science into resource management through presentations, discussion panels, and workgroups (USDA Forest Service 2011).

Bulkley Valley Interface Conference: Smithers, BC, July 2010

The “Interface” conferences address issues and topics encountered where Crown lands border settlement or agriculture. The School of Environmental Planning at the University of Northern British Columbia, along with the Bulkley Valley Research Centre, government planners, a Wet’suwet’en representative, and academic and NGO researchers, organized the Bulkley Valley Interface Conference. The audience included planners, researchers, First Nations planners, and citizen group representatives (Bulkley Valley Centre 2010). The conference’s primary themes were: research and public participation in planning for interface lands and the links between interface planning and community development (Bulkley Valley Centre 2010).

Regional Land Use Planning in a Global Economy: Jasper, Alberta, September 2010

The Canadian Institute of Forestry (CIF-IFC) hosted an interdisciplinary meeting and conference on regional land use planning to address the issues of land cover change and the competing values and objectives for natural resources on global, regional, and local scales (Foothills Research Institute 2010). Presenters included professionals and researchers from throughout Canada representing private industry, NGOs, universities, and all levels of government. As with the presenters, the audience included a vast array of stakeholders in natural resources management.

Human Dimensions of Natural Resource Management: Revelstoke, BC, October 2010

The Columbia Mountains Institute of Applied Ecology (CMIAE) held a conference that was intended to examine the means by which natural resource managers can include social values and human behaviors in decisions regarding natural resource management to invigorate management plans and actions and to ensure their effectiveness (CMIAE 2010). Presenters from national and provincial government agencies, universities, NGOs, and environmental consultants presented research that regarded the human dimension in natural resource management. The audience consisted of natural resource managers, public interest groups, consultants, researchers, and academics (CMIAE 2010). The conference goals included the achievement of understanding and addressing a multitude of personal, social, and cultural values in resource management; resolving issues through the inclusion of both social science and natural science in management; managing conflicts in natural resource management; and promoting stewardship across stakeholder groups (CMIAE 2010).

Current Trends in Forest Management Assessment

In assessing the current trends in forest management, notes and conference websites and programs were examined. As some conferences covered a broad range of topics other than those specific to forest management, only those presentations relevant to forest management were considered. The materials were examined for recurring topics across all meetings, in order to determine common themes across conferences. Presentation, panel, and working group topics were assessed for whether they dealt solely with forestry or rather considered larger ecosystems or included other resources or incorporated social or human components. Presentation and discussion topics were assessed for whether they fit into one or more of the following categories: management techniques, environmental protection, stakeholder interests, or economics. Notes were examined for similarities and differences in topic substance; whether, for instance, the presentations tended to present environmental protections in terms of restrictions or opportunities. The results of these evaluations reveal the current tenor and content of forest management practices. They further expose what topics and issues are deemed valuable to the array of conference audiences.

The topics chosen, and the types of presenters and audience members participating, reveal stakeholder relationships and institutional structure and dynamics. Therefore, information from meeting websites and programs was the primary material used to determine who participated and who didn't and for whom each meeting was organized. Personal observations while in attendance yielded non-content "facts" regarding stakeholder relationships from the conferences, including, for instance, the noting of interactions between audience members and conference presenters.

The ultimate purpose of attending the meetings and conferences was to obtain a backdrop or context for the remainder of the study. The information gathered discloses the "pulse" of important issues and relationships within forest management. While the meetings ranged from local to regional to national in focus, they all exhibited common themes of stakeholder relationships and of institutional structure and dynamics in forest management.

Semi-structured Interviews

To understand forest managers' perspectives and the potential changes of those perspectives over time and to reveal changes in forest management practices over time, it was important to talk with forest managers. In-depth interviews provided insight into modifications or transformations of forest managers' management practices as a function of changing forest policies and the manner in which practices have been modified or transformed. In addition, interviews enabled better understanding forest managers' rationales for implementing particular practices. Optimally, the interviews could explicitly divulge the reasons for changing practices. In-depth interviews were semi-structured to provide a framework for conversation that also allowed interviewees to elaborate and speak freely, to ultimately allow more than would be expressed through either structured interviews or surveys.

Ethics and IRB Approval

Given that this project involved human subjects, IRB approval was acquired. A request for exemption from review was submitted, as subjects who agreed to participate would remain anonymous. In addition, participants would not be asked to reveal any information that would breech confidentiality or be of a personally or professionally sensitive nature. Personal information collected (i.e. whether individual works for public, private industrial, or private non-industrial; type of education received) was non-specific enough to keep individual identity private. The Texas State IRB granted exemption on 04/29/2010.

Interview Procedures

Interview-guiding questions—adapted for PNW interviews and for BC interviews (Appendix A)—were designed to fulfill objectives 1 and 2. The selection of interviewees used stratified random sampling, common in sample selection for interviews (Baxter and Eyles 1997). The population of interviewees was identified through a snowball sampling process: suggestions were made by current contacts, other interviewees, or subjects were identified via a search of relevant agencies and companies. Potential interviewees from each of the owner classes (private industrial, private non-industrial, state, and federal) and tenure classes (non-leased, woodlot license, timber supply area license, community forest agreements, tree farm license, and pulpwood license) were contacted. Initial contacts were made either in person, via email, or telephonically. A copy of the interview questionnaire (or interview outline) was provided prior to attaining final consent to those who, when contacted in-person, expressed interest in participation. Potential interviewees in this group accept participation after review of the questionnaire. Email contacts, on the other hand, received the questionnaire as an attachment to the introductory email that explained the research being conducted. Their agreement to participate was based on the information that they received and reviewed.

Arrangements were made with those who agreed to be interviewed in a session of about one hour in duration. Interview times in actuality lasted between 30 minutes for the shortest interview to two hours for the longest, though the majority of interviews were an average length of about an hour. To ensure that participants were comfortable responding to questions, the interviewer endeavored to remain neutral in attitude and reassure participants as necessary. The majority of participants were open with responses, though often made sure to state that they were expressing their own opinions and not those of the agency or company for whom they worked. Interviews usually took place in work offices, though some were conducted in homes or cafés. Location did not seem to inhibit participation.

The original goal was to primarily interview individuals who directly managed forests; however, not all who agreed to interview were directly involved in managing a forest, though all had roles in forest management. This was especially true BC, where those who worked for the Ministry of Forests or the Ministry of Environment filled roles of oversight in forest management rather than direct forest management due to the organizational structure of the forest industry, the government's policies, and provincial regulatory structure. In both the PNW and BC, despite efforts to obtain a representative selection of interviews for each landowner class, those who agreed to participate predominately came from federal and ministry forestry departments. However, each broader owner or tenure class did have at least one person representing their perspective in the PNW. In BC, no participants represented either the woodlot or the community forests perspectives, even though both are classes of importance in this study.

In the Pacific Northwest, 13 people agreed to participate. There were three representing private industry, one from private non-industrial forests, two who managed state forests (one from Oregon and one from Washington), seven federal forest managers, and one who represented a tribal perspective. There were 12 participants in British Columbia: one from private industry on privately owned land, two from private industry on publicly owned land, six from the Ministry of Forests, one from the Ministry of Environment, and two represented the tribal perspective. There were two more interviewees from BC who had agreed to participate, but who had moved to locations that complicated access (i.e. constraints of time, distance, and/or funding).

All interview sessions were audio taped (with participant knowledge and permission) to reduce unnecessary interruption of responses and to ensure that important information was not missed. All audiotapes were transcribed to provide a textual medium for content analysis. Responses were documented, categorized, and assessed for common threads and themes following the methods traditionally used in content analyses.

Content Analysis

Among the many reasons to conduct content analysis provided by Weber (1985), three are most pertinent to this study: coding, attitude and behavioral descriptions, and elucidating the perspectives of individuals, groups, and institutions. Through content analysis, it is possible to code (and thus reduce) vast amounts of textual data into manageable units. The coded data then provide a means to reveal the personal, group, and institutional perspectives on forest management, and trends in attitudes and behaviors towards forest management and policy.

Reliability in content analysis is generally increased by having more than one person code the data into the same set of categories and with the same set of coding rules (Weber 1985; Richards 2005). However, as this dissertation is an individual's project, and as the time and labor involved in coding is extensive and intensive, respectively, only one person coded these data. This was done manually rather than using computer software. Given the language of forest management and the different meanings that can be ascribed to the same word or phrases (i.e. environment, ecosystem management or ecosystem based management), manual coding was determined to be the approach that would provide the most reliable results.

All interviewees responded to specific questions, providing the general themes under which the data were coded. Descriptive data are coded to provide information about the participant—such as educational attainment—and the company, agency, or organization for which the individual worked or about actions and behavior (Richards 2005; Saldaña 2009). Questions 1, 2, 3, 7a, 8, and 9 were designed to provide descriptive information about the agency or company and the individual, while the remaining questions were more open-ended and designed to provide more detailed perspectives.

It should be noted potential error was introduced in responses to open-ended questions in that often participants responded to earlier or later topics while answering a question, or that the responses to one question linked to the responses given for another. Additionally, responses were not necessarily discretely exclusive. Some responses fit more than one category and these were classified into each category they fit. Not all participants responded adequately to all questions. In some cases, inadequate or missing responses were due to participant time constraints, while in others, a participant simply did not effectively address the intent of the question. In such situations, no response was recorded. The coded data were input into an Excel spreadsheet. Charts and tables were created for visualization and comparison.

Forest Cover Change

With the advances in remote-sensing and GIS technologies, landscape and regional analyses are becoming increasingly effective, though the scale and resolution of the data still affects accuracy. As this project examines forest cover change at a landscape scale, Landsat images with a 30-meter resolution were chosen for analysis. This scale allows for adequate coverage to sample areas within the coastal forest ranges of Oregon, Washington, and British Columbia. Landsat imagery is now available at no cost and is readily accessible. It is also commonly used in landscape analyses. Furthermore, change detection analysis for Oregon and Washington from 1984 to 2002 enabled the use of existing data and analyses from the Laboratory for Applications of Remote Sensing in Ecology (LARSE). The LARSE project used Landsat imagery, in part, for the analysis of forest disturbance over time.

The LARSE lab has conducted change detection analysis for the regions of Washington, Oregon, and California that fall under the jurisdiction of the Northwest Forest Plan from the years 1972 to 2002 (Healey et al. 2003). The resulting composite image highlighted forest cover changes caused by fire, timber harvest, and the Mount St. Helens eruption in 1980. The LARSE change-detection process used Landsat 4-5 TM for the time frame of interest in this study. Data from the LARSE composite were therefore used to determine forest disturbance for the years 1984 and 1995. In order to remain consistent with their results, the general procedures used by the LARSE team were used to determine forest disturbance for the year 2008, except for hand-editing for landslides, river and water edges, and parcels too small to be due to harvests. This step was not completed due to researcher limitations and time constraints. In addition, the metadata for the LARSE lab procedures provided no precise threshold, and only indicated that disturbed areas would demonstrate higher disturbance index values, thus there are potentially some differences between the outcomes of the LARSE procedures and those from this study due to potential differences in the threshold used. The change in forest cover across the five ownership classes discussed here was then determined for the entire study period using the LARSE results for 1984 and 1995 and the new results for 2008.

To analyze forest cover change in the coastal forests of British Columbia, Landsat 4-5 TM, 30-meter resolution images from the years 1985, 1994, 2005 and 2009 were used. The dates were selected for each area enabled analysis of nearly equal time segments prior to and after the implementation of forest policy changes up to 2005 when the policy changed again in BC. Initially, the intention was to evaluate forest cover change from 2005 to 2008 to gauge the impact of the Forest and Range Practices Act (FRPA), and prior to the economic downturn that began during the year 2008. However, cloud-free imagery for 2008 for British Columbia was unavailable, and the most usable data for the end date of analysis was from 2009. The potential issue with using these data (from 2009) is that the economic downturn began in 2008 and therefore could skew the results, as economic conditions can contribute significantly to changes in harvest and forest cover after 2008. Nevertheless, as the 2009 image was significantly more usable than 2008, and earlier dates would have been closer to the change in policy than I would have liked, I opted to use the 2009 image.

Scene and Sample Area Selection

Scene selection required adequate representation of the coastal forests in the regions of interest. As I intended to analyze only a subset of any given scene, one scene each from Oregon, Washington, and British Columbia was selected. In all cases, more than one scene was available with coverage of the coastal forests. In Oregon, five scenes were available from which to choose. The scene covering row

47/path 29 [Figure 4.1] was chosen, as it is situated over the coastal forests in an area of the state containing a range of landowner classes. The scene does extend over the Pacific Ocean, but does not extend beyond the coastal forests to include much of Willamette Valley or any of the Cascade Range, areas not in the study area of this project. Three scenes were available for Washington: one straddled the Oregon border, another was primarily water, and one was available on row 47/path 27 [Figure 4.2] and encompassed most of the Olympic Peninsula. This scene contained public land—a landowner class missing in the scene that straddled the border with Oregon. Many scenes covered the coastal forests of British Columbia. However, as my interviews were primarily from forest managers managing forests on Vancouver Island, the Sunshine Coast, and in the Great Bear Rainforest, the scene selected was from row 49/path 27 [Figure 4.3]. An alternative, row 50/path 25 could have been selected, but there were insufficient cloud-free scenes for this area.

In each of the scenes selected, the area of interest was reduced to exclude portions of the scene for various reasons. In British Columbia, the mountainous region that bounds the coastal forests on the east on the mainland was excluded from the analysis. In the scene from 2005, the best image still included a region of extensive cloud-cover in the south. To make the scene usable, that area was excluded from all of the scenes in all other years. On the Olympic Peninsula in Washington, the Puget Sound and the highly urbanized area to the south were excluded from analyses, as was an area over which there was cloud cover in the 2005 scene. Finally, for the Oregon scene, the eastern edge of the scene was excluded because of distortion due to misalignment of the satellite bands used in the

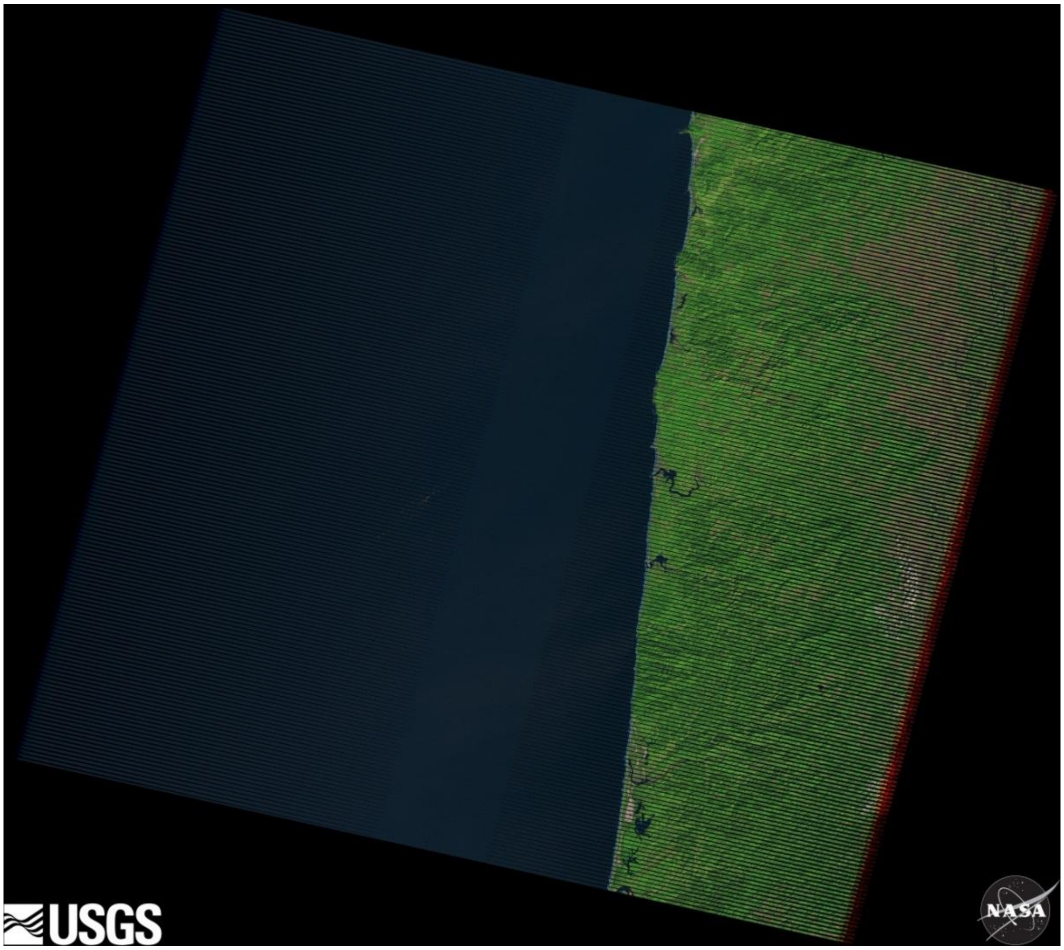


Figure 4.1. Oregon scene, row 47/path 29. Source: USGS.

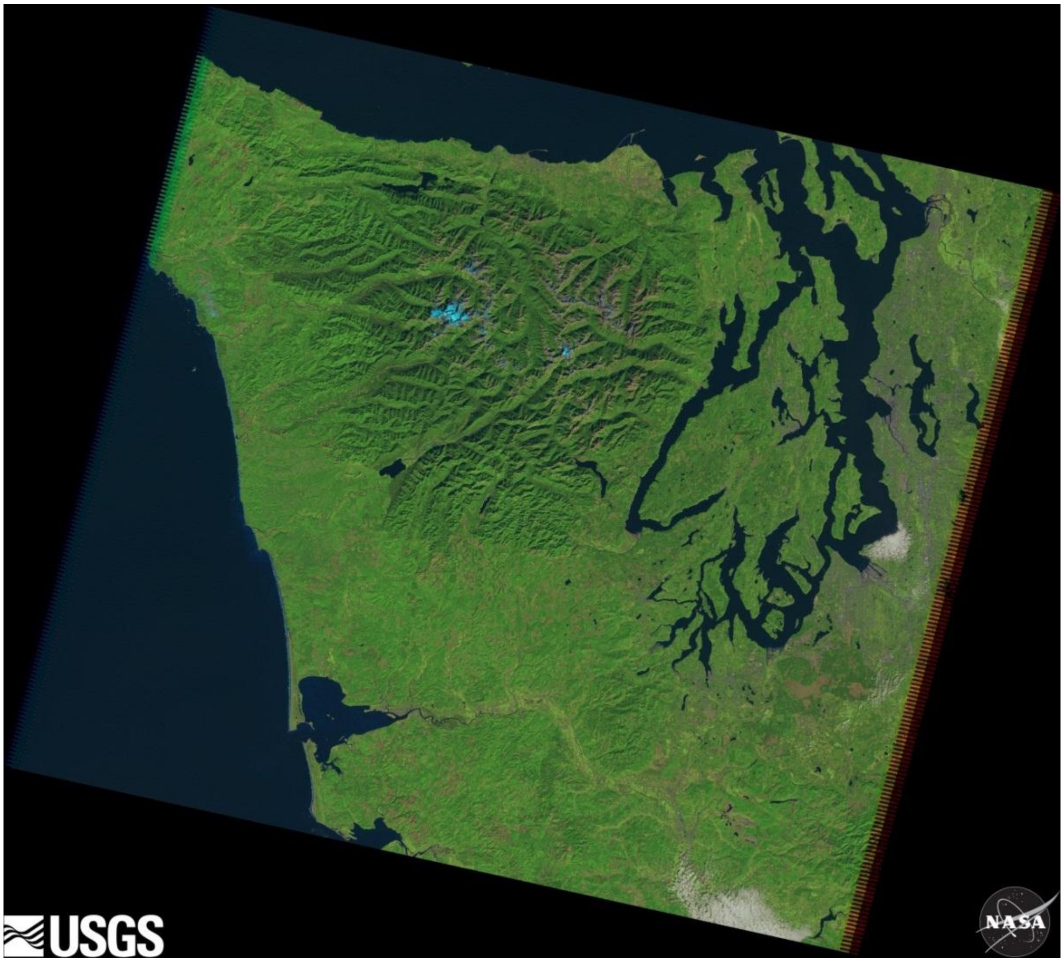


Figure 4.2. Washington scene, row 47/path 27. Source: USGS.

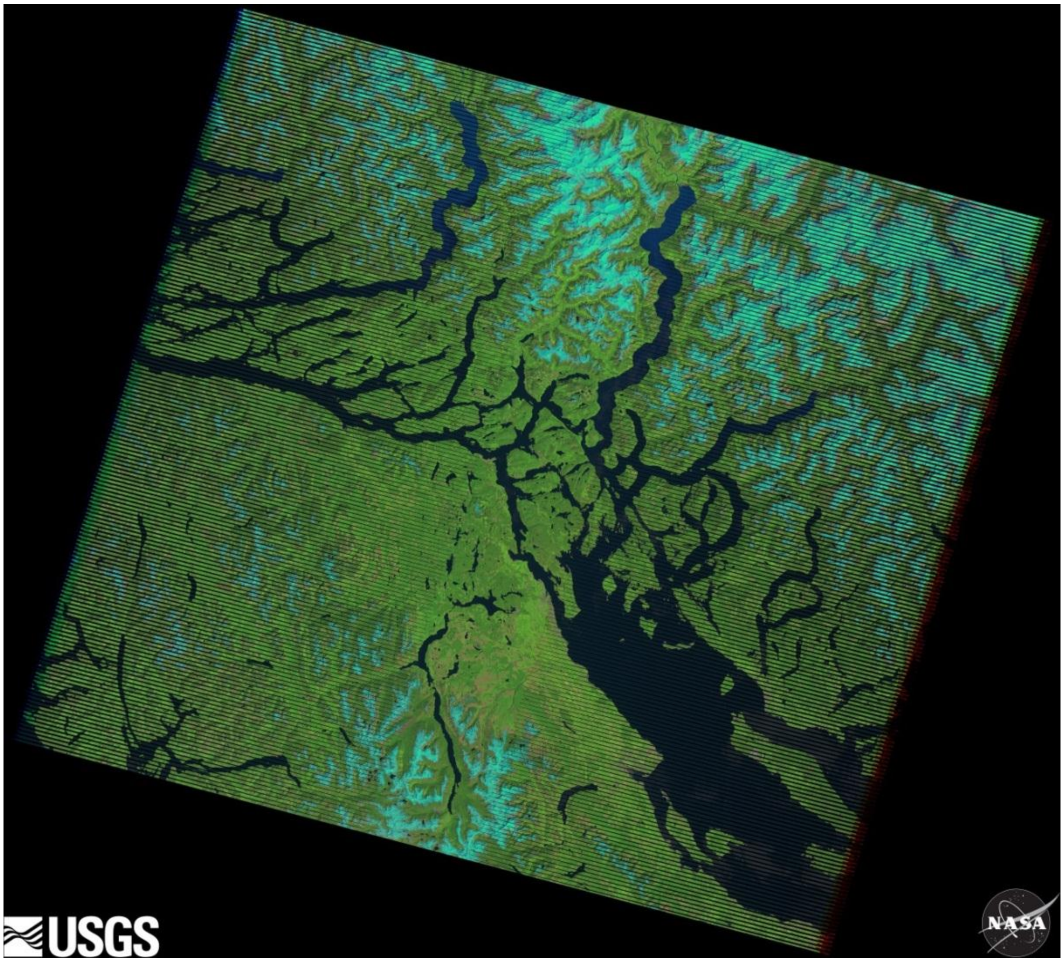


Figure 4.3. British Columbia scene, row 49/path 27. Source: USGS.

scene. As much of the ocean as possible was excluded from the Oregon scene but only those parts that did not also exclude land.

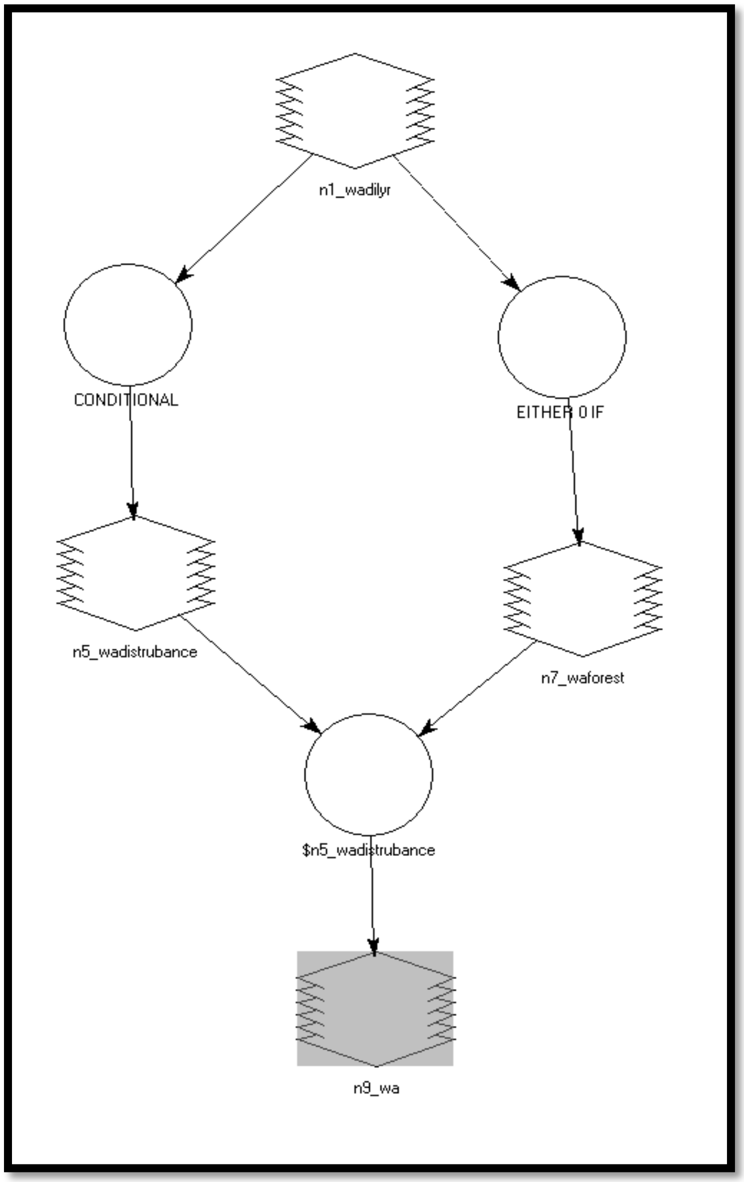
Image Processing in ERDAS Imagine 9.2

Change-detection analyses were conducted using a combination of ERDAS Imagine 9.2 and ArcGIS 10. Forest-cover change detection was performed in ERDAS Imagine 9.2 and the results were imported into ArcGIS 10 to determine the change over time across ownership classes. In the case of the PNW, the LARSE assessment of forest cover change was conducted in ERDAS Imagine. The 2005 and 2008 images for Oregon and Washington and the 1985, 1994, 2005, and 2009 images for British Columbia were processed using ERDAS Imagine 9.2 to determine forest disturbance using the procedures the LARSE team described in the their metadata (Healy et al. 2003).

Prior to determining forest disturbance for each scene, all had to be formatted. In Oregon and Washington, the 2008 image was first geo-registered to the 1984 scene, and in British Columbia, the 1994, 2005, and 2009 images were geo-registered to the 1985 scene to align all images with the initial image in each region. Following geo-registration, tassled cap transformation was performed on each image. The tassled cap transformation converts spectral values from each of the seven bands into measures of brightness, greenness, and wetness, and can enable differentiation of forested from non-forested land covers. A mask was applied to each scene to remove all non-forested (i.e. urban land, water, barren land, and agricultural lands) areas.

After the tassled cap transformation was performed and the masks applied, a model was created to convert the tassled cap pixel values into a disturbance index that would indicate forest disturbance. The model first converts the pixel values (DN) for each of the three tassled cap bands (brightness, greenness, and wetness) into an expression of standard deviations above or below the mean using the formula (DN-x)/SD, where DN = the pixel value, x = the mean, and SD = the standard deviation. The model then combines the results from the three bands into a single disturbance index band using the formula: Brightness - (Greenness + Wetness), where Brightness = Band 1, Greenness = Band 2, and Wetness = Band 3 from the previous operation. The equation for the disturbance index is the same used in Healy et al. 2003.

Once the disturbance indices were calculated, the disturbance index layers for 2008 in Oregon and Washington, pixel values were examined to determine the threshold for forested versus disturbed-forest pixel values. The 1984, 1995, 2005, and 2009 disturbance index layers for British Columbia were combined into a single multi-temporal layer. In the Oregon and Washington scenes and in the British Columbia layerstack, values equal to or greater than zero were correlated with disturbance. Once this was determined, another model to reclassify forested and disturbed areas from each year in each scene was created (Figure 4.4). The final ERDAS Imagine 9.2 step employed a 3 x 3 modal filter to remove speckle.



Input layer:
Washington Layer Stack

CONDITIONAL:
CONDITIONAL { (STACK MAX ($n1_wadilyr) == $n1_wadilyr(1)) 1, (STACK MAX ($n1_wadilyr) == $n1_wadilyr(2)) 2 }

EITHER 0 IF:
EITHER 0 IF ($n1_wadilyr(1) < 0 AND $n1_wadilyr(2) < 0) OR 1

Figure 4.4. Model diagram for Washington forest disturbance for 2008 and command statements for model.

Forest Change by Owner Class Using ArcGIS 10

In ArcGIS 10 ArcMap, an ownership layer for the PNW and BC was added. The ownership layer for PNW was acquired from the Oregon/Washington office of the U.S. Bureau of Land Management (http://www.blm.gov/or/gis/data.php) and the layer for BC was acquired from the provincial government's site DataBC (http://www.data.gov.bc.ca/dbc/geo/wms/index.page). Both layers are vector maps with polygons for owner or tenure classes. The boundaries of polygons with similar designations were dissolved so that the numerous individual polygons created for each feature class could be analyzed as a single polygon. Within the Oregon and Washington scenes, the ownership variables examined were: USFS, BLM, USFWS, BIA-managed, state-owned, private industrial and private non-industrial classes (Figures 4.5 and 4.6). In BC the tenure variables of interest were non-leased public (which includes parks and protected areas), woodlot license, active license, community forest, Indian reserve, and private (Figure 4.7). In each of the owner/tenure layers, there were more designations than indicated here; however, most of these designations fell under the broader categories of interest, and were therefore clumped together in the analysis. For all data sets, changes in forest cover that were not added to the categories of interest were not incorporated in the analyses. The owner/tenure layers were clipped to match the areas of interest.

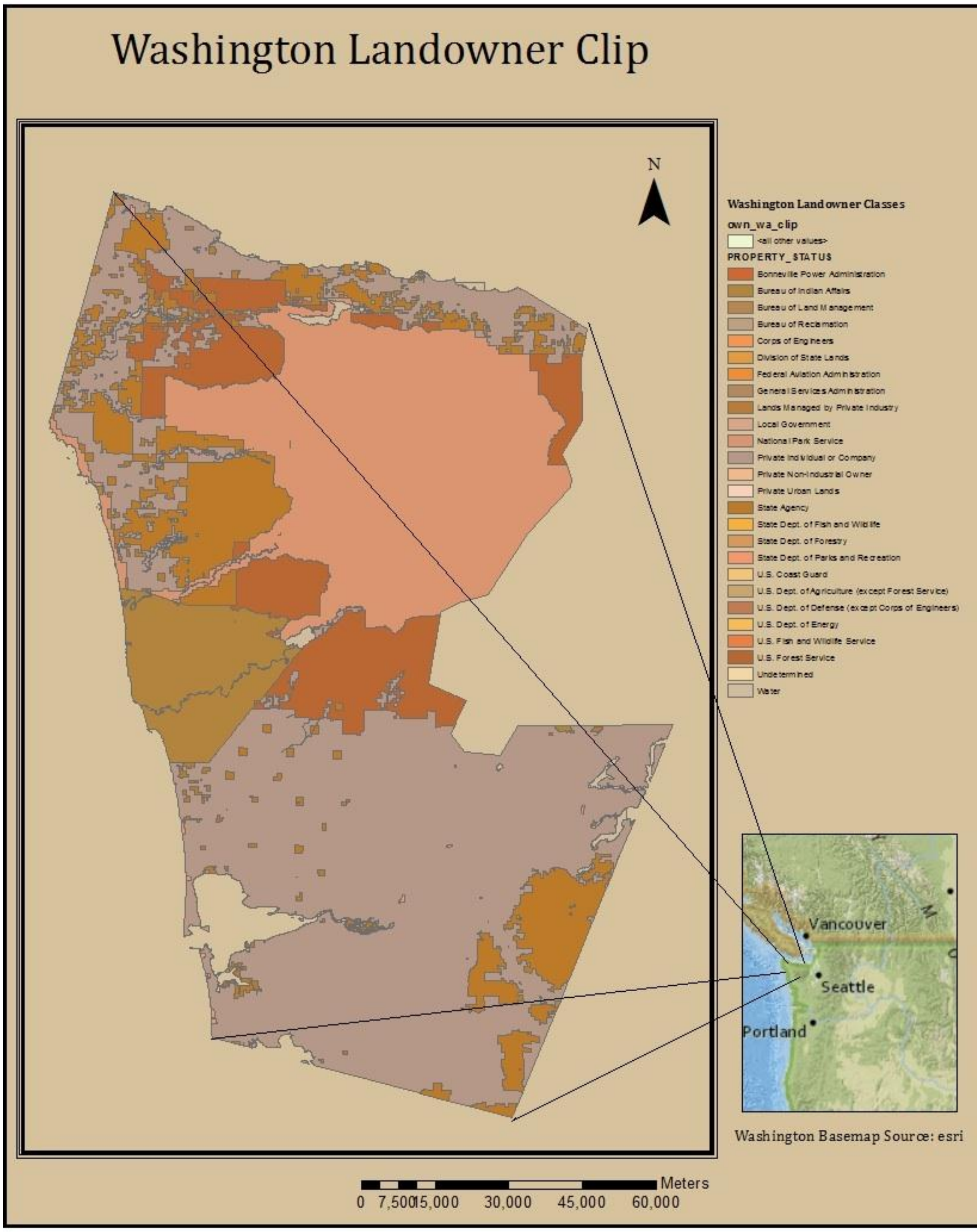


Figure 4.5. Washington study area, with BLM ownership classifications.

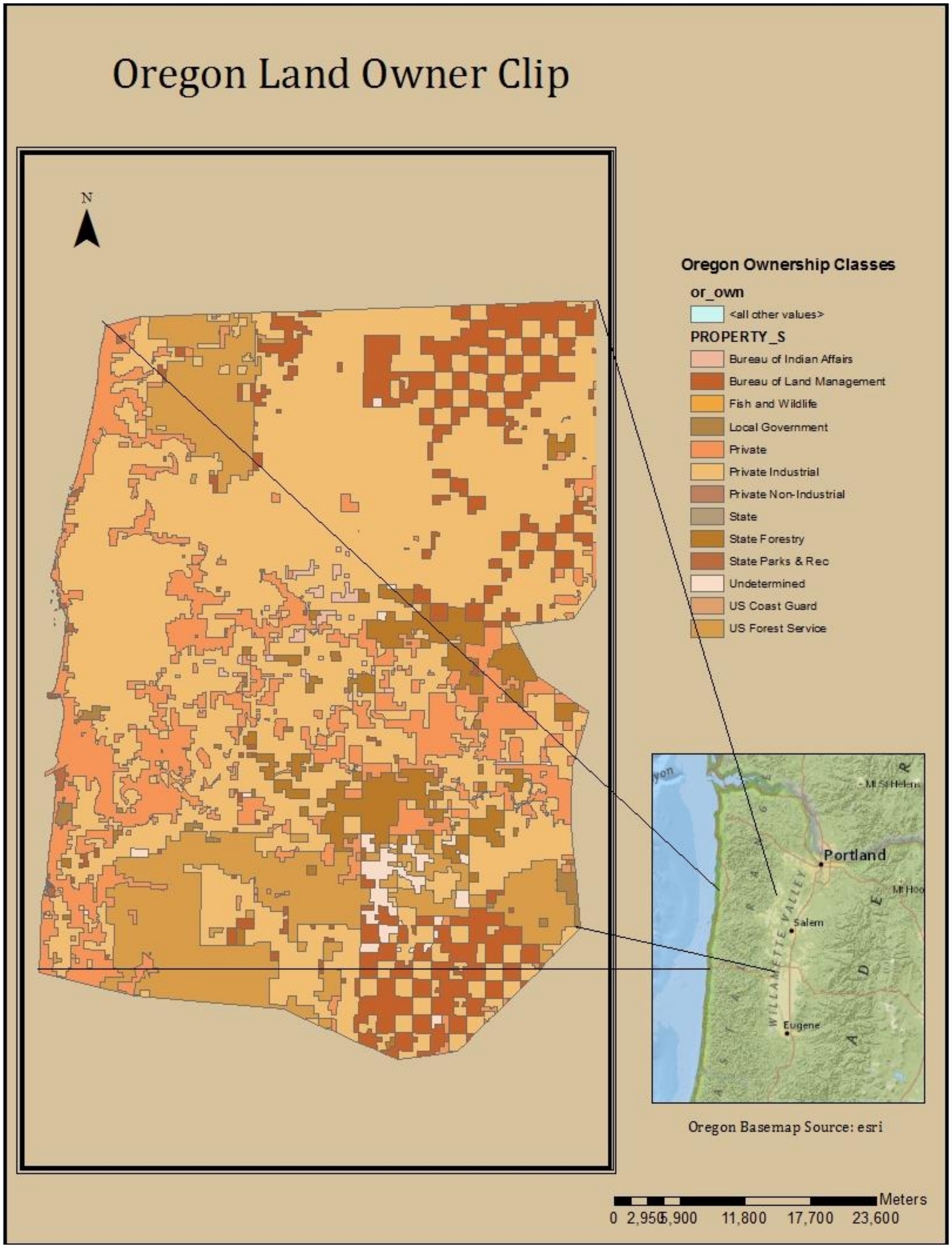


Figure 4.6. Oregon study area, with BLM ownership classifications.

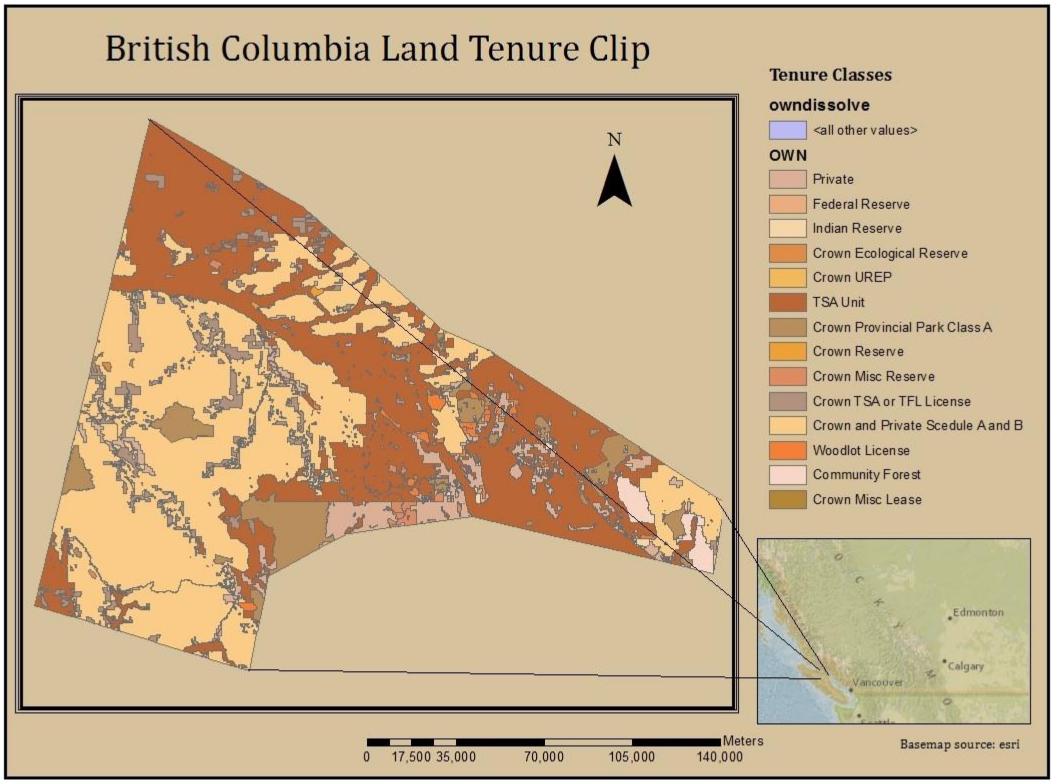


Figure 4.7. British Columbia study area, with MoF ownership classifications.

To extract the information needed to determine forest disturbance in 1984 and 1995 from the LARSE composite image, the image was imported into ArcMap and was clipped twice: once to match the area of interest for Washington and the second time to match the area of interest for Oregon. Two reclassifications were then performed. The first was to reclassify background, water, non-forest, and disturbances prior to 1984 as background, with a pixel value of 0, and the remaining area as forested, with a pixel value of 1. The second was to reclassify background, water, non-forest, and disturbances prior to 1995 as background and the rest of the scene as forest, again with pixel values of 0 and 1, respectively.

The disturbance images for Oregon and Washington were imported into ArcGIS 10 ArcMap and were clipped to match the areas of interest in each state. Again reclassifications were conducted, this time on the clipped 2008 images for Oregon and Washington. In the reclassification of the 2008 scene, pixels containing non-forested and areas of disturbed forest were assigned a value of 0 and forest area pixels were assigned a value of 1 and reflect the forest cover at that time. These newly created layers denote the land covered in forest and eliminate the data reflecting the diversity of the remaining land cover classes and background noise.

The multi-temporal image for forest disturbance for the years 1985, 1994, 2005, and 2008 in British Columbia was added to the owner/tenure feature class layer and clipped this image to correspond with my area of interest for BC. I then performed four reclassifications using the same procedures as above. This process resulted in four different layers representing forested areas for each year and ignoring all other land cover classes.

The owner layer for Oregon, Washington, and British Colombia and the reclassified forest layers were then used to calculate zonal statistics. The parameters of the function were set to determine the zonal statistics of forests grouped by landowner type. Zonal statistics determined the number of pixels classified as forest within each ownership type in each scene. In addition, zonal statistics determined the total area of forest canopy cover under each ownership variable for each date from the pixel counts, thus the differences between the areas measured from one date to the next demonstrate loss or gain of forest area over time for each of the owner/tenure classes. Zonal statistics were also calculated on the images which indicated forest land use versus non-forest land uses (i.e. the masked images) and the ownership layers to determine the total number of pixels classified as forest areas. The total number of forest land use pixels indicates the total forest landbase for each owner within the Area of Interest. These figures were then used to calculate canopy cover as a percentage of the total forest landbase within the study area for each owner class.

Summary

This mixed-methods study uses three approaches to meet the research objectives. The methods together comprise qualitative and quantitative approaches. The first method utilized is observations of meetings and workshops for the purpose of discovering topics and themes important in contemporary forest management, as well as to better understand stakeholder relationships and institutional dynamics. The second method is the content analysis of semi-structured interviews with forestry professionals in the PNW and BC. These interviews will reveal more in-depth information regarding institutional dynamics, and will, further provide insight into managers' perspectives on and practices in forest and ecosystem management as well as their understanding of the concept of resilience as it applies to forest systems and to society. The final method is an analysis of forest-cover change in the years prior to and following implementation of new policies in the PNW and BC. This analysis was conducted using a combination of ERDAS Imagine, ArcGIS 10.0.

The chapter that follows is the first of three chapters on the analyses that resulted. Chapter Five comprises the analysis of the conference observations. The chapter is divided into two sections. The first section reveals the common topics found in the PNW conferences, while the second section reveals the topics common to the BC conferences.

CHAPTER FIVE

ANALYSIS OF FOREST MANAGEMENT MEETINGS AND CONFERENCES

This chapter provides the results of an assessment of topics presented at conferences and meetings in the PNW and BC. The purpose of this assessment was to determine the common forest management topics across conferences within each region. This establishes a context within which the themes that are deemed important to forest management are revealed by their inclusion in conferences and meetings. In addition to the regional commonalities, some topics were discussed in all six conferences. In fact, three topics were common to all six conferences, and only one topic in each region was not important in the other regions. While there are topics that were discussed across all conferences, the perspectives presented on those topics were often different. Despite some of these differences, commonalities point to current trends in topics important in forest management. The first section of the chapter provides the analysis of the common themes from the PNW conferences and the second section describes the analysis of common themes from the BC conferences.

Commonalities in Pacific Northwest Meeting and Conferences

Two of the three conferences in the PNW were interdisciplinary, with multi-agency or stakeholder representation. Only the Forest Landowners Association was focused on a narrower audience and interests. However, there were four topics common to the three PNW gatherings. Ecosystem protection was one such topic. In the Forest Landowners Association meeting, two presenters discussed ecosystem protection, one in terms of harvesting and the other in terms of certification for sustainable practices. The presentations and discussions on ecosystem protection were simultaneously broader and more in depth in both the Mountain Climate Conference and the Dry Forest Management conference. Presenters in the Mountain Climate Change Conference addressed the topic of ecosystem protection under the framework of climate change predictions, risks, and uncertainties and with particular foci on climate change effects on water and precipitation, fire, and vegetation and system resilience. The framework for discussion at the Dry Forest Management conference was forest management in the drier regions regulated by the NWFP, with more specific foci on wildlife (especially endangered species) habitat, forest health, and wildfire risks and vulnerability.

A second common topic among the three conferences was the topic of management techniques and approaches. The Forest Landowners Association meeting addressed management approaches for varied forest system types, harvest standards for certification, silviculture and post-harvest site management, pre-commercial thinning, and non-timber harvests. The management topics discussed at the Mountain Climate Change Conference discussed adaptive management planning and implementation, the complexity of wildland fire management, and the collection of data by citizen scientists. The Dry Forests Management conference's primary focus was on management approaches and techniques. Topics ranged from defining scalar approaches to management, relationships between system components, adaptive management approaches, silvicultural treatments and the effects on wildlife, planning and managing for patchiness, wildlife management and stand management objectives, shifts in management and harvest approaches at specific sites, ecosystem management approaches, and management modeling.

The third topic common to all three conferences was stakeholder relationships. At the Forest Landowners Association meeting, presenters discussed relationships with state and federal government agencies, with Canadian forest companies and the government, with tribes, with NGOs, and with contractors and stakeholders. At the Mountain Climate Conference, stakeholder relationships were addressed in terms of scientist-manager relationships, citizen education, participation, and communication, media involvement, stakeholder knowledge, and NGO participation. Participants discussed stakeholder relationships at the Dry Forest Management conference in terms of cross-agency and cross-ownership collaborations and participation and in terms of multi-disciplinary and collaborative approaches to management.

The fourth common topic presented in the PNW was the financial component of forestry. Within the Forest Landowners Association meeting, this topic was more broadly addressed than during the Dry Forest Management conference. Participants in the Forest Landowners Association meeting discussed the financial implications of the US-Canada Softwood Lumber Agreement, the financial costs of habitat restorations (specifically fish barrier removals), and revenue potential from non-timber products. At the Mountain Climate Conference, there was some discussion of the economic barriers to adaptive management approaches as well as the financial burden of environmental disasters. The financial component of forestry was touched on in the Dry Forest Management conference, with one participant discussing state management goals for revenue and one presenter talking about incentives and resources for creative management.

Commonalities in British Columbia Conferences

The three conferences in BC were all multi-disciplinary and included multiple stakeholder participants and presentations. Three of the four common topics in the PNW meeting and conferences were common to the BC conferences: ecosystem protection, management techniques and approaches, and stakeholder relationships. The topic of financial implications in forest management was not found in all three conferences in BC. However, the BC conferences had one common topic not found in the PNW in the topic of First Nations rights and participation.

The topic of ecosystem protection was addressed to some degree in each of the three conferences. At the Bulkley Valley Interface conference, presenters talked about citizen knowledge increasing ecosystem protection, the implications of results-based management on ecosystem protection, conflicts between protection and multiple interests, habitat planning, protection of environmentally sensitive regions, and bottom-up initiatives for protection. Participants in the Human Dimensions of Natural Resource Management presented topics in ecosystem protection under the framework of the human dimensions of ecosystem protection and focused on human-species conflicts in protected areas, mandates for protection, regional protection strategies, stewardship volunteer efforts, and climate change adaptation in human and natural systems. The Integrating Opposing Land Issues conference presented topics in ecosystem protection within the framework of resource extraction and ecosystem protection. Speakers focused on mitigating ecosystem damages during the extraction process, restoration of natural ecosystems following extraction, protection of endangered species and their habitats, the implications of results-based forest management for ecosystem protection, and biodiversity conservation.

Management techniques and approaches were topics seen at the three BC conferences, as they were in the PNW. Participants in the Bulkley Valley Interface conference discussed adaptive management practices, management for multiple landscape values, making use of interactive maps in the planning process, an examination of private versus public land ownership in the management of natural resources, and forestry planning across the interface. The Integrating Opposing Land Issues conference focused on processes for restoring ecosystems following resource extraction, riparian restoration (including removing fish barriers), prescriptions for restoration, road construction and removal planning, planting and monitoring, and a bioregional approach to management. The topics presented at the Human Dimensions of Natural Resource Management touched on management techniques and approaches in forestry with discussions of ecosystem based management, collaborative management approaches, adaptive management techniques, multi-scale planning, incorporating climate into management decisions, treatments, practices and monitoring, and local level management approaches. There was, overall, less discussion about specific forestry techniques at the BC conferences than there was at the PNW conferences.

The topic of stakeholder relationships was common to all three BC conferences and it was a dominant theme in all three conferences. The Bulkley Valley Interface Conference included discussions on innovative public involvement, stakeholder collaboration and consultation, public input in the policy planning and development process and in resource planning, First Nations rights, relationships, and collaboration efforts, and the implications of results-based management for stakeholder involvement. Presenters at the Integrating Opposing Land Issues discussed stakeholder relationships between extractive industries and the public, multi-stakeholder involvement and input, and collaborative efforts in resource and ecosystem management. Stakeholder relationships were central to the Human Dimensions of Natural Resource Management conference. This conference presented discussions on shared knowledge, multiple ways of knowing, institutional trust and trust between stakeholders, stakeholder participation in the decision-making process, management for multiple stakeholder values, and public involvement in the planning and management process.

First Nations rights and participation was a topic prominent in all three BC conferences. In each conference, there were presentations dedicated solely to this topic. The Bulkley Valley Interface conference included presentations on the legal rights of First Nations, land and title rights, and conflicts over Crown title versus First Nations constitutional rights. At the Integrating Opposing Lands conference, participants discussed First Nations consultation and inclusion, and First Nations involvement in collaborative management efforts. Presenters in the Human Dimensions of Natural Resource Management conference provided information on Crown-First Nations shared governance and decision-making efforts, the role of First Nations in collaborative management approaches, Crown and First Nations Agreements, and First Nations management practices and priorities and ecosystem values.

Summary

The analysis of meetings and conferences revealed four topics common within each region, and three of those topics were common across all conferences in both the PNW and BC. Topics common to both the PNW and BC conferences were: ecosystem protection, management techniques and approaches, and stakeholder relationships. All PNW conferences also included discussion of the financial component of forestry, while in BC, the topic of First Nations rights was common amongst all three conferences. The upcoming chapter will present the analysis of the semi-structured interviews.

CHAPTER SIX

ANALYSIS OF SEMI-STRUCTURED INTERVIEWS

This chapter reports the results of interview content analysis. Each interviewee was assigned a number and identification is limited to the number, which signifies only the number assigned to their digital voice recordings. There were a total of 12 respondents in the PNW. Eleven interviews were face to face and one respondent from a state agency in the PNW participated via telephone. One set of responses was received via email from an individual who had been asked to participate. This person no longer resided in the region. The emailed responses, unfortunately did not sufficiently answer the questions, and thus were not included in the analysis. Twelve respondents also participated from the British Columbia. The responses for individual interview questions are presented in order and in their own sections. Additionally, responses are separated according to region. Tables and charts provide a visualization of results. Appendix B contains tables showing all responses to all of the questions.

Responses to Question One

The first question asked of respondents serves to identify landownership structure for the agency or company. In the PNW (Table 6.1), the structure of the federal and state agencies result in one ownership type per respondent, as public forestlands are both held and managed by the federal agency. Participant #6 had originally been selected as a retired federal agency manager; however, this person also owned small woodlot size non-industrial private forests. As such, he provided responses under both categories for all questions that were about current and past management experiences and perspectives; however, for questions 9, 11, 12, and 13, the participant's responses were categorized under private non-industrial, as these questions were not specific to ownership, and this individual's most recent experience was as a private non-industrial landowner. Respondent #2 was not an active forest manager, but, rather, worked for an organization that represented private industrial landowners and was therefore aware of the general forest management practices in the region. This person was also responsible for disseminating information and educating private industrial landowners who were members of the organization for which they worked. The decision was made to include this individual's perspective in the interview process because of their

Table 6.1. Dispersion of PNW employer forest ownership among respondents.

Question 1: Are the forests you manage under private industrial, non-industrial, state, or federal ownership?					
Interviewee	Private Industrial	Private Non-Industrial	State	Federal	Tribal
1	1				
2	1				
3	1				
4			1		
6		1		1	
7				1	
8					1
9				1	
10				1	
11				1	
12				1	
13			1		
Total	**3**	**1**	**2**	**6**	**1**

breadth of knowledge regarding private industrial forest management practices and because of their role in the management of private industrial forests. As stated in Chapter IV, the participants were predominantly federal forest managers (7). The balance was comprised of private industrial (3), state (2), and private non-industrial and tribal (1 each) representatives.

The ownership and organizational structure in British Columbia (Table 6.2) resulted in responses under multiple categories from participants from the Ministry of Forests and the Ministry of Environment. Two of the respondents (20 and 23) worked for the Ministry of Forests, yet worked very closely, or predominantly, with First Nations. As such, these two individuals, though they worked for the province and indicated multiple tenure designations in question #1, responded to interview questions from the perspective of First Nations forestlands. In addition to the two Ministry of Forests respondents providing a First Nations' perspective, there were six additional respondents who worked for the Ministry of Forests, and one for the Ministry of Environment. The majority of participants were from the public sector. Two respondents (21 and 24) worked for private industrial companies that held tenure licenses on public lands. One participant (16) worked for a private industrial company that owned private forestlands, which make up a nominal percentage of the land base in British Columbia.

Table 6.2. Dispersion of BC employer forest ownership/tenure among respondents.

Question 1: What type of license does the owner of the forests you manage hold? ?						
Interviewee	TSA	TFL	Community	Tribal	Woodlot	Private
PI (Pvt)						
16						1
PI (Pub)						
21	1	1				
24	1	1				
MoF						
5	1	1	1	1	1	
15	1	1	1	1	1	
17	1	1	1	1	1	
18	1	1		1		
19	1	1	1	1	1	
22	1	1	1	1	1	
MoE						
14	1	1	1	1	1	
Tribal						
20	1	1	1	1	1	
23	1	1		1	1	
Total	**11**	**11**	**7**	**9**	**8**	**1**

Responses to Questions Two and Three

The purpose of the second question was to discover the amount of land for which the participant was responsible, whether for direct management or for oversight. Twelve of the 13 respondents from the PNW provided their answers in acres (these were converted to hectares for consistency across responses in the PNW and BC and because the hectare is a metric unit of measurement). Forestlands in the PNW ranged from a 66-hectare woodlot to 890,308 hectares of federal forestlands associated with one respondent. The interviewees from BC provided responses ranging from 150,000 hectares from a private industrial respondent to 15,000,000 hectares from a Ministry of Forests respondent. One individual (12) from the PNW did not know specifically how many hectares were under the district's oversight. In BC, three respondents (18, 19, and 22) belonging to the Ministry of Forests stated that they did not know the number of hectares for which their offices were responsible. The respondent from the Ministry of Environment stated that there was no applicable number because the Ministry of Environment does not have direct oversight of specific forestlands.

While the second question provided information on how much forestland was managed or overseen by each respondent, the third question was to determine the composition of these managed forests. In the PNW, the predominant species identified was Douglas fir while in BC respondents indicated that the majority of forests are hemlock and cedar. Five respondents in the PNW indicated that their managed forests were even-aged, single species composition, while no BC participants stated that their forests were even-aged, single species. Mixed conifer/mixed-age composition was the least often cited in the PNW, but the second *most* cited in BC (excluding the non-specific "other" category).

Responses to Question Four

Question four was to determine which laws, policies, and regulations affect forest management, and the ways in which they do. All participants (N=12 PNW, N=12 BC) responded to both components of this question. In Question 4a (Figure 6.1), the Endangered Species Act was the only law named by participants from all categories in the PNW. No policy in BC (Figure 6.2) affected participants from all categories, though FRPA affected four of the five owner/tenure categories; only private industrial on private lands were unaffected. Federal managers listed more laws, policies and regulations than any other owner category, as did the Ministry of Forests managers. However, not all respondents provided the same set of laws, policies and regulations in their responses. Three of the policies and regulations were named by only one participant in the PNW and seven were named by one participant in BC. The respondents from the private industrial and the tribal categories in the PNW and private industrial on private lands in BC listed the fewest number of policies affecting forest management.

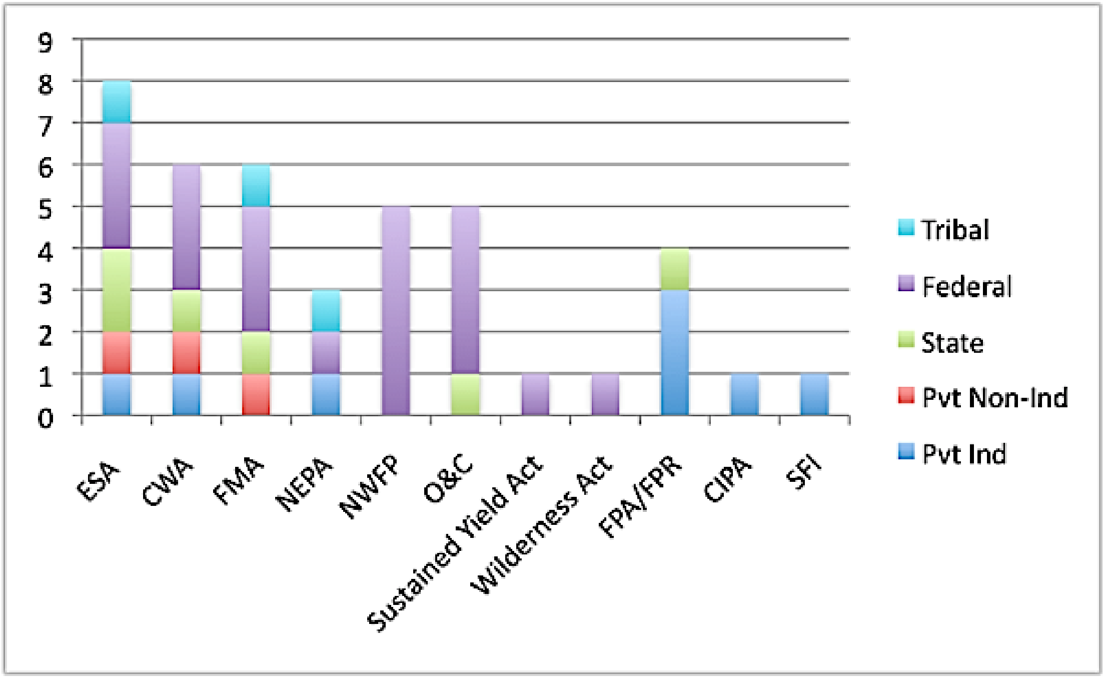


Figure 6.1. PNW policies and regulations.

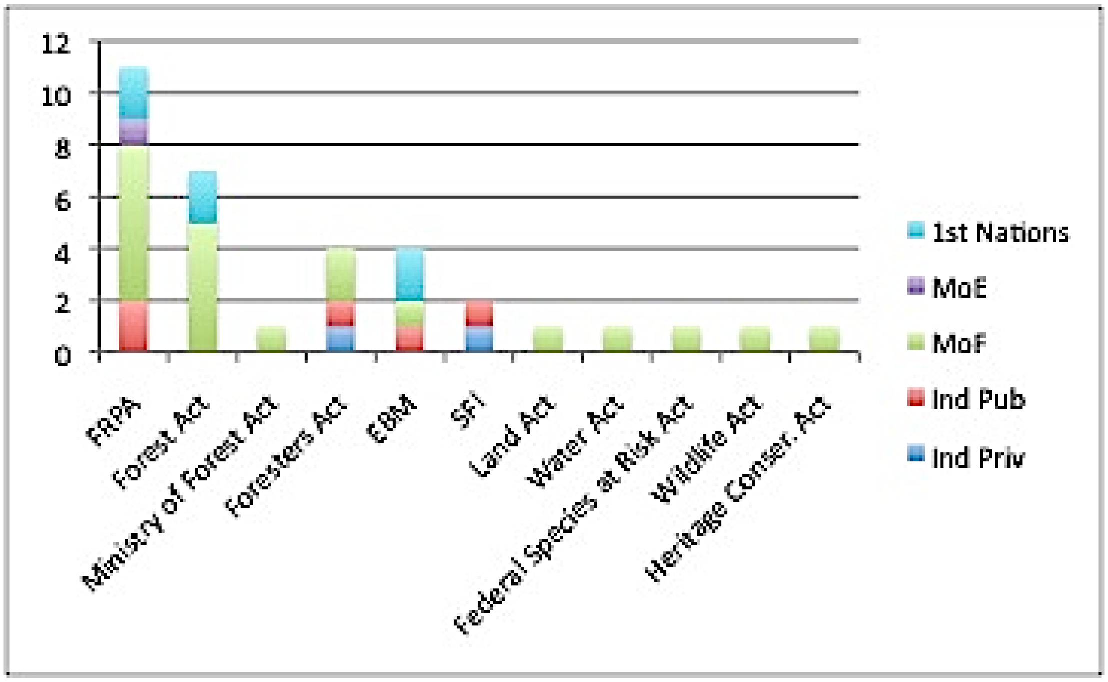


Figure 6.2. BC policies and regulations.

Reponses to how policies and regulations affect forest management were grouped into three categories of impact: Management Oversight, Management Constraint, and Management Approach (Figures 6.3 and 6.4). Responses were categorized as Management Oversight effects when participants indicated that certain policies provided a means for oversight of the management practices at either a local, regional, state, or national scale in the U.S. or a local, regional, or provincial scale in Canada. In addition, Canada had one other response in this category. The Foresters Act provides oversight of the professionalism of the individual forester. Management Constraint responses were those that indicated that policies and regulations were perceived as hindering some component of forest management, while Management Approach responses were those that indicated that policies and regulations compel some type of management action or behavior from forest managers.

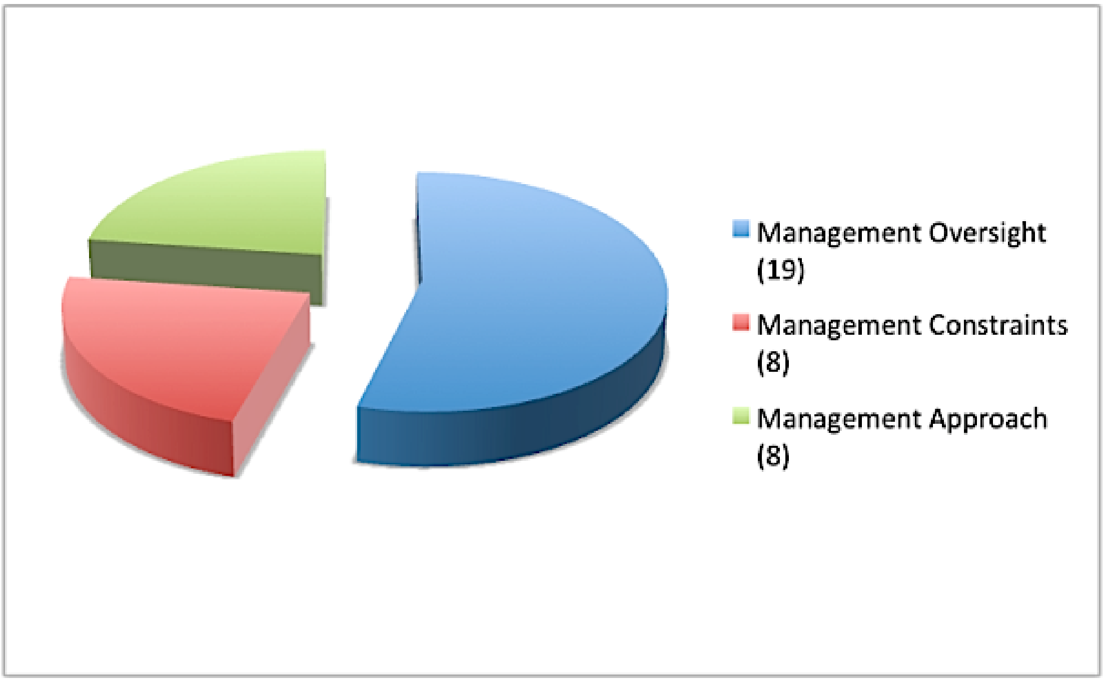


Figure 6.3. PNW effects of policy implementation.

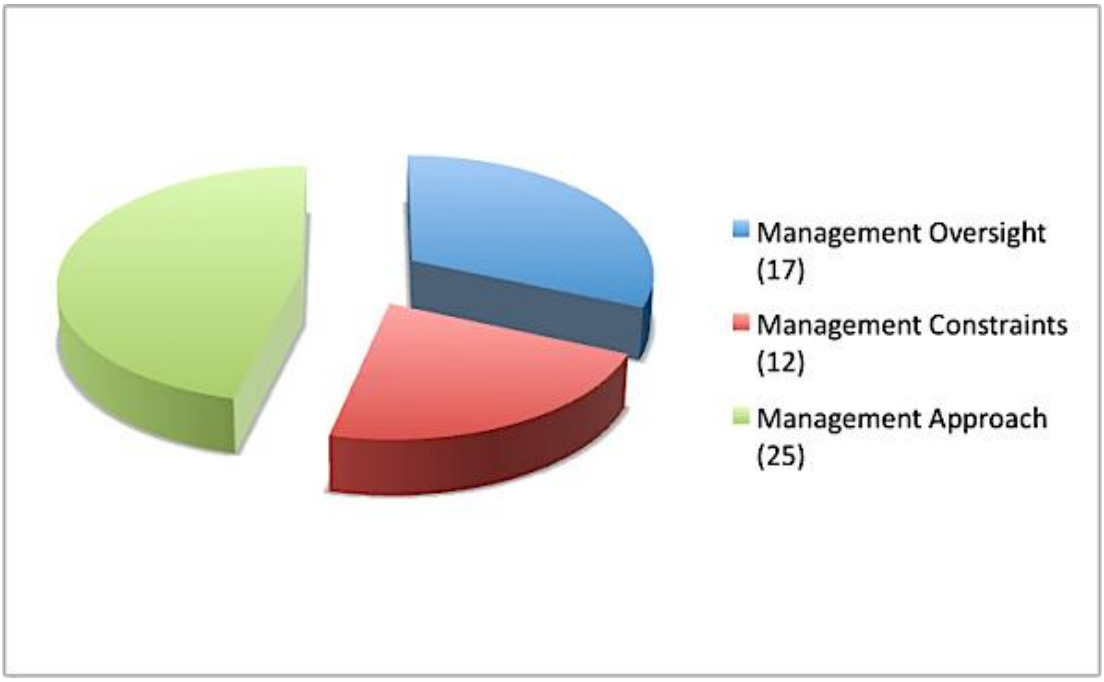


Figure 6.4. BC effects of policy implementation.

Pacific Northwest Question Four Results

In the PNW, the majority of the respondents indicated that the biggest effect of the implementation of policies was to provide oversight for forest management practices (Figure 6.5). For individuals from the Bureau of Land Management, the issue of oversight was an important one. With the implementation of the federally mandated NWFP, four of the six federal agency respondents stated it has become increasingly challenging for the BLM to concurrently fulfill the mandate to raise revenue as the agency is required to do by the Oregon & California Lands Act of 1937. Non-federal forest managers noted that oversight of forest practices on non-federal lands is regulated by the state, and, as one respondent indicated, there are conflicting opinions regarding the stringency of state regulations, with some thinking the regulations too stringent and others feeling they are not stringent enough. Tribal lands, it seems, only adhere to certain federal policies, such as the National Environmental Protection Act (NEPA), but are otherwise regulated as private lands, with voluntary compliance to some state regulations.

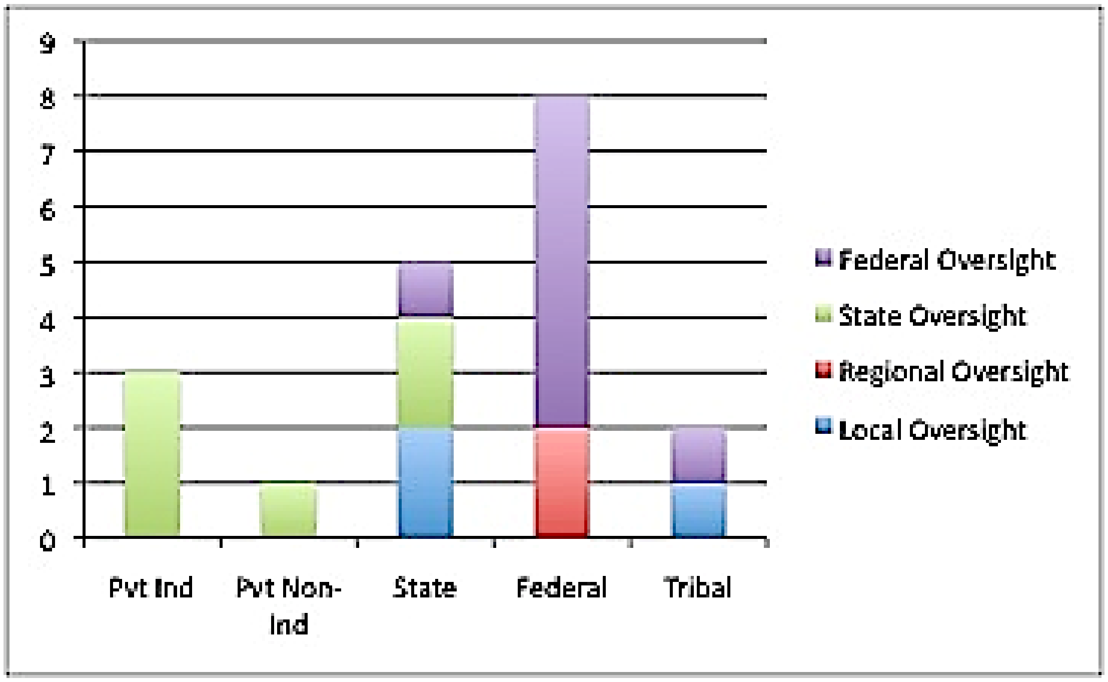


Figure 6.5. PNW Breakdown of “Oversight” responses by ownership category.

In addition to management oversight, the results of policies were equally viewed as constraining management practices or to compel particular management actions or behaviors (Figures 6.6 and 6.7). Constraints were not stated as a direct result of policy, but rather as an indirect result through the use of policy to file lawsuits or through restrictions on behaviors due to the need to protect the rights of Native Americans. Two federal agency respondents and one private industrial respondent saw the effects of lawsuits on forest management as an important outcome of policy. One respondent from a private industrial company and one from a state agency, as well as the representative of the tribal perspective, listed protection of tribal rights under policy as a constraint to management actions.

Forest managers from all landowner designations indicated that regulations also compel some sort of action on the part of forest managers. By far the predominant response from managers on the manner in which regulations compel action is through the implementation of environmental protection requirements. One of the individuals from a private industrial company revealed that industry had been pro-active in initiating changes in regulation on environmental protection, as the thought was that, through industry initiation and participation in the process, regulations were more likely to consider industry needs in conjunction with environmental needs. BLM managers again indicated conflict with mandates in the Oregon & California Act of 1939 (O & C Act) in that requirements for environmental protection in the NWFP negate the ability to meet the requirements for Sustained Yield in the O & C Act.

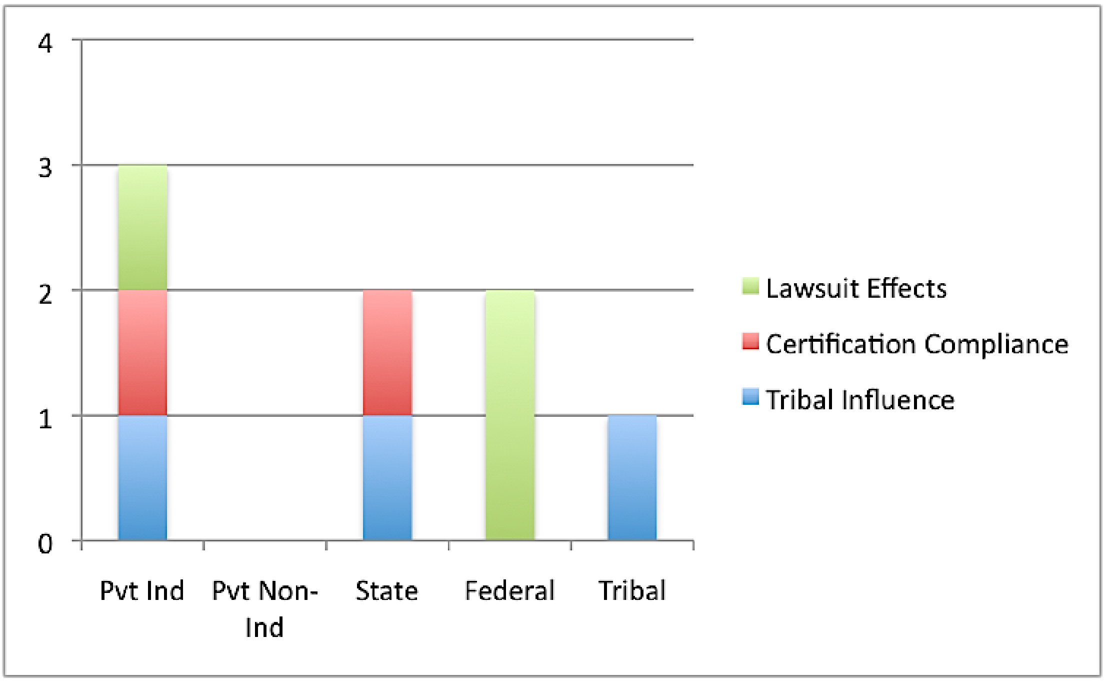


Figure 6.6. PNW Breakdown of “Constraint” responses by ownership category.

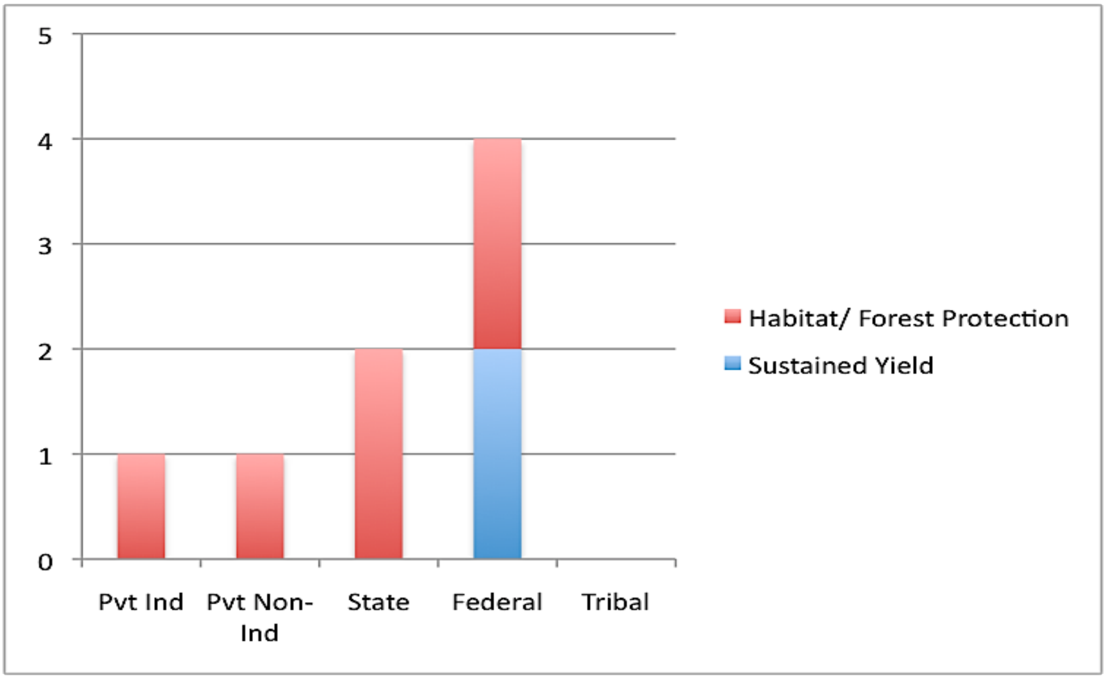


Figure 6.7. PNW Breakdown of “Approach” responses by ownership category.

British Columbia Question Four Results

In British Columbia 11 participants indicated that management oversight was an effect of policy. Oversight at the provincial level was the most often cited level of oversight (Figure 6.8). The Ministry of Environment representative and the Private Industrial on private lands representative are the only two individuals that did not provide provincial oversight as a response. A total of four participants indicated that policy also provided regional oversight, and these individuals worked in regions that are guided by Ecosystem Based Management, a regional agreement between several First Nations groups, environmental NGOs, private industry, and the provincial government. Three individuals also indicated that policy could have effects at the local level. Three individuals referred to the Foresters Act, which provides oversight for professional behavior and responsibilities.

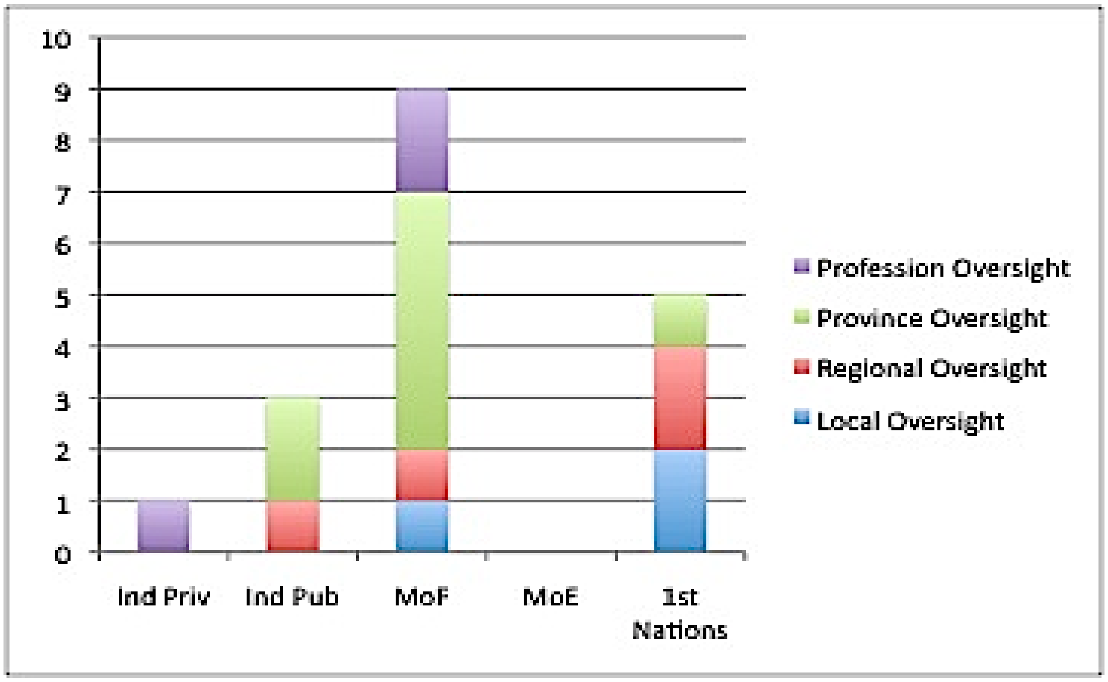


Figure 6.8. BC Breakdown of “Oversight” responses by ownership category.

Interestingly, management constraints were the least often cited results of the manner in which policy effects forest management practices (Figure 6.9). Unlike the respondents from the PNW, the use of policy to support legal action was not listed as an outcome of policy. Instead, participants from BC discussed the effects of policy on the structure of forest management. This was particularly true for those working for the Ministry of Forests, as the participants noted that the changes in policy resulted in changes to the responsibilities of the Ministry within the institutional structure of forest management. Policy implementation provided additional effects in the form of constraints imposed by sustainable forestry certifications and restrictions due to the protection of First Nations rights.

First Nations' rights play a significant role in forestry in BC. One respondent indicated that First Nations have a significant political presence in forest management, negotiating the terms of land management and serving as governing partners in the process. First Nations consultation is therefore required prior to implementing land management decisions that potentially impact First Nations. Other than First Nations' rights, the other response for constraints focused on the constraints imposed on management practices through voluntary compliance with sustainable forestry certification. The private forest manager indicated that the company's primary "regulatory" structure, in terms of management practices on the ground, is the Sustainable Forests Initiative (SFI). One other private industrial manager indicated that company compliance with a certification program constrained management practices.

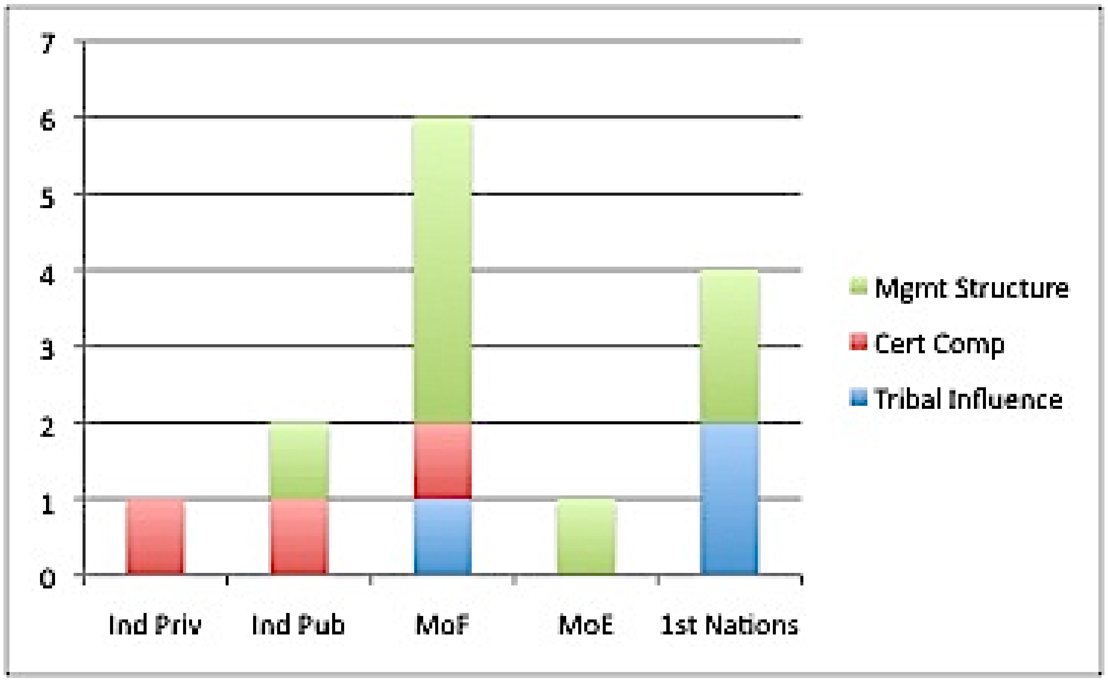


Figure 6.9. BC Breakdown of "Constraint" responses by ownership category.

The majority of responses to question 4b fell within the management approach code (Figure 6.10). Respondents most frequently stated that policy implemented specific management guidelines for practices, such as desired outcomes or protocols for dealing with multiple stakeholders. All six interviewees from the Ministry of Forests, as well as one interviewee from each of the other groups, indicated that policy guided management approach through providing structure for management strategy. In addition, participants indicated that policy also outlined specific guidelines for forest production—regulating tenure structures, stumpage, and allowable cuts. Finally, policy was seen to compel specific behaviors and actions towards the protection of forests or habitats.

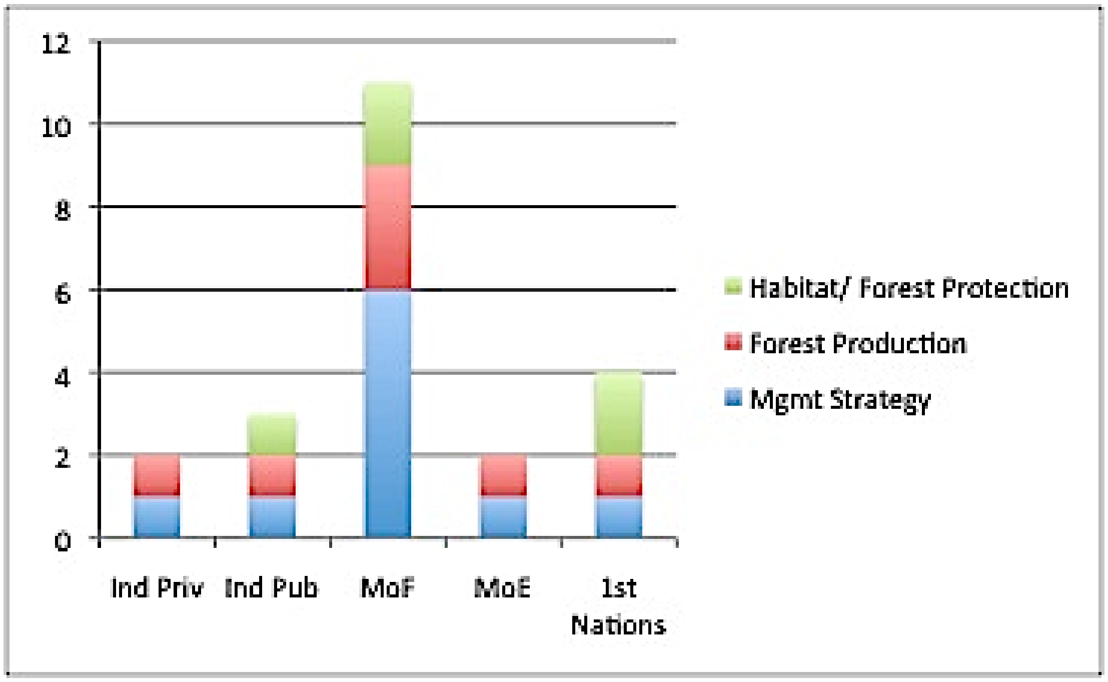


Figure 6.10. BC Breakdown of “Approach” responses by ownership category.

Responses to Question Five

Many of the interviewees I spoke with had been involved in forest management for a number of years, and question five aimed to get at policy changes over their careers as well as how shifts in policy subsequently altered management practices. The first part of question five was coded into one of three categories. Policy changes were coded as more stringent, less stringent, or no change. The response coding for the second part of question five was similar to question four, though focused on individual behaviors versus general policy intentions. Responses to the second part of question five were coded under either constraints, if policy changes resulted in restricting the management practices of the interviewee, or actions, if the policy changes resulted changing the management actions of the interviewee.

Pacific Northwest Question Five Results

The overwhelming majority of participants indicated that the changes in policy have resulted in more stringent guidelines. Two participants (6, as private non-industrial landowner, and 13) did not respond to this question. All but one other participant (8) stated that policies were becoming more stringent during the time that they were involved in forest management. Participant 8, speaking from the tribal perspective, was the only interviewee who felt policies had become less stringent over time. Participant 1, a private industrial manager, stated that in Oregon, there had been no real change in policy effects, as Oregon had implemented its own set of regulations prior to the implementation of the NWFP. However, the individual went on to state that it was a different situation in Washington, where the effects of policy changes resulted in more stringent guidelines. Speaking from the perspective of a federal employee, participant 6 said policy changes became more stringent in terms of government participation, and the power given some agencies, but less stringent as policies moved from prescribing actions to designating desired outcomes.

Policy changes were seen to more often constrain management behaviors for the interviewees than they were seen to result in specific actions. A total of fifteen responses fell under the “Actions” code versus 21 under the “Constraints” code. Within the “Actions” code, respondents most frequently cited an increase in management practices that fulfilled requirements for protection, followed by increased collaboration between other agencies and with stakeholders (Figure 6.11). Within the “Constraints” code, respondents most often indicated that policy changes led to increases in regulatory requirements, followed closely by comments on the reduction of the land base from which timber could be extracted (Figure 6.12). The tribal representative stated that this question did not really apply to tribal lands, as the regulations affecting their lands had not changed. The individual went on, however, to indicate that tribes had acquired more land and

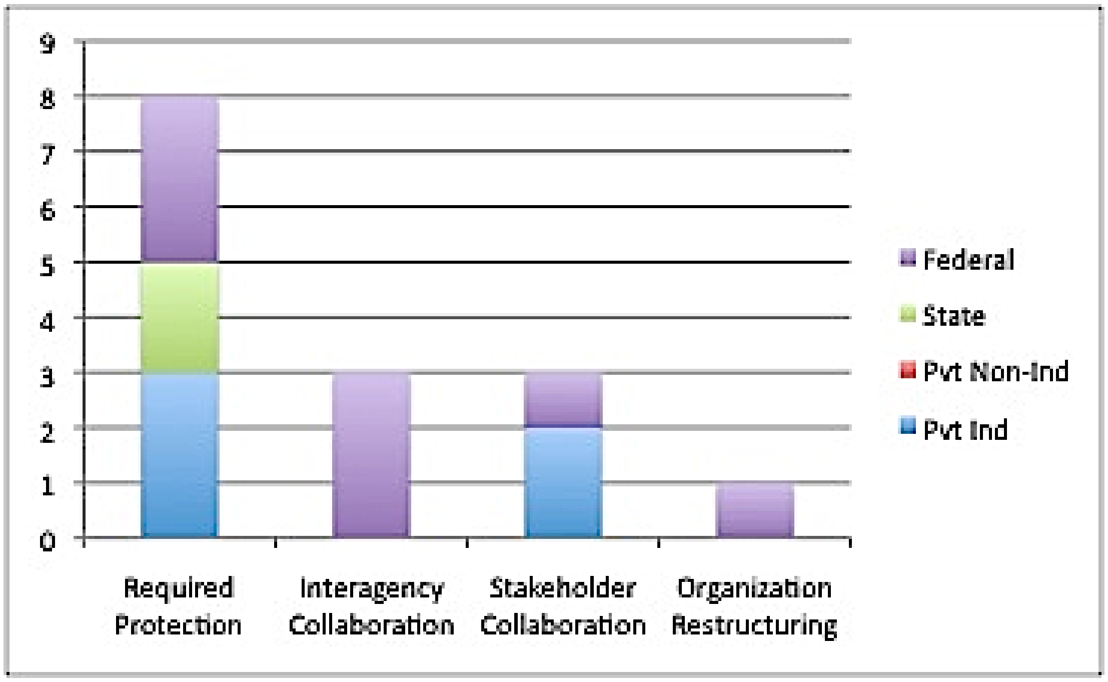


Figure 6.11. PNW Breakdown of “Actions” responses by ownership category.

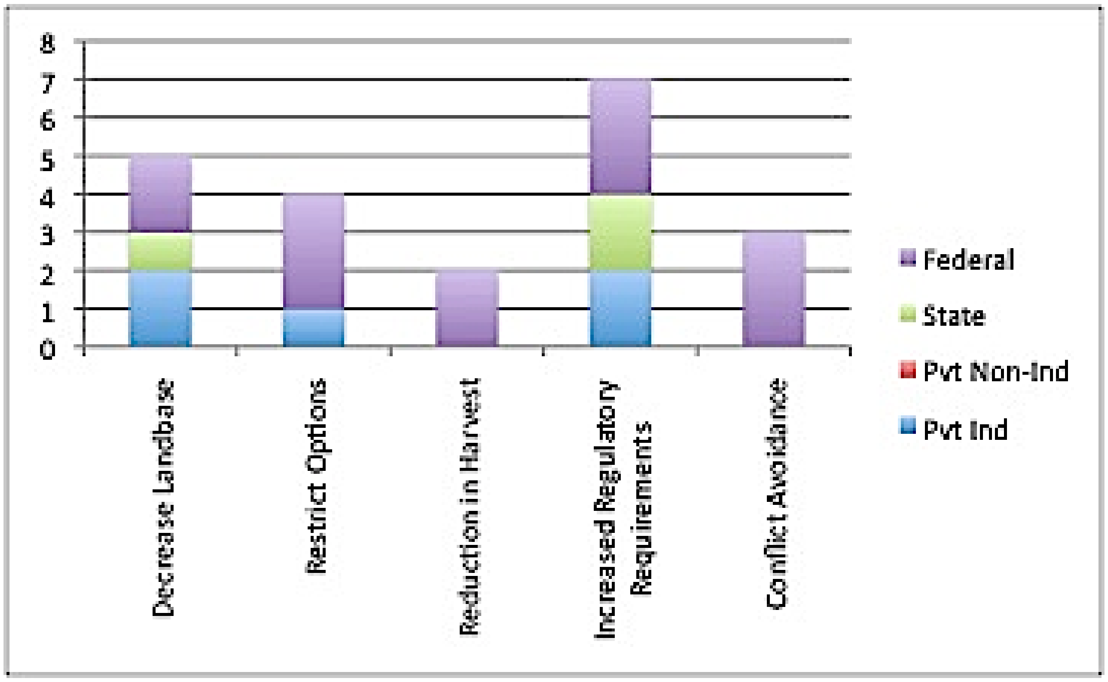


Figure 6.12. PNW Breakdown of “Constraints” responses by ownership category.

have thus actually increased the land base from which they could extract timber, engage in conservation and stewardship practices, or engage in traditional cultural practices.

British Columbia Question Five Results

British Columbia has seen two primary changes in policy affecting forest management since the mid 1990s, and, as such, many respondents provided more than one answer to this question. Participants 24 (from private industry on public lands) and 22 (from the Ministry of Forests) stated that the goals of the policies hadn't changed, though the requirements for how to accomplish those goals had. Participant 24 indicated that with the FPC, the regulatory requirements were more stringent than they had been prior to the FPC, but that with the passing of FRPA, regulatory requirements became less stringent than with the FPC. Participant 22 indicated that policy has become less stringent in regulatory requirements with the implementation of FRPA. Three other participants revealed that the FPC resulted in more stringent requirements, and then with FRPA, requirements were less stringent. Five respondents (one from private industrial on private lands, three from the Ministry of Forests, and one tribal representative) indicated that policies and regulation had become more stringent during the time they had been forest managers. One Ministry of Forests employee and the Ministry of Environment employee provided comments indicating their beliefs that policy requirements had become less stringent.

BC managers indicated two additional effects of forest policy changes that were not mentioned in the PNW, but that had an effect on forest management practices. The first of these was that with the implementation of FPC, various components of the Forest Act were separated into two different policies instead of one, changing the institutional dynamics of forest management. Four participants (5, 14, 15, 19) made comments to this effect. Additionally, participant 5 from the Ministry of Forests stated that changes in policy resulted in changes in the land classification system, providing ecosystem classifications that were meant to help guide management decisions.

More respondents indicated that policy changes resulted in a change to their own management actions than restricted management practices. A total of 30 responses fell under the “Actions” code, while 24 responses were coded as “Constraints”. Within the Actions code (Figure 6.13), nine individuals commented on changes in policy leading to an increase strategic management planning from managers to meet the requirements of policy, while eight stated that changes in policy led to increases in practices to protect habitat. Stakeholder collaboration and changes to responsibilities based on organizational restructuring were also seen as individual management actions that followed policy change. One participant from the Ministry of Forests stated that the changes in policy resulted in increased collaboration between the Ministry of Forests and other government agencies, such as the Ministry of Environment.

Of the 24 responses within the Constraints code, there were two predominant perceptions about the effects of policy changes on changes to

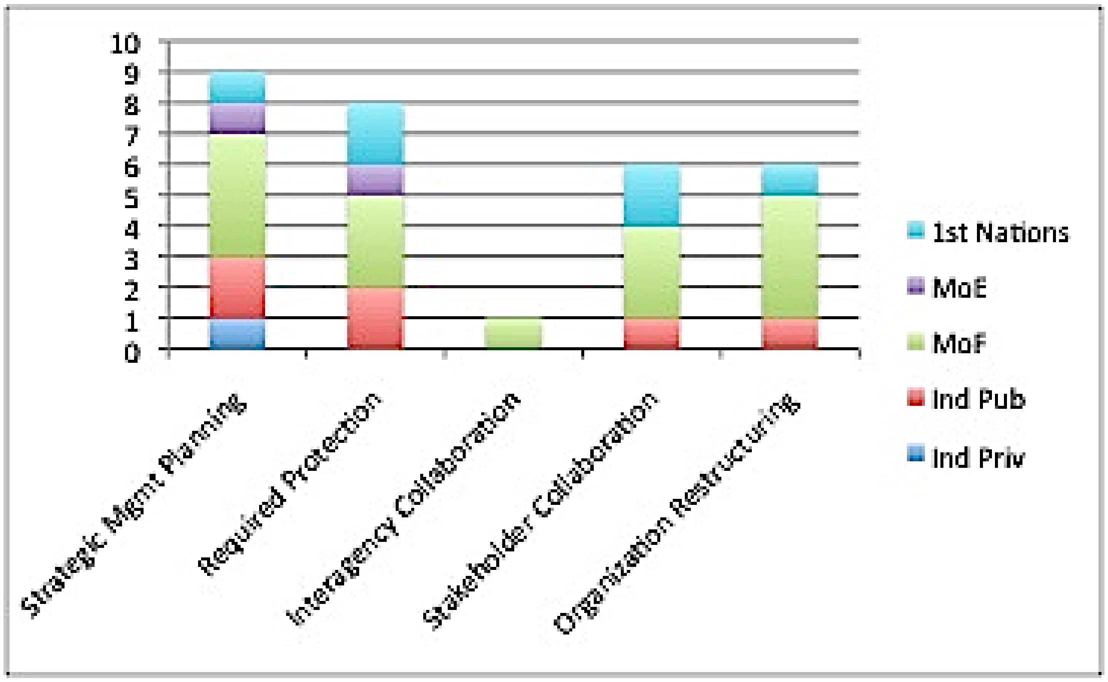


Figure 6.13. BC Breakdown of “Actions” responses by ownership category.

management practices (Figure 6.14). The first of these was a restriction in the options for management. Increased regulatory requirements went hand-in-hand with the restriction of options. Indeed, the restriction of options was seen as a direct result of the increased regulatory requirements in nearly half of the comments. More specifically, four individuals stipulated that management restrictions were the result of the FPC because the regulations under this policy required management prescriptions to be followed without room for creativity or flexibility. FRPA was seen to loosen those restrictions. A participant from private industry on public lands indicated that the changes in policy led to a reduction in harvest, as did a participant from the Ministry of Forests. Ministry of Forests participants also indicated that policy changes have led to a decrease in social and community forestry and a reduction in the landbase available for harvest. One of the tribal representatives also noted this reduction in the landbase available for harvest, due to an increase in protected lands.

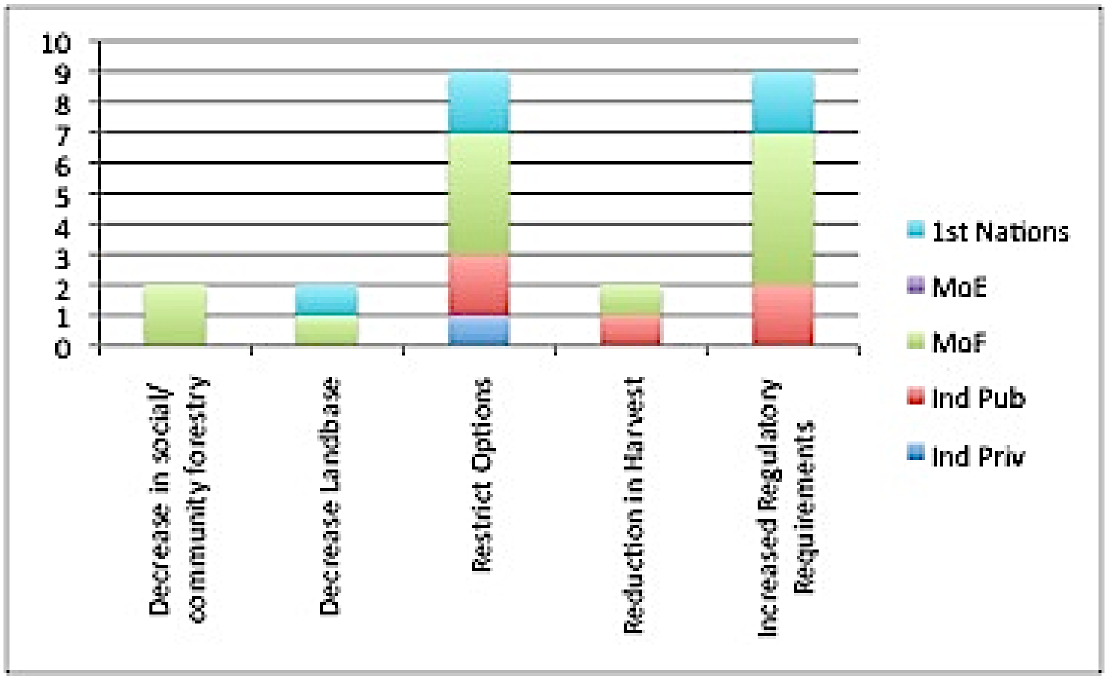


Figure 6.14. BC Breakdown of “Constraints” responses by ownership category.

Responses to Question Six

In the sixth question, I wanted to discover what role the particular policies of interest (NWFP and FPC/FRPA) played in the participant's forest management practices. Primarily, I wanted to clarify whether the policies of interest had a direct, indirect, or no role in the management practices of the interviewee. While it would seem that the responses to this question would be obvious, as each of the policies were implemented to regulate particular segments of forest landowners, there were a few unexpected responses. Primarily, the unexpected responses suggested that though the policy of interest did not have a direct bearing on forest management practices for the participant's company or agency, that company or agency chose to voluntarily comply with the goals and desired outcomes of the policy.

Pacific Northwest Question Six Results

The only participants directly affected by the NWFP were the employees working in a federal agency. These individuals indicated that the NWFP has direct repercussions for their forest management practices. All participants from federal agencies indicated that the NWFP is the primary guiding policy for forest management on federal forests. Even in forests managed by the BLM, where the O & C Act is perceived as the mandate for forest management for BLM lands, the NWFP has superseded the O&C Act as the primary guiding policy.

The three private industrial forest managers indicated that the NWFP played an indirect role in guiding their forest management practices. Two of the individuals stated that the NWFP resulted in an increase, or an initial increase, in market share for timber. The third individual stated that due to the passage of the NWFP, and to the events that led up to its passage, the state set aside private lands for spotted owl protection. Furthermore, this individual stated that many private forest owners avoid growing spotted owl habitat, as they would be forced to protect that forest if spotted owls moved in. The same participant indicated that some private industry forest owners are opting to comply voluntarily to some components of the NWFP by agreeing to provide “safe harbor”, increase forest rotations, and create more forest structure, as long as they can still manage and harvest responsibly. The private non-industrial forest owner stated that there might have been some indirect influences of the NWFP for private non-industrial forest owners; however, much of the changes in state regulations for private land originated from the results of science, rather than the influences of the NWFP.

According to one of the state forest managers, the NWFP indirectly influenced state management practices in that the NWFP and the events surrounding its development, led to an awareness of the need to protect habitat for endangered species. Moreover, the state’s management strategy for creating a moving mosaic of structure diversity was intended to complement the protection offered endangered species in the federal forests. The second state forest manager indicated that the state voluntarily supported the NWFP in key forests.

Similar to the response of two of the private industrial forest managers, the tribal forests representative stated that one of the indirect benefits for tribal timber harvests was that the price obtained for timber initially increased due to the reduction in harvests from federal forests. An additional indirect role of the NWFP for tribal forest managers was the increased protection of fish habitat through stream buffers required in the NWFP. This individual indicated that there were no effects on forest management for tribal managers, as the NWFP does not regulate tribal lands though those lands are considered federal treaty lands.

British Columbia Question Six Results

Given that British Columbia has gone through two policy changes during the period of interest for this study, I formatted the question a bit differently for British Columbia than for the Pacific Northwest. Question six for BC became a two-part question. In the first part, I opted to assess the role of the most current policy (FRPA) in forest management for each of the interviewees. The second component of the question then aimed to ascertain what the participants saw as the differences between the FPC and the FRPA.

In response to the first component of question six, all but three of the participants indicated that FRPA played a direct role in forest management. The 10 respondents who said that FRPA played a direct role nearly all indicated that FRPA provides the overall guidelines for forest management and provides for the enforcement of results and strategies outlined in the regulations. The individual from the Ministry of Environment stated that another effect of FRPA was to remove the Ministry of Environment from a direct role in forest management to an advisement only role. One Ministry of Forests and one First Nations representative indicated that though FRPA provides the overall guidelines for forest management in the province, for the two individuals in particular, the regional Ecosystem Based Management agreement trumps FRPA as a guiding document. Ecosystem Based Management provides regulations and strategies that are in addition to those provided in FRPA. The second First Nations and another Ministry of Forests participant stated that FRPA had an indirect role in forest management, as the implementation of Ecosystem Based Management was the primary guiding document used in their districts. Finally, the participant from Private Industry on private lands stated that though the company does not have to follow FRPA, they consider what occurs on Crown lands when making management decisions, but can be more flexible and creative.

In drawing comparisons between FPC and FRPA, by far the most often cited difference stated (by 12 of 13 participants) was that FPC was prescriptive, while FRPA was results-based. FPC provided specific prescriptions for management in various circumstances that were intended to lead to specific results. Guidebooks were created that contained these prescriptions. Interviewee number 24, from Private Industry on public lands, indicated that these prescriptions would have been well received had they had some flexibility built into them. FRPA allows, according to four of the participants, more flexibility in management strategies. FRPA provides the end goals, or the results, but depends upon the “professional reliability” of the individual forester to get there. Similar to the idea of prescriptions versus results-based is the idea of standardized procedures versus streamlined process. Three individuals stated that the administrative process in the FPC was standardized and cumbersome, while the process is streamlined under FRPA.

Five participants (two from Private Industry on public lands and three from the Ministry of Forests) noted that the role of the Ministry of Forests changed with the change of the policy. Under FPC, the Ministry of Forests had to approve management plans prior to action occurring on the land and was thus able to immediately enforce the requirements of the FPC. With FRPA, enforcement only occurs if the end goals are not achieved, thereby delaying enforcements until after the errors have occurred. Participant #14 indicated that where multiple interests drove the FPC, FRPA is industry-driven. Six individuals commented that on some level there was no difference between FPC and FRPA. The participant from Private Industry on private lands noted that there was no difference between the two policies for forest management on private lands. The remaining five individuals all stated that the goals and objectives in the two policies are the same; it's the means by which to meet the goals and objectives that has changed.

Responses to Question Seven

The seventh question sought the interviewees' perspectives on company and agency goals for forest management and the techniques used to meet these goals. In the PNW, there were six primary goals named by participants: 1) make money, 2) maintain working forests, 3) produce timber, 4) balance multiple values, 5) maintain habitat, and 6) restoration. British Columbia participants also named the first five goals, but instead of restoration, listed compliance as a sixth category. In both regions, other goals were cited, and categorized under a category of “Other” because they were not common goals shared with any other participant. For example, in BC, one participant listed “Safety and Respect” as one of the company goals. This was not a goal named by any other participant. In these situations, the goals are used as anecdotal data rather than as a common theme amongst multiple forest managers.

The second component of question seven examines the techniques used to meet the goals stated in part one. I chose two codes for this question: “Extractive” and “Protective”. A response was placed under the Extractive code if the purpose of the technique was harvesting timber. If the purpose of the technique was for some level of protection, then that response was placed under the Protective code. I additionally created a chart that displays the types of techniques identified under each code by the participants.

Pacific Northwest Question Seven Results

The most common response for question 7a, provided by 10 participants, was that one of the company’s or organization’s goals was to balance multiple values, closely followed by timber production from nine participants. All federal, the two state managers, and the one Native American representative all stated that a maintaining habitat was an agency, or group, goal. Furthermore, forest or habitat restoration was listed as a goal by the private non-industrial participant, the two state managers, and three federal managers. One private industrial manager, the private non-industrial forest owner, the two state managers, and three federal managers all stated that a company or agency goal was to make money, while one private industrial manager and two federal managers stated that it was a goal to maintain working forests.

A total of 29 responses fell into the "Extractive" category, with managers from all ownership classes naming extractive techniques for meeting goals. Thinning was the most frequently identified technique, named by ten different participants (Figure 6.15). For three of the six federal managers, thinning was the only extractive technique identified. Respondents indicated that thinning was the only extractive technique used because if other extraction methods are attempted, a lawsuit ensues. As such, thinning is even occurring in areas where clear-cuts would be more beneficial (such as on lands where Douglas fir is grown, as the species is not shade tolerant). BLM managers stated that though they can currently meet O & C Act requirements through thinning, eventually, the lands available for thinning will run out, and difficult decisions will need to be made. One individual noted that this was essentially "kicking the can down the road", such that future decision-makers will have to make that hard decisions that current-decision makers aren't making. The remaining ten extractive techniques were identified by fewer than five participants, less than half of the number identifying thinning.

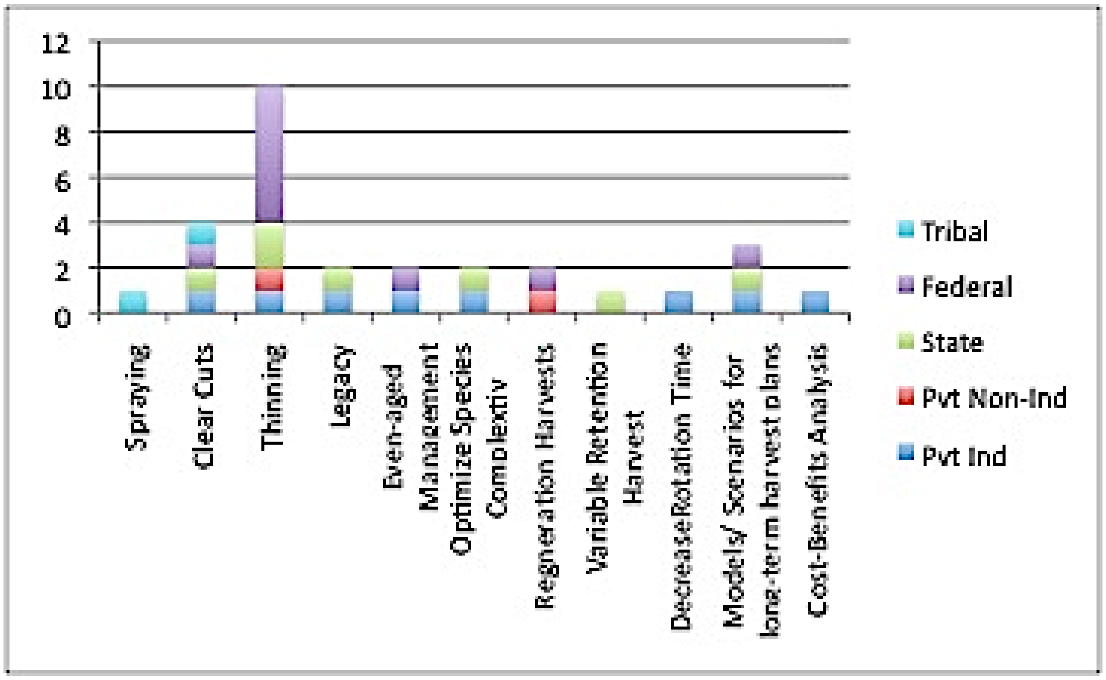


Figure 6.15. PNW Breakdown of “Extractive” responses by ownership category.

Protective techniques were identified nearly as often as extractive techniques. While the number of responses coded as "Protective" was almost equal to those coded as "Extractive", the federal and state forest managers provided the majority of responses in this category, at 13 and 10 respectively. The two most named techniques, at six each, were habitat buffers, and habitat building (Figure 6.16). The remaining eight techniques were identified no more than half as frequently as habitat buffers and building. Only one private industrial manager indicated that they engaged in protective techniques, and those techniques were aimed at protecting upland habitat and leaving downed wood and snags.

There were some differences noted in the responses from state managers. The state manager from Washington indicated that the state regularly engages in habitat restoration and creation, along with variable retention thinnings. The other state manager, from Oregon, stated that the state's method of forest management is to emulate various forest conditions across the landscape, thus managing for structural succession and rotating stand types over long time scales. Prescriptions for management are used to meet target goals.

Federal forest managers listed multiple protective techniques, with several referring to thinning being used as an ecosystem restoration technique. One federal manager noted that ecosystem management was intended as a multi-use management approach with a science component that consists of a focus on managing for biodiversity and ecosystem health. Part of the focus on managing for biodiversity and ecosystem health means protecting late successional forests where they exist, and building them in areas where they need help.

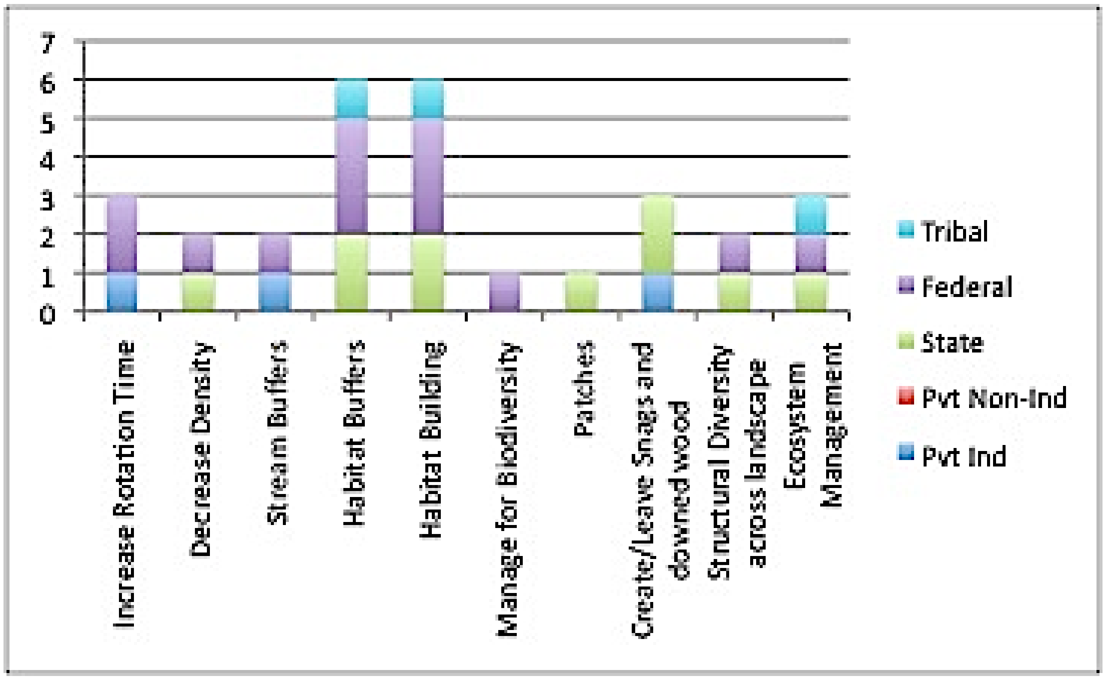


Figure 6.16. PNW Breakdown of "Protective" responses by ownership category.

British Columbia Question Seven Results

As was seen with the responses to question 7a in the PNW, the most cited goal in BC was to balance multiple values. Nine participants identified this goal, including one Private Industrial on public lands manager, five Ministry of Forests employees, the employee from the Ministry of Environment, and both of the First Nations representatives. Maintaining ecosystems or habitats was the next most identified goal, named by a total of six participants from Ministry of Forests, Ministry of Environment, and First Nations participants. Five participants—from all categories of ownership except Ministry of Environment—listed timber production as a goal, while four listed making money, and two stated that maintaining working forests was a goal. One private industrial from public lands manager and three Ministry of Forests' employees stated that policy and regulatory compliance was a company or agency goal.

A total of 26 responses fell into the "Extractive" code, with no one owner category providing the majority of responses (Figure 6.17). Variable retention harvest was the most identified extractive technique, named by seven individuals, followed by clear cuts, which was named by five participants. Thinning and species complexity were each identified three times, while the remaining six were identified by fewer than three individuals. The manager for private lands indicated that they practiced shorter reforestation times (meaning they get trees planted in a shorter amount of time than seen in other harvest areas) along with shorter harvests to increase yield over time. The two private industrial managers from public lands stated that they engage an adaptive management approach. Variable retention, that is ecologically based, is a technique used by both of these managers. Variable retention results in variations in species, density, and shape of harvested area.

Three managers from the Ministry of Forests also indicated the trend towards varying the shape of the harvest, along with a trend away from even-aged stands to optimal-complexity stands. One respondent from the Ministry of Forests indicted that some of the variations in shape are intended to blend better into the landscape than traditional block cuts. Larger cuts are sometimes used as a means to mimic natural disturbance regimes. A Ministry of Forests manager also noted that TFL licensed lands tend to be better managed than TSA licensed lands due to the longer tenures on TFL lands that are based on area rather than volume.

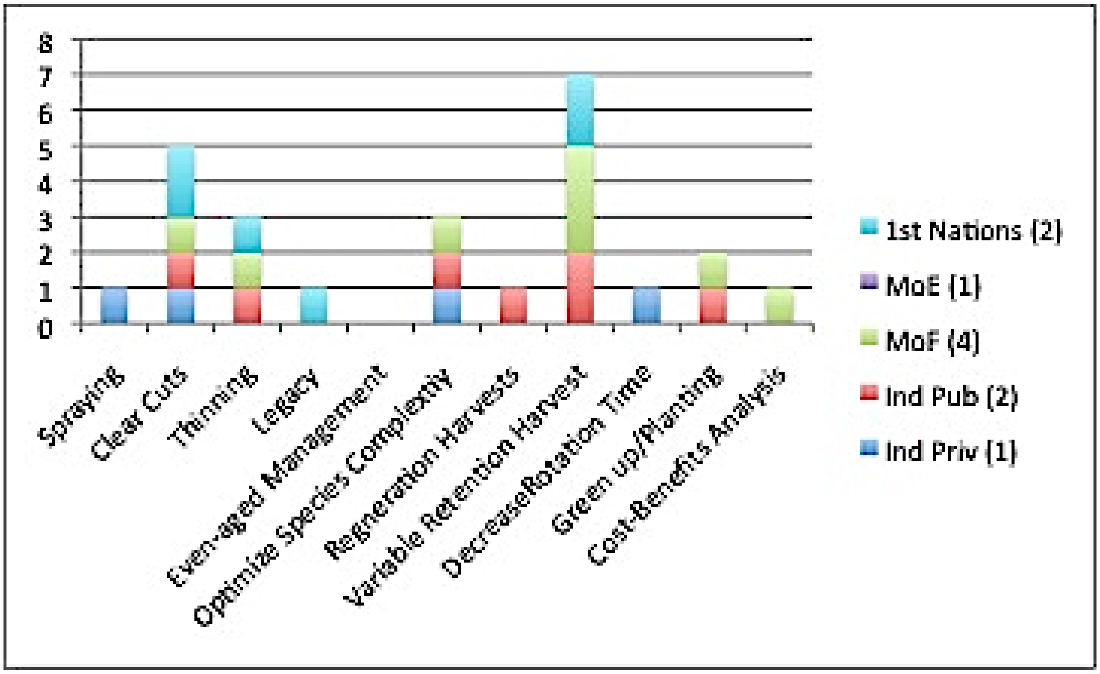


Figure 6.17. BC Breakdown of “Extractive” responses by ownership category.

In terms of “Protective” techniques, Ministry of Forests’ personnel, followed by Private Industrial on public lands and the First Nations representatives, gave the majority of responses under this code. No single technique was named more than the others, and half of the techniques were identified by either seven or eight individuals (Figure 6.18). Increased rotation time and decreased density were two protective techniques identified by participants from the PNW that were not identified by participants from BC.

The manager from private industry on private lands noted that the company has conducted extensive watershed analyses and considered watershed ecosystem health needs in the development of management plans. This person further indicated that the company engages in multi-value management, but not multi-use management, and that they manage for critical wildlife, endangered species, and water quality. Additionally, the company seeks input from stakeholders for their goals in watershed management. One of the private industrial managers from public lands spoke of the extensive efforts of the company to develop new approaches to forest management that considered old growth, biodiversity, wildlife, water quality, and social values. They manage for biodiversity, ecological representation at the landscape scale, and for habitat and species protection.

Ministry of Forests managers and the representative from Ministry of Environment indicated common goals for managing for ecosystem and habitat needs, though the Ministry of Environment representative states that these goals are not currently being met under FRPA. Several Ministry of Forests managers also noted a tension between managing for ecosystem and societal goals and managing for economic values. That aside, Ministry of Forests managers note goals for protecting streams, habitats, and ecosystem health, and with a consideration of multiple values.

The First Nations representatives noted that on First Nations' lands, protective techniques are inherent in the value assigned to environmentally and culturally significant land. Old growth, habitat, and species protection all occur. In addition, ecosystems are managed for water quality, wildlife values, and biodiversity. Cedar trees are culturally valued and thus are planted, not for harvests, but for their cultural value. Finally, where harvests occur, the edges are managed and patches are left to make harvested areas appealing to wildlife.

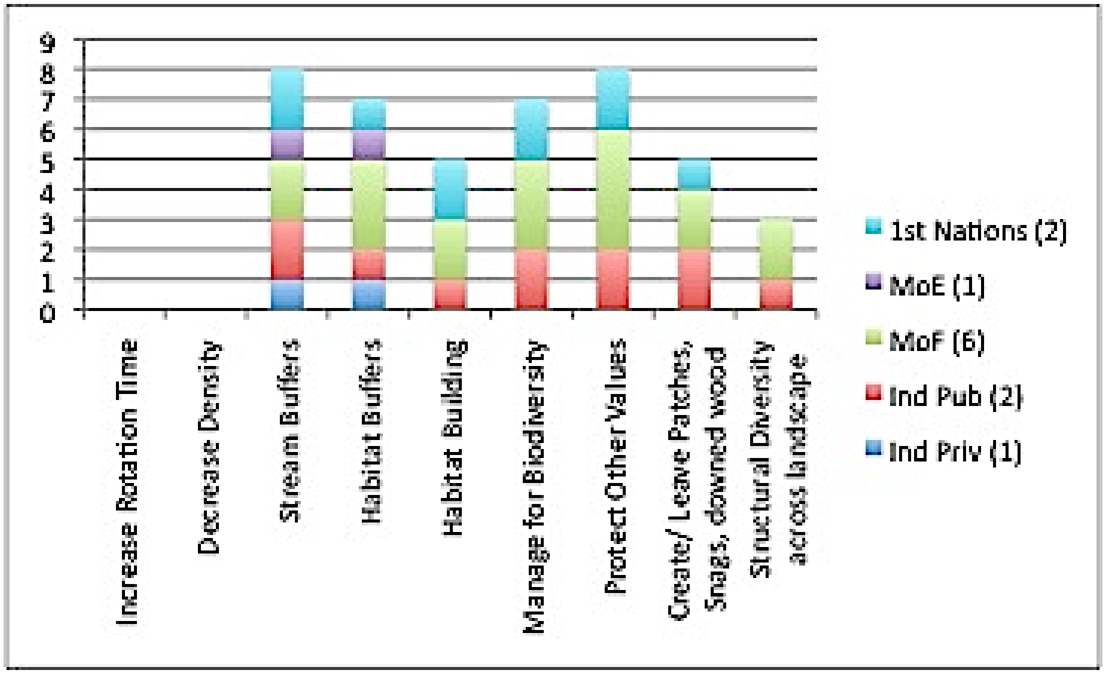


Figure 6.18. BC Breakdown of “Protective” responses by ownership category.

Responses to Question Eight

Question eight sought to discover what participants felt drives forest management for their company or agency, and then what they felt the primary driving force would be. In both the PNW and BC, economics was named more frequently than any other driver, though that was closely followed by policy and regulation, public pressures, and, in the PNW, conservation and stewardship. In the PNW, 10 participants stated that economics was a driver of forest management. All private industrial managers, one state manager, and one federal manager named it the primary driver behind forest management. In BC, the results were similar. Nine participants identified economics as a driver for forest management, with two participants from private industry, one from the Ministry of Forests, and one First Nations representative stated that it was the primary driver.

Managers in the PNW identified both policy/regulations and conservation/stewardship an equal number of times. However, five of the nine participants who listed policy/regulations stated that it was the primary driver, while three identified conservation/stewardship as the primary driver. In both cases, it was state and federal managers who identified either category as primary driver. Eight managers stated that public pressure is a driver of forest management, with two federal managers indicating it was the primary driver. Managers in the PNW identified two other drivers: the timber trade and preservation. PNW managers did not name Native American influences or rights as a driver of forest management.

In BC public pressure was seen as a driver more frequently than policy and regulations, though the difference was nominal. Eight managers listed public pressure versus seven identifying policy and regulations. However, of the participants that identified policy and regulations as a driver, three named it as the primary driver, while two stated that public pressure is the primary driver for forest management in BC. Six managers identified conservation and stewardship as a driver, and two of those named it the primary driver. Managers in BC also listed industry and preservations as drivers of forest management. Unlike the PNW, managers in BC did identify First Nations rights or influences as a driver for forest management, with one Ministry of Forests' individual naming it as the primary driver.

Responses to Question Nine

In question number nine, the aim was to get at how education or training shaped a manager's perspectives on forest management. The first part of the question, then, was to ascertain the type of forestry training participants received. Tables 6.3 and 6.4 display the respective results for the PNW and BC. If a participant received a degree that was not in Forestry, that degree is listed under the "Other" column, as are non-degree certifications or programs. The majority of respondents in both the PNW and BC received at least a bachelor's degree in Forestry. A total of five PNW managers and two BC received some type of master's degree. Seven

Table 6.3. Education level for PNW managers.

Question 9: What type of training did you receive in forestry and forest management					
Interviewee	No College	BS Forestry	MS Forestry	PhD Forestry	Other (specify)
PI					
1					MS Forest Ecol
2		1	1		Cont ed for cert
3		1			Cont ed for cert
Total	**0**	**2**	**1**	**0**	
PNI					
6		1			MS Admin of Forests
Total	**0**	**1**	**0**	**0**	
State					
4		1			Cont ed for cert and mgmt training
13					3 yrs undergrad in bio and econ + 2 yrs forestry tech
Total	**0**	**1**	**0**	**0**	
Federal					
7			1		Partial PhD
9		1			Cont ed for cert
10		1			MS Forest Bio + cont ed
11				1	BS natural science
12					Bachelors Bio and Math education, cont ed
Total	**0**	**3**	**1**	**1**	
Tribal					
8			1		Cont ed for cert
Total	**0**	**0**	**1**	**0**	

Table 6.4. Education level for BC managers.

Question 9: What type of training did you receive in forestry and forest management					
Interviewee	No College	BS Forestry	MS Forestry	PhD Forestry	Other (specify)
PI (Priv)					
16		1			Registered Prof Forester
Total		**1**			
PI (Pub)					
21		1			Registered Prof Forester and a BSE
24		1	1 Forest ecology		BS Dual major forestry resource/enviro assess
Total		**2**	**1**		
MoF					
5		1			Silviculture diploma
15					Engineering technician/then entemology and r.s./gis
17					
18		1			Registered Prof Forester
19		1			MS silviculture
22		1			Registered Prof Forester
Total		**4**			
MoE					
14	1				Forest technician/on the job
Total	**1**				
Tribal					
20		1			
23					Resource management diploma
Total		**1**			

participants indicated that they participated in continuing education courses to fulfill certification requirement.

When asked how this training affected the participant's perspectives on forest management, the responses tended to fall within three categories. Responses were placed in the "Career" category if the respondent indicated that their training affected their perspectives in a manner that drove their career paths. The "Values' category was used when a respondent indicated that their training shaped the values they held regarding forest management. If responses indicated that training shaped the perspective from which individuals approached forest management, those responses were placed in the "Approach" category.

Pacific Northwest Question Nine Results

A majority of the participants from the PNW indicated that their training shaped their career paths. Two individuals who work for private industry indicated that by the time they had finished with their education, they had changed careers. Interviewee 1 had begun as a researcher and had changed careers to work in private industry. Five participants—one state manager, three federal managers, and one tribal representative—indicated that their education provided them with a management perspective, preparing them to enter the workforce ready to manage resources. Three participants indicated that their education had shaped the values they held regarding forest management. The private non-industrial manager stated that the education this individual received led to an appreciation of interdisciplinary perspectives and values. Two federal managers stated that they valued the idea of sustainable forest management for multiple values. Five participants said that their training in forestry had shaped how they approach forest management. Participants 6 and 10 stated that their education led them to use a holistic approach to forest management. Participants 10 and 12 received training that gave them a landscape-level approach to forest management. Interviewee 12 also stated that training led to a long-term approach. In addition to the “Career”, “Values”, and “Approach” codes, one private industrial forest manager said that training did not affect perspectives for foresters in general, but, rather, perspectives in industry tend to evolve over time and cultural shifts in perspectives precede changes in training approaches.

British Columbia Question Nine Results

For British Columbia forest managers, training more frequently shaped their approaches to forestry than it did their values or career paths. Eight participants indicated that their education had an effect on their approach to forest management. Participants 18, 20, 23, 24 indicated that their training background led them to approach forest management from a holistic perspective. One private industrial and one Ministry of Forests’ forest manager indicated that training led to a long-term approach. Participants 18 and 19, both from the Ministry of Forests, stated that education led to a landscape-level approach to forest management. Participants provided responses that fit into the “Values” code nearly as frequently as the

“Approach” code, with a total of seven responses coded as “Values”. One private industrial forest manager, one worker at Ministry of Forests, and both First Nations representative indicated that their training led to an appreciation of interdisciplinary perspectives and values, while one Ministry of Forests, the Ministry of Environment representative, and one of the First Nations representatives indicated that their training led them to value sustainable management for multiple values. Four participants stated that their education or training shaped their career paths. Interviewees 21 and 14 indicated that their training provided them with an experiential understanding of forest management, rather than only a theoretical or academic perspective. Interviewees 5 and 22 both said that their training prepared them to manage a resource. One participant provided a response that did not fit into one of the three codes, as this individual indicated that classroom training had no real effect on perspectives, and perspectives were shaped more from summer internships than academic environments.

Responses to Question Ten

Given the changes in policy and practices, as well as the range of experiences I had expected to find, I was interested in discovering how participants perceived their perspectives had changed over time. The responses to question 10 were coded into one of three categories: Collective, Individual, or Objective. An interviewee’s response was codes as “Collective” when the response indicated that the participant's perspective changed to include perspectives from outside themselves. The "Individual" code, alternatively, was used for responses that indicated changes to internal traits. The final code, "Objective", was used for responses that did not include perspectives of others or personal traits.

Pacific Northwest Question Ten Results

More responses from the PNW managers were coded under the "Collective" code than either the "Individual" or "Objective" codes. Only two participants did not provide responses that fit into this category, one from private industry and the other the private non-industrial forest manager. Ten of the 11 participants who supplied comments that were coded as "Collective" indicated that their perspectives had become broader over time (Figure 6.19). Most often this seemed to be a result of working with a wide range of individuals from varying backgrounds in with different areas of expertise. A total of three comments fell into the "Individual" category, two from federal forest managers and one from the private non-industrial forest manager (Figure 6.20). Most individuals stated that their knowledge had increased, and for the same reasons that their perspectives broadened: they learned from the expertise of other professionals. Finally, five responses were coded under the "Objective" category, and four of those came from federal forest managers and one from the Native American representative (Figure 6.21). Within this category, the most frequently noted comment was that experience in the field led to an understanding of the complexity of systems and the need to manage for the system.

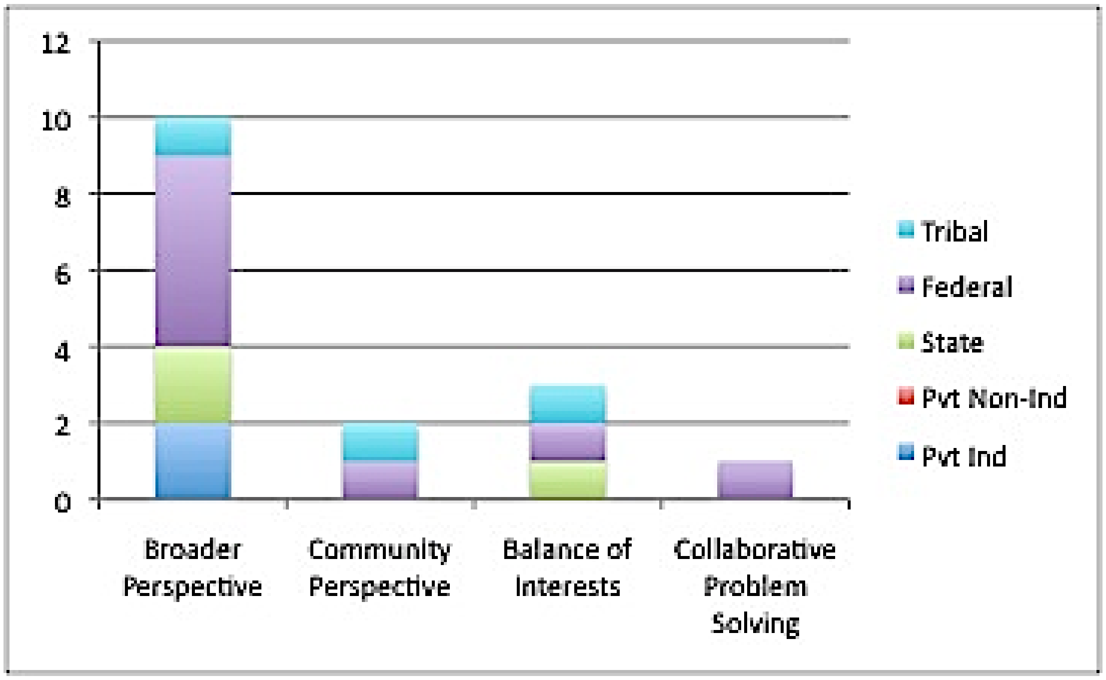


Figure 6.19. PNW Breakdown of “Collective” responses by ownership category.

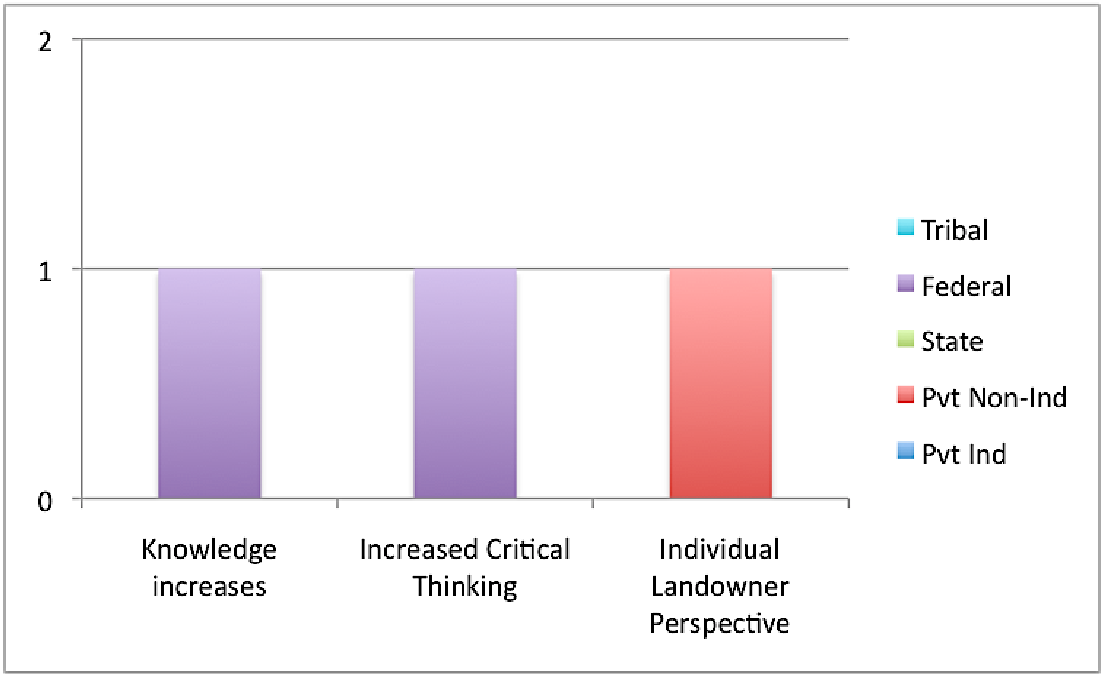


Figure 6.20. PNW Breakdown of “Individual” responses by ownership category.

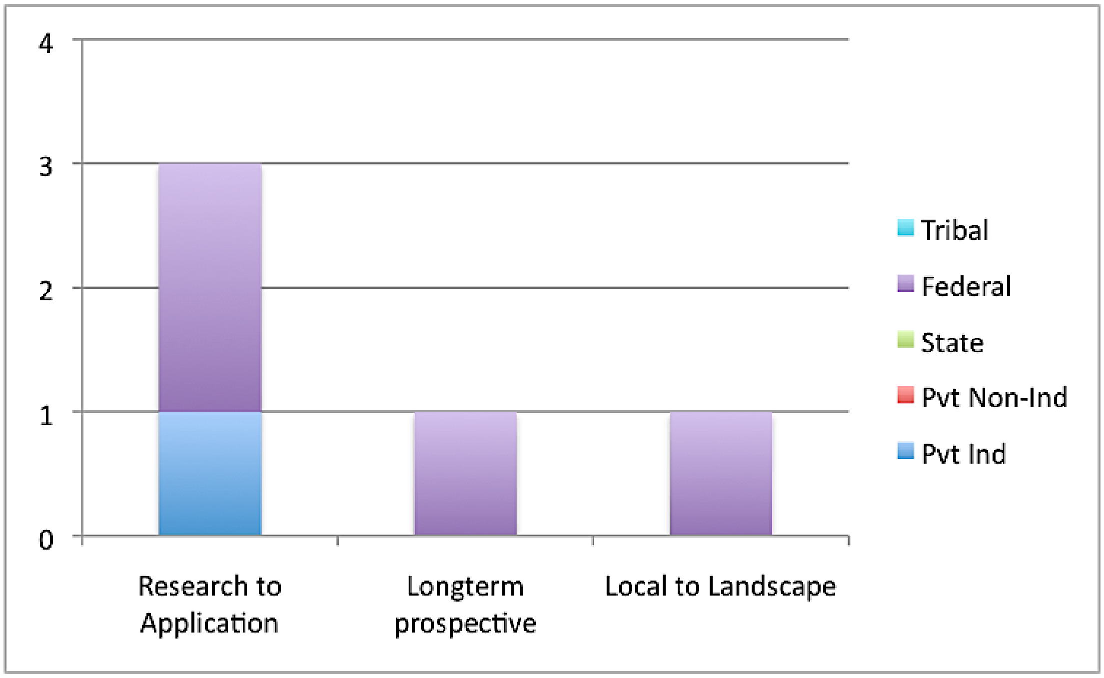


Figure 6.21. PNW Breakdown of “Objective” responses by ownership category.

British Columbia Question Ten Results

As with the PNW, the majority of responses from BC managers could be coded under the "Collective" category. However, the other two categories, "Individual" and "Objective" had more responses within them than they did with the PNW interviews. Within the "Collective" category, seven participants indicated that they had developed a broader perspective over time, making this the most cited response within the "Collective" category, as it was with PNW managers (Figure 6.22). There were nine responses coded under the "Individual" category. Within that code, seven participants indicated that their knowledge had increased over the years that they had been working in the forest industry, and the two First Nations representatives indicated that they had improved their critical thinking skills (Figure 6.23). There were also nine comments that were coded under the "Objective" category. Of those nine responses, four participants had indicated that they had developed a systems perspective, while three interviewees noted that their perspectives had changed from local scale to landscape scale, one manager indicated a change to long-term thinking, and one manager indicated a move from a research perspective to an applied perspective (Figure 6.24).

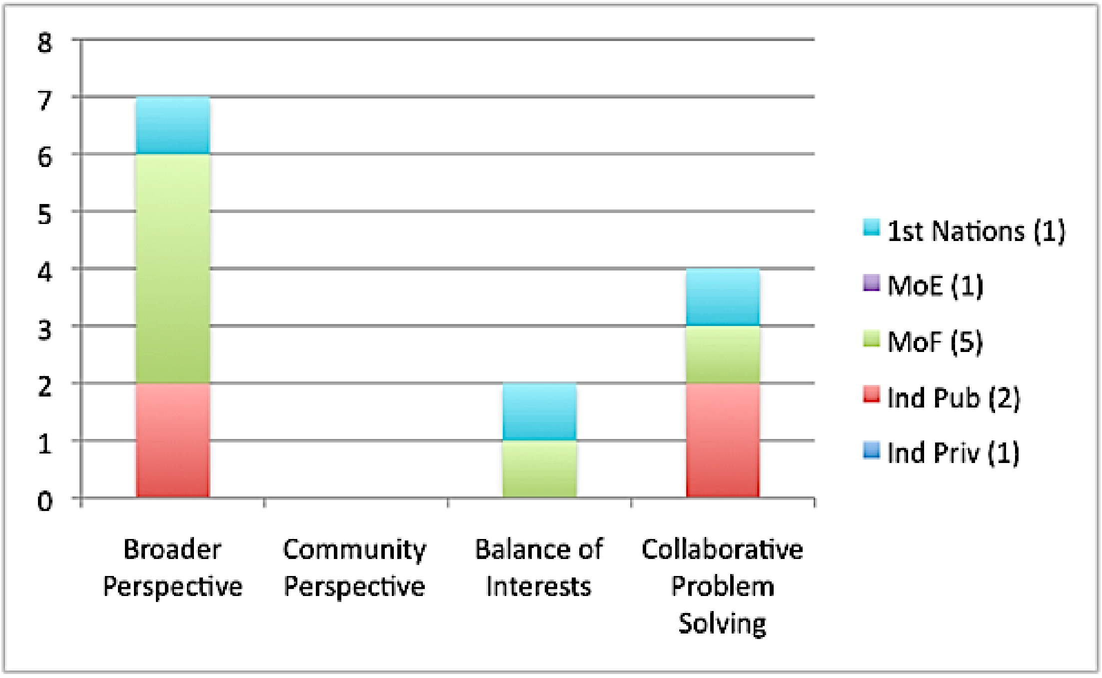


Figure 6.22. BC Breakdown of “Collective” responses by ownership category.

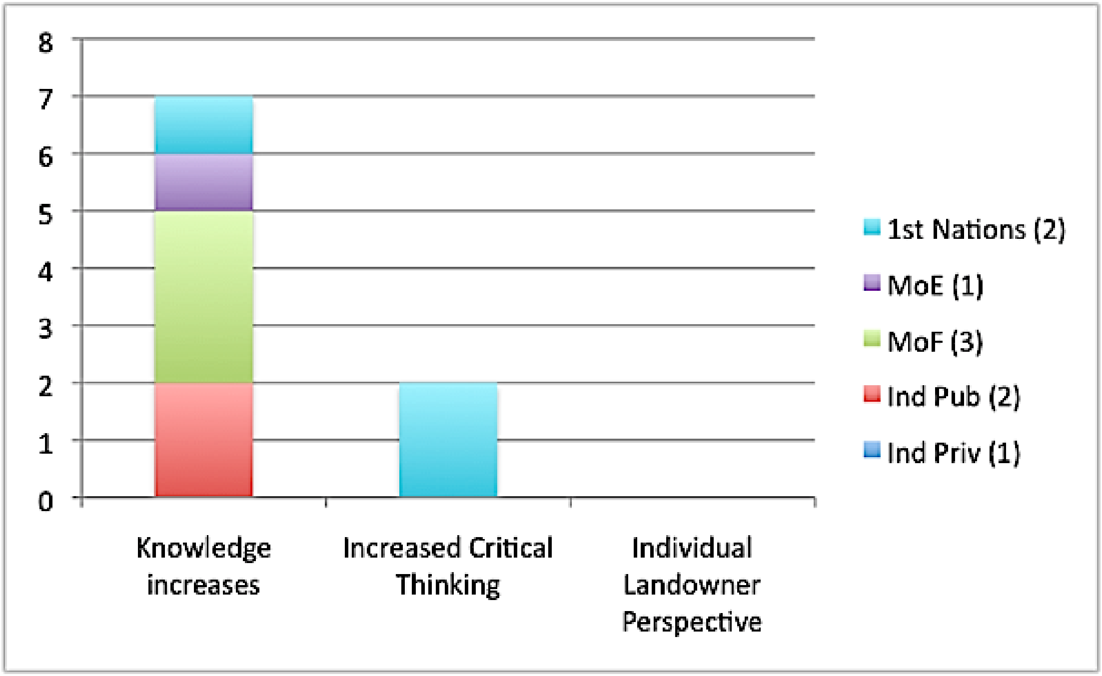


Figure 6.23. BC Breakdown of “Individual” responses by ownership category.

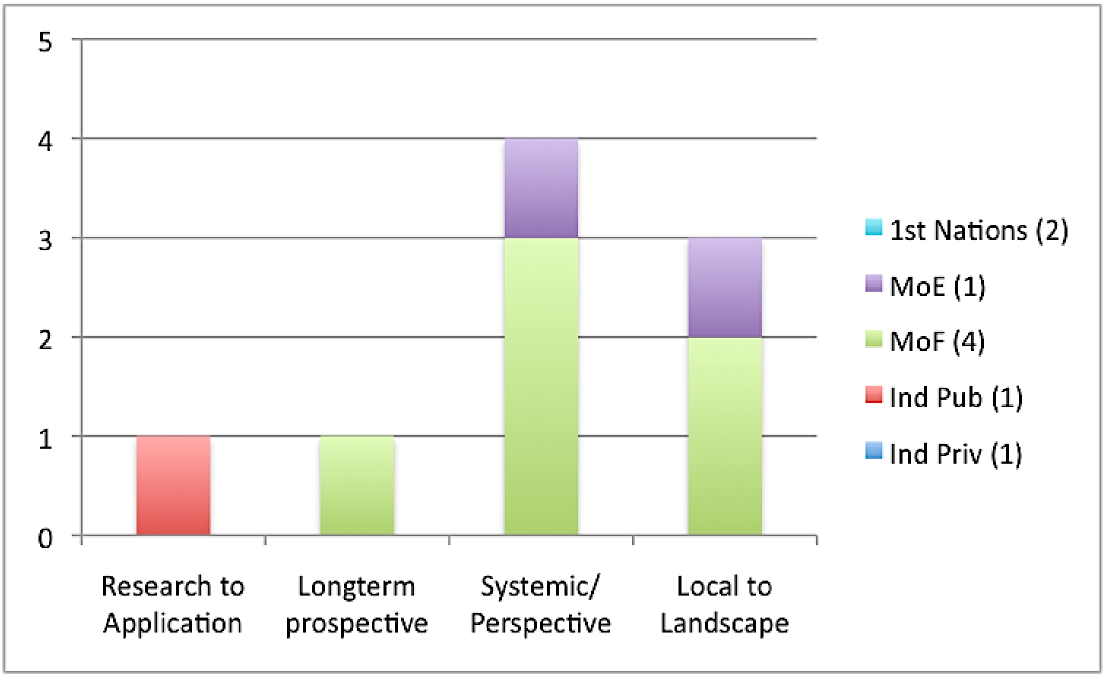


Figure 6.24. BC Breakdown of “Objective” responses by ownership category.

Responses to Question Eleven

The intent behind question 11 was to ascertain how training and other influential factors affect management decisions. In other words, how do the perspectives obtained from education, training, and influential factors get operationalized in on-the-ground decision-making? What types of management result from managers' backgrounds? For both the PNW and BC, one interviewee did not make management decisions, thus, that individual did not have a response for this question and was categorized as "N/A" (Figures 6.25 and 6.26). The range of responses was greater for BC than for the PNW, with nine categories of responses versus six. Seven participants in the PNW and five in BC indicated that because of their background and experiences, they approached the decision-making process from the perspective of multi-value management. Five participants from BC indicated an approach to management that utilized problem-solving and planning skills to address issues that arise in the management decision-making process. This was not an outcome of education and experience noted by PNW managers. In the PNW, five managers stated that their training and experiences led them to make decisions based on the concept of management for working forests. None of the BC managers noted this outcome. Four participants in BC and three in the PNW stated that one of the outcomes of their backgrounds and experiences was a decision-making process that incorporated an ecosystem management or collaborative

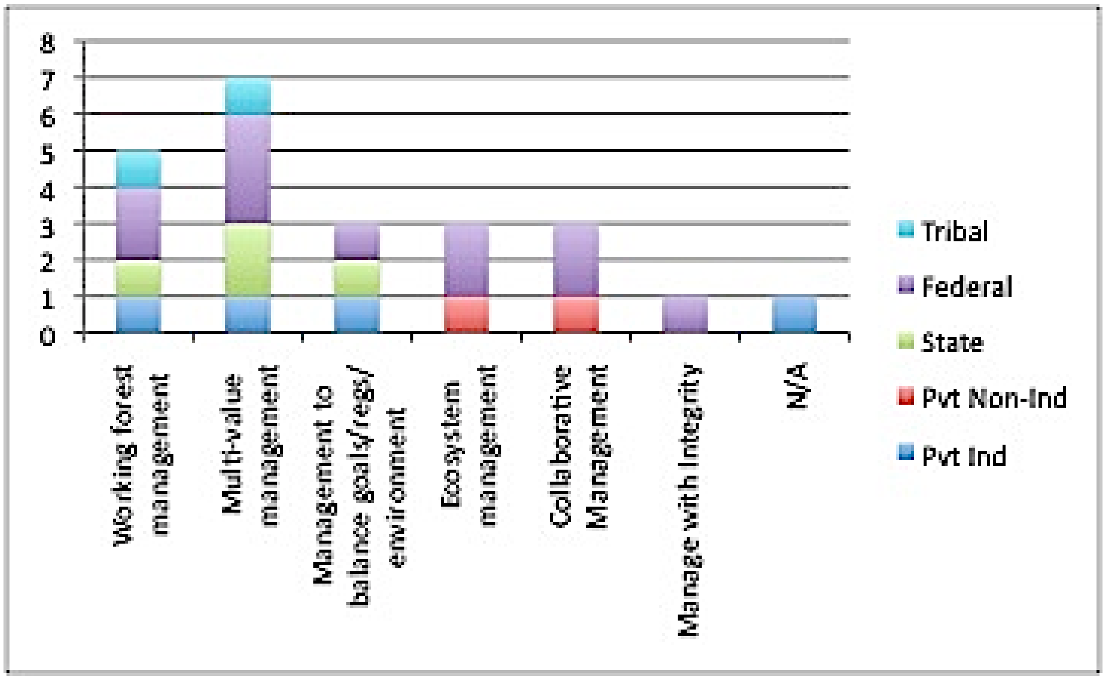


Figure 6.25. Results of the PNW responses to question 11 displayed by ownership class.

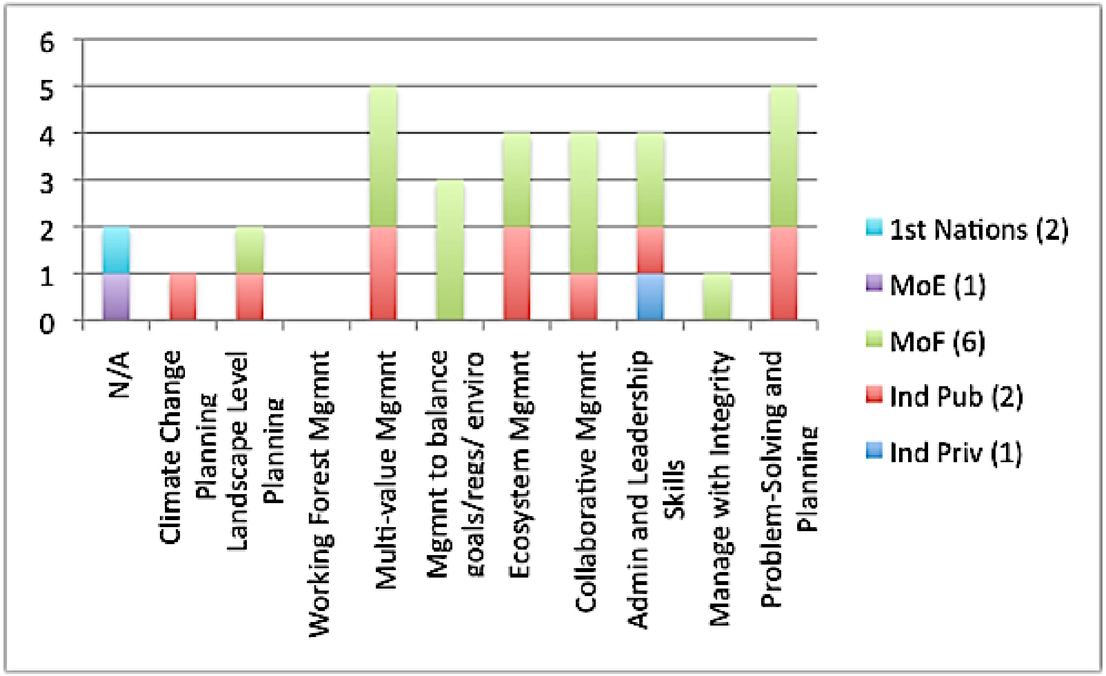


Figure 6.26. Results of the BC responses to question 11 displayed by ownership class.

management approach. Four participants in BC, but none in the PNW, indicated that they utilize administrative and leadership skills in the decision-making process. Three interviewees from the PNW and three from BC stated that they make management decisions with the intent to balance company/agency goals, policy and regulations, and environmental health. Two managers from BC, and none from the PNW, incorporate landscape-level planning into their decisions on forest management. One person from the PNW and one from BC indicated that their training and other influential factors have led them to manage with integrity. One BC manager commented on the influence of training and experiences in a decision-making process that incorporates climate change planning. Climate change planning was not an outcome of training and experiences noted by PNW managers.

Responses to Question Twelve

In Question 12, I asked participants whether or not the implementation of ecosystem management in the NWFP and the FRPA influenced their perspectives on forest management. This question posed some challenges in that there were different ideas as to what constitutes ecosystem management. The challenge occurred when interviewing BC managers because of the similarity between the term ecosystem management and the name of a regional agreement between multiple stakeholders called Ecosystem Based Management. Though the FPC and FRPA stipulate a goal to manage forests as ecosystems, the majority of BC participants responded to this question using Ecosystem Based Management as their frame of reference. Nonetheless, the responses provided by the BC managers still fell under the three codes for this question: “Approach”, “Scale”, and “None”. Responses from the PNW and BC were coded as “Approach” when comments indicated that the concept of ecosystem management influenced the manner in which the individual practiced forest management. The code “Scale” was used when responses indicted that the ecosystem management influenced the scale of the individual’s perspective on forest management. The last code, “None”, was used when individuals stated that they were not influenced by the concept of ecosystem management, as introduced in policy.

Pacific Northwest Question Twelve Results

Responses from the PNW managers nearly equally fell under the “Approach” code and the “Scale” code, with 11 and 12 responses respectively. A majority of participants indicated that the concept of ecosystem management from the NWFP influenced them to either implement prescriptions to protect ecosystems and/or habitats or practice forest management from a multi-resource or multi-value perspective (four responses each) (Figure 6.27). Five participants indicated that ecosystem management in the NWFP influenced them to see forest management from a landscape perspective, while four stated that it influenced them towards diverse management practices for varying situations (Figure 6.28). Three individuals indicated that the NWFP’s ecosystem management approach influenced

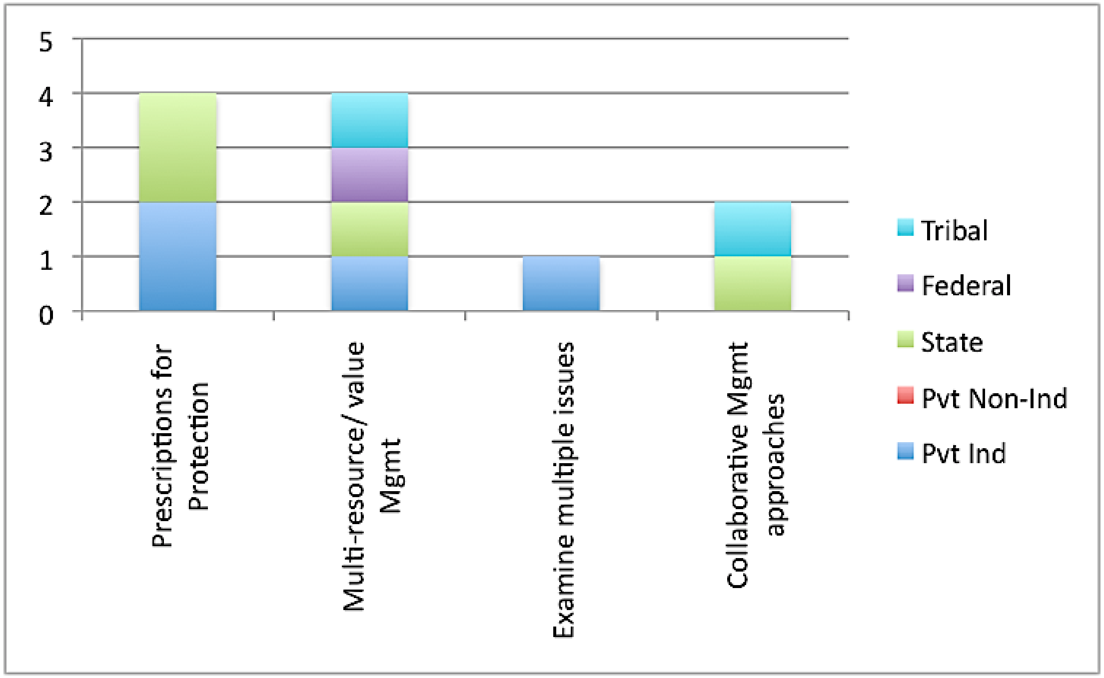


Figure 6.27. PNW Breakdown of "Approach" responses by ownership category.

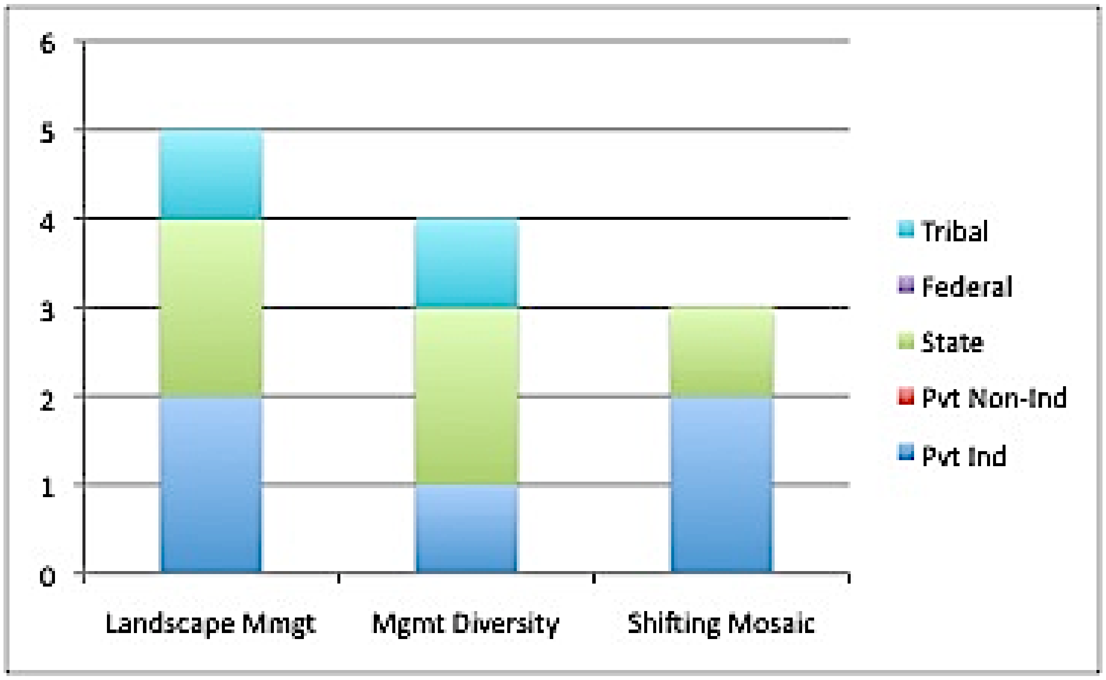


Figure 6.28. PNW Breakdown of “Scale” responses by ownership category.

them to plan for shifting age/species classes (a shifting mosaic) across the landscape, mimicking a more natural forest succession pattern.

Five participants indicated that ecosystem management implementation in the NWFP did not influence their perspectives on forest management. One individual stated that the coastal forests did not need management to be healthy and that management was for timber, with which ecosystem management does not help (Figure 6.29). The remaining four participants indicated that there was no affect from the implementation of ecosystem management in the NWFP, with one individual stating that he/she did not know that ecosystem management was necessary and was uncertain as to whether it is any better as a form of management than traditional management practices, while the other three stated that they held an ecosystem management perspective prior to the implementation of the NWFP.

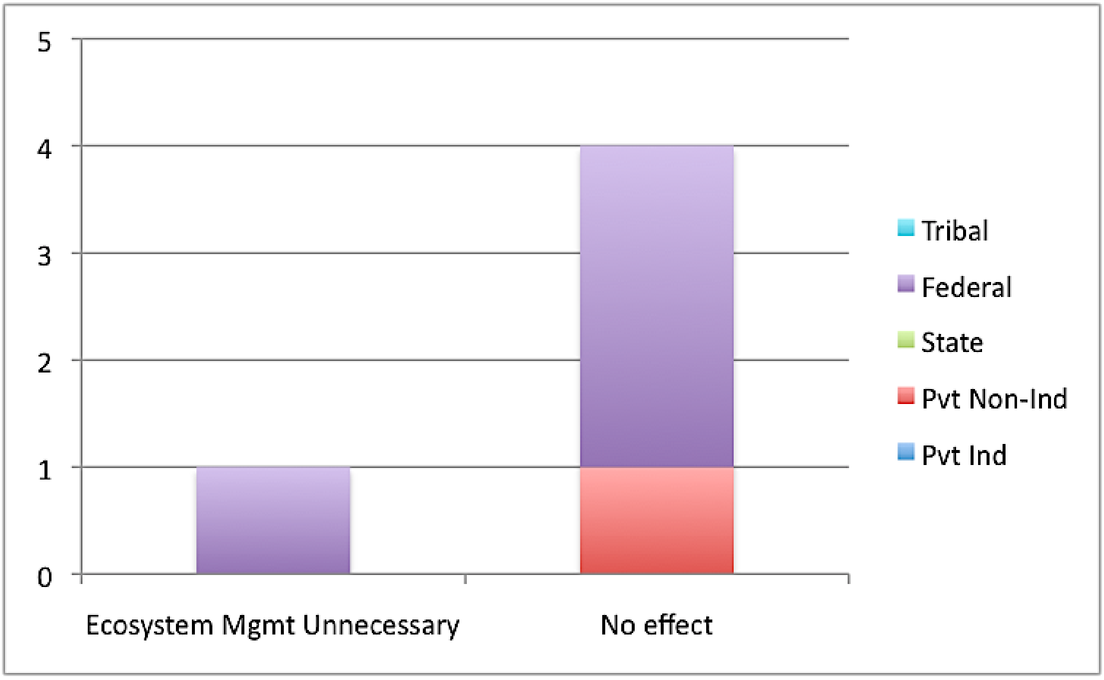


Figure 6.29. PNW Breakdown of “None” responses by ownership category.

British Columbia Question Twelve Results

For the BC forest managers, eight responses were classified under the "Approach" code, while the "Scale" and "None" codes were each used for six responses. As with the participants from the PNW, the majority of comments in this category indicated that ecosystem management in FRPA influenced the individuals to either implement prescriptions for protection or approach forest management from a multi-resource or multi-value perspective (Figure 6.30). Three participants stated that they now viewed forest management more from a landscape perspective than they had prior to codifying the concept of ecosystem management (Figure 6.31). Three participants also indicated that ecosystem management influenced them to see the need for a diversity of management practices suited to varying forest conditions.

Within the "None" category, one respondent indicated that he/she was not sure Ecosystem Based Management was the way to go, as it is very costly and does a disservice to communities (Figure 6.32). This individual also stated that what Ecosystem Based Management did tell us was that there is a great deal of public distrust of forestry and that the EBM did seem a compromise between those who want to log and those who want to preserve. Of the remaining five, all of whom stated that ecosystem management had no effect on their perspectives, three of them indicated that they had held an ecosystem management perspective prior to codifying the practice into policy. The participant from Private Industry on private lands stated that the company already practiced many of the goals for ecosystem

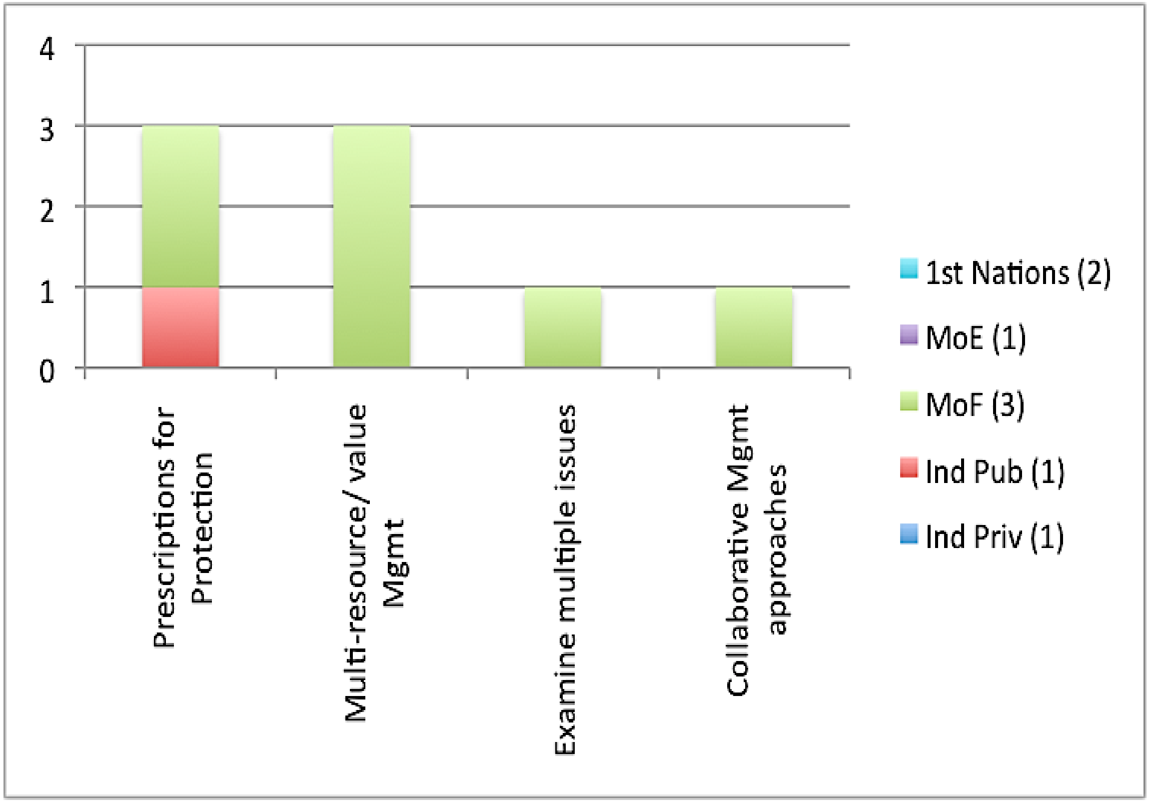


Figure 6.30. BC Breakdown of “Approach” responses by ownership category.

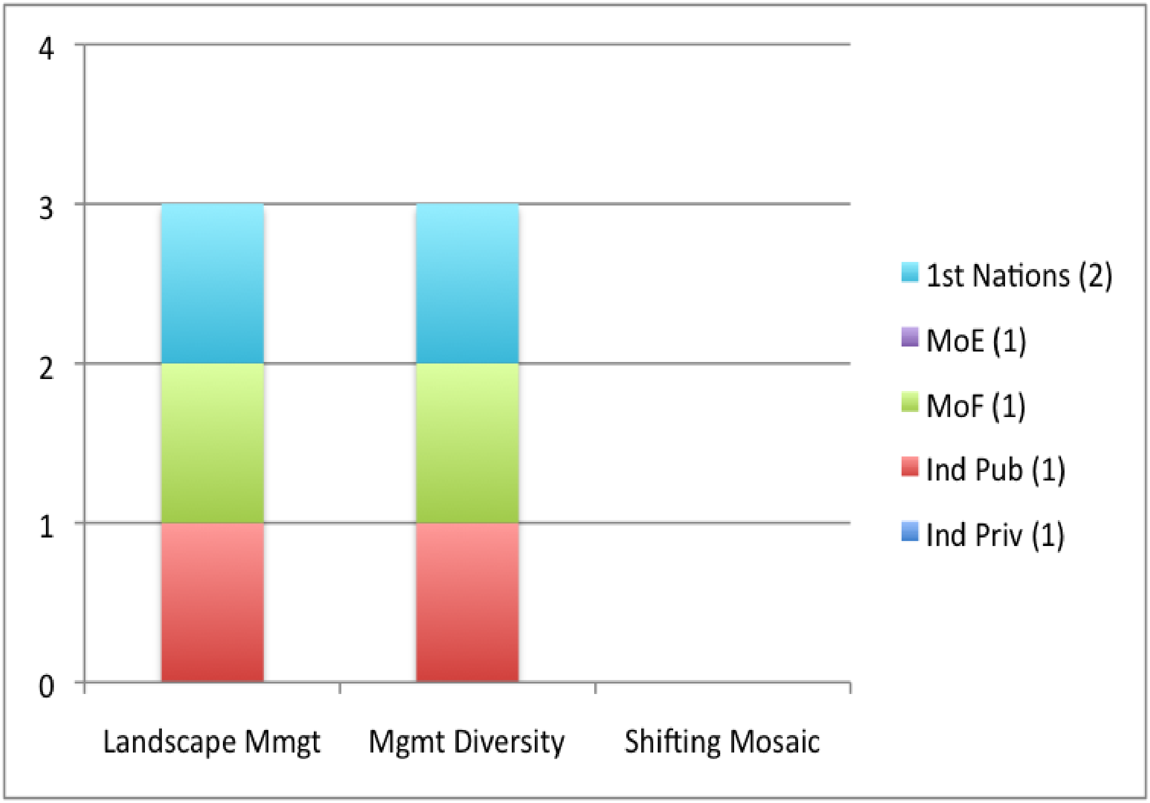


Figure 6.31. BC Breakdown of “Scale” responses by ownership category.

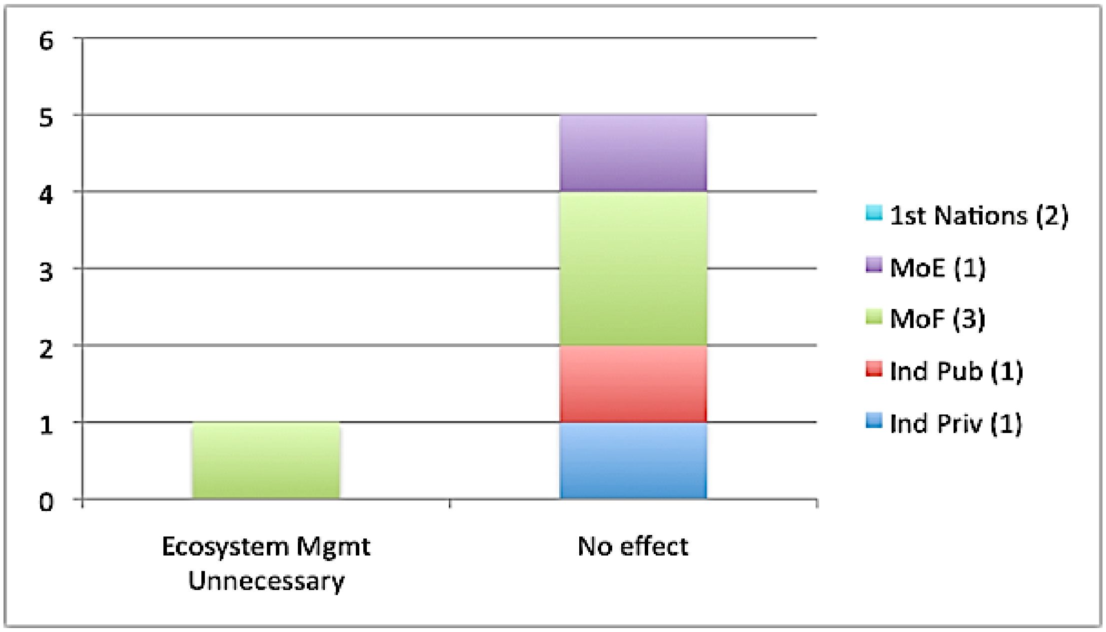


Figure 6.32. BC Breakdown of “None” responses by ownership category.

management, with the exception of the goals for old growth, and that public perception of ecosystem management does not make it good science. This individual went on to comment that the company also sold off or donated land for conservation.

Responses to Question Thirteen

With question 13, my aim was a better understanding of the manner in which forest managers perceived the concept of "resilience". This question was broken down into three parts. In the first part of the question, I asked what makes a forest resilient. The second component asked what make society resilient. In the third part of the question, I asked participants if they thought it was possible to simultaneously have resilient forests and resilient societies. Question 13c asked a closed-ended response and thus had only "Yes", "No", and "I Don't Know" responses.

Question 13a responses were coded into one of three categories: "Biological", "Management", and "Societal". Responses were placed in the "Biological" category if the comments indicated a biological mechanism or definition for forest resilience. The "Management" code was used for responses that indicated resilience is accomplished through some form of management. If forest resilience was defined in terms of societal uses or implications, then the "Societal" code was assigned for that comment.

Four codes were assigned for question 13b responses: “Societal Dynamics”, “Economic Dynamics”, “Individual Dynamics”, and “Environmental Dynamics”. Responses assigning societal resilience to the traits or dynamics of society were placed in the “Societal Dynamics” category. When participant responses indicated that societal resilience was the result of economic conditions, they were placed in the “Economic Dynamics” category. The “Individual Dynamics” code was used for responses defining societal resilience by the traits of individuals. The final code, “Environmental Dynamics”, was assigned to those responses giving credit to environmental conditions or uses for resilience in society.

Pacific Northwest Question Thirteen (a) Results

A significant majority of responses fell under the “Biological” code for question 13a. A total of 19 responses were coded “Biological” versus seven responses in the “Management” category and six in the “Societal” category. The majority perspective regarding a biological component for forest resilience was that forests are inherently resilient (Figure 6.33). Respondents who indicated that forests are inherently resilient often stated that nature heals itself and that forests will always grow back, even after human disturbance. Bio-diverse forests and healthy forests were seen as capable of providing and maintaining functions and services over time and following perturbations.

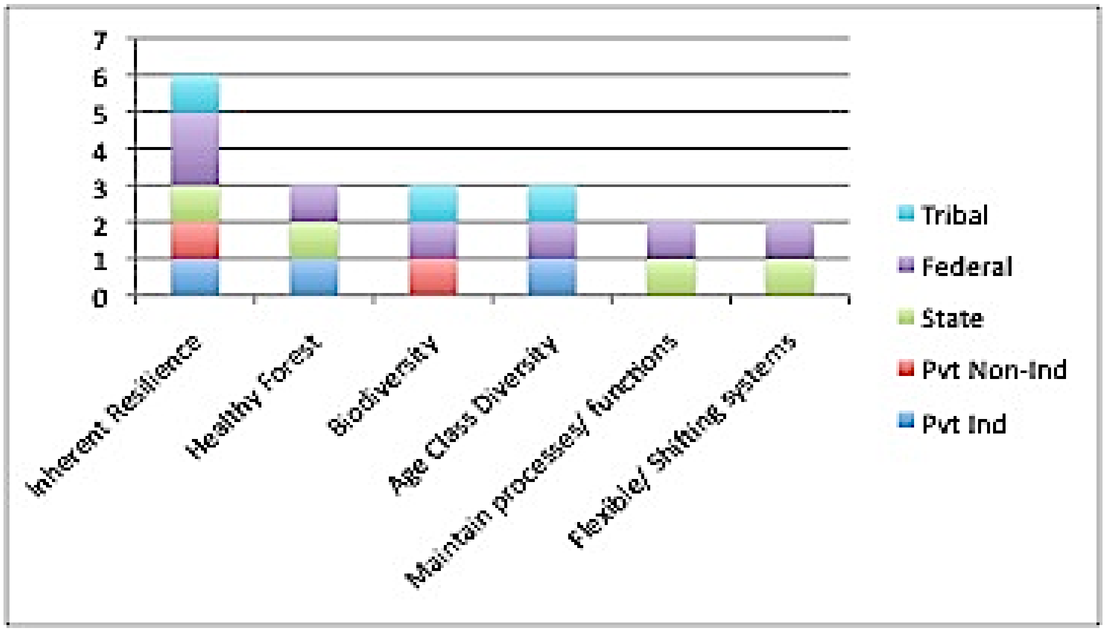


Figure 6.33. PNW Breakdown of “Biological” responses by ownership category.

A total of seven comments indicated that resilience happens through forest management. Of those, five individuals stated that active management could lead to resilient forests, while two individuals stated that forests are resilient when they are kept working (Figure 6.34). For these individuals, nurture and care along with clear goals for forest management will make it resilient. In addition, forests that are kept productive, with a utility for the owner along with some kind of benefit, will remain as forests and will therefore be resilient. Three individuals indicated that forests are resilient when they provide services for society (Figure 6.35). Forests will be resilient when society perceives of a value in those forests and are thus motivated to maintain them as forests. As such, according to one respondent, people need to be out in the forests to appreciate them and to see their value. Similar to this view about the perceived value of forests are the ideas that an educated public leads to resilient forests and that forests could be resilient if protection was incentivized.

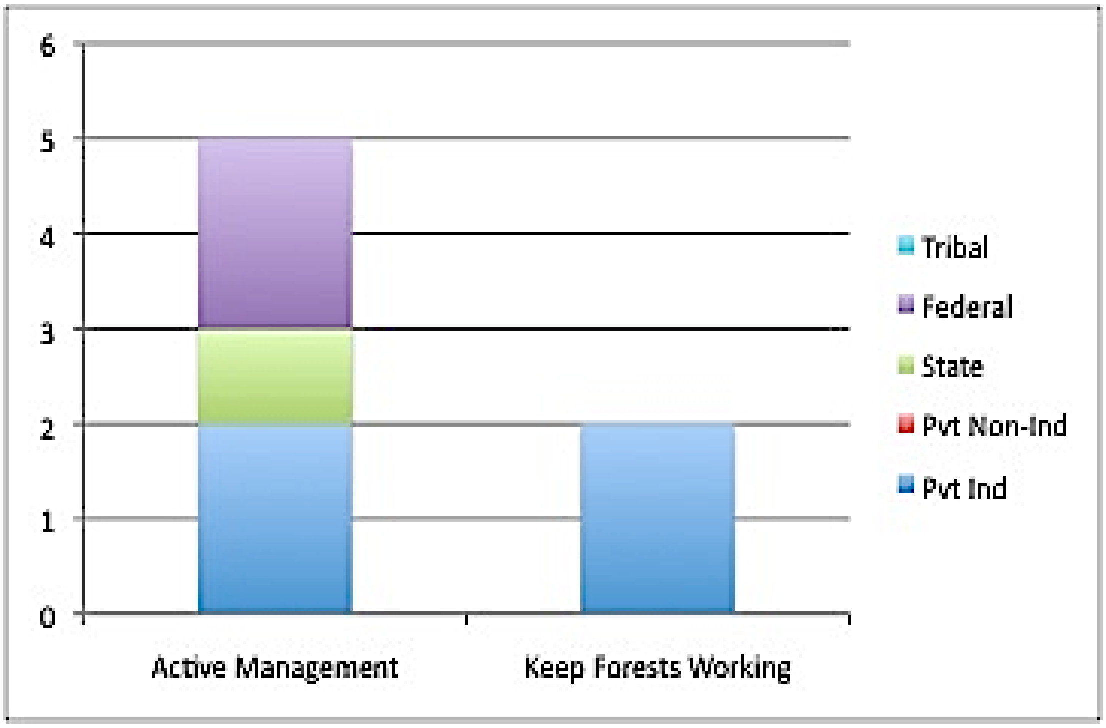


Figure 6.34. PNW Breakdown of “Management” responses by ownership category.

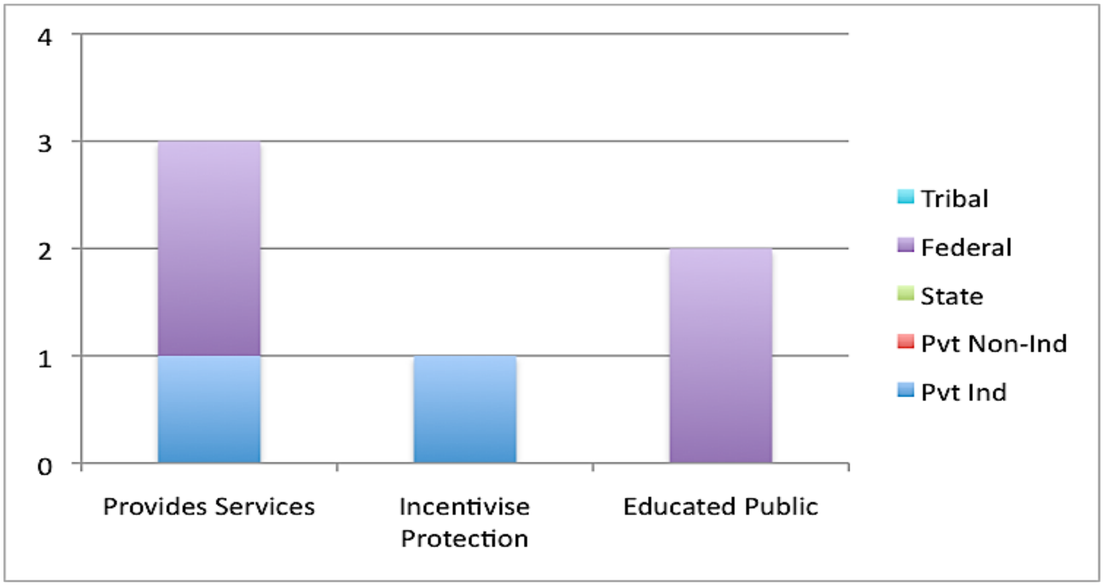


Figure 6.35. PNW Breakdown of “Societal” responses by ownership category.

British Columbia Question Thirteen (a) Results

As with the PNW, BC managers most frequently provided a biological definition of resilient forests, with 24 comments falling into this category. Seven responses were coded as “Management” and two as “Societal”. The majority of respondents commented that higher levels of biodiversity lead to more resilient forests (Figure 6.36). One individual noted that, with climate change, it is difficult to tell what will make forests resilient, but that deciduous species will be more likely to be resilient to climate change than non-deciduous species. Likewise, another individual noted that diversity would improve forest adaptability in the face of climate change. Participants also indicated that forests are resilient when they maintain their processes and functions when confronted with perturbations. While inherent resilience was the most common response in the PNW, in BC only four participants provided this answer, stating that trees will grow back, even where we think they should not, they still grow back. Age class diversity and forest health are also seen to increase the potential for forest resilience, as does forest system flexibility and adaptability.

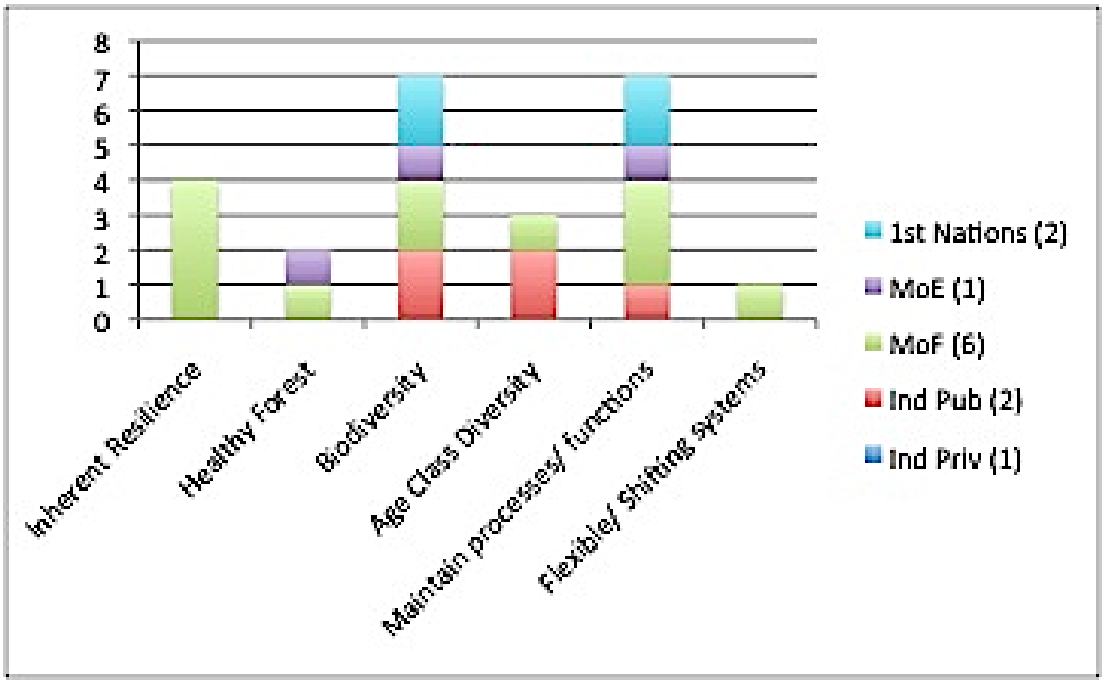


Figure 6.36. BC Breakdown of “Biological” responses by ownership category.

Seven participants attributed forest resilience to management and two to societal traits. The responses from the BC managers in this category were similar to those from the PNW managers, with five individuals stating that active management leads to resilient forests and one indicating that forests are resilient when they are kept working (Figure 6.37). Two participants indicated that it is important to manage forests for a variety of values, and understanding which values are important to society; however, according to another, it is important to manage for values in a way that does not compromise the integrity of the forest. It is through multi-values management and management that does not compromise system integrity that forests are maintained as forests, and are thereby made resilient. Only two participants attributed forest resilience to societal traits, and both indicated that forests providing services to society are resilient (Figure 6.38).

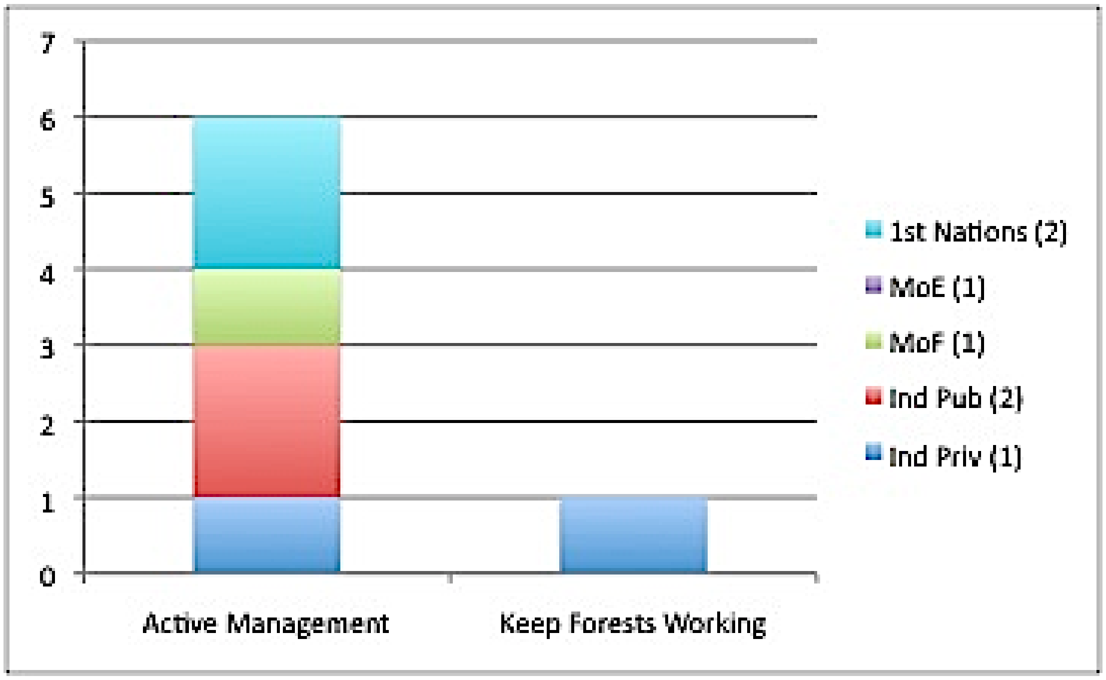


Figure 6.37. BC Breakdown of “Management” responses by ownership category.

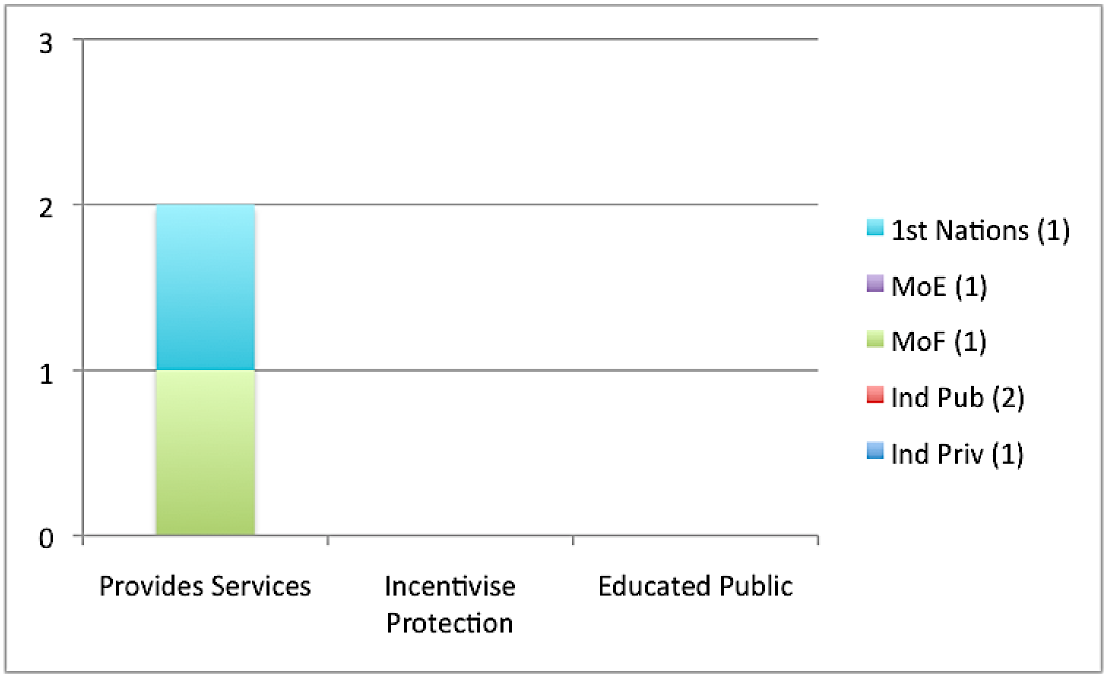


Figure 6.38. BC Breakdown of “Societal” responses by ownership category.

Pacific Northwest Question Thirteen (b) Results

More responses were coded as “Social Dynamics” than any of the other three codes, with a total of 16 responses fitting this category. The most common response in this category was an indication that a society’s ability to adapt to change makes that society resilient (Figure 6.39). This included adaptation to new ideas and new situations. The ability to adapt was seen as an inherent trait in societies and people, as people and societies must endure adverse conditions and adapt to new ways on a regular basis. Participants also noted that effective governance, with a healthy political system open to a free exchange of ideas and opportunities for local governance, leads to more resilient societies. Collaboration and a sense of community were also seen as paths to building resilient societies.

Five participants provided a total of five responses to question 13b that were coded as “Economic Dynamics”. Individuals who cited economic dynamics as a path to resilient communities noted that single-source economies are less resilient and that diverse economies lead to economies that are more economically viable, and thus more resilient (Figure 6.40). Two comments were coded as “Individual Dynamics”. One individual noted that people within a society have to be physically healthy in order for the society to survive, while the other noted that education leads to open-mindedness and flexibility, which then leads to resilience (Figure 6.41). Nine responses were coded as “Environmental Dynamics”. Resources played a key role in societal resilience for some participants (Figure 6.42) For these respondents, society was seen as more resilient if it had access to productive resources and if those resources were managed efficiently. Other participants deemed societal resilience as a product of environmental health and a connection to nature and to natural resources.

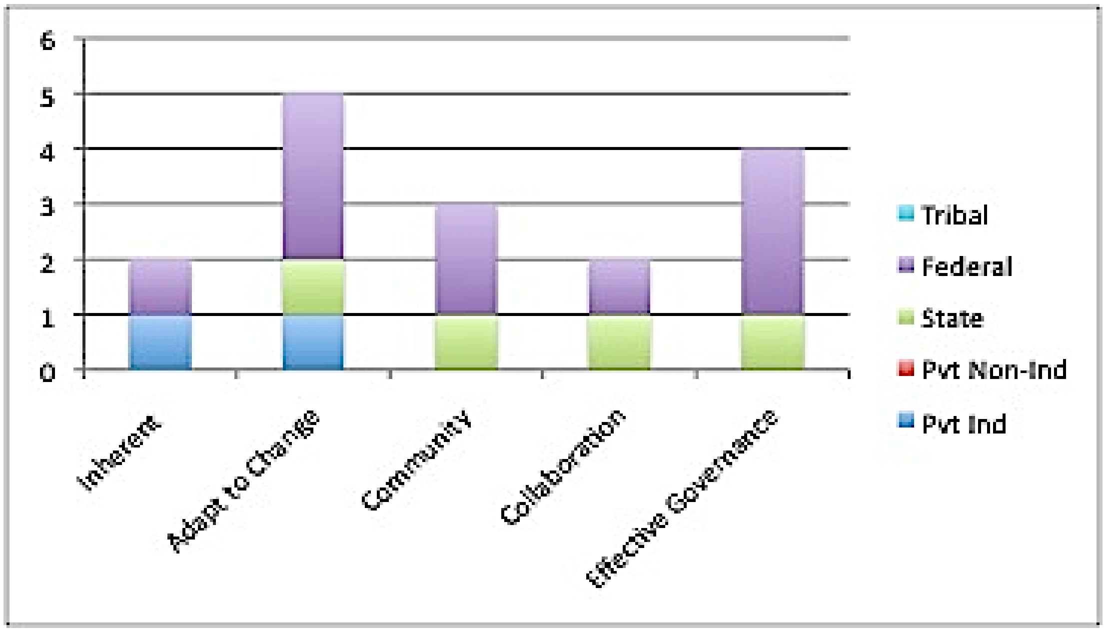


Figure 6.39. PNW Breakdown of “Social Dynamics” responses by ownership category.

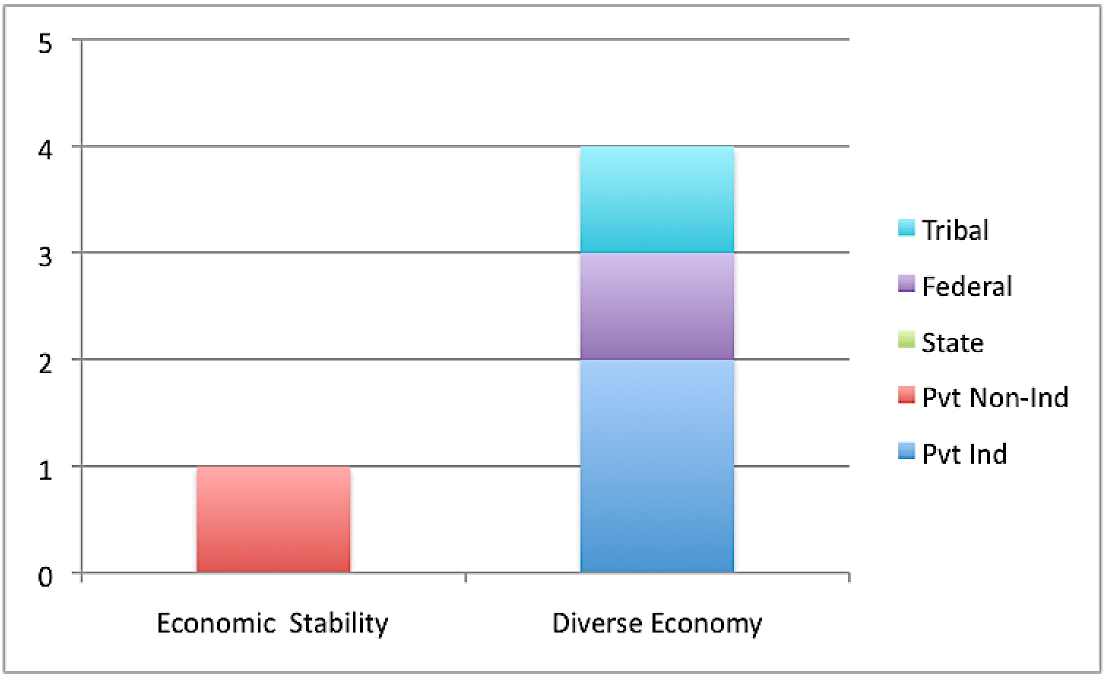


Figure 6.40. PNW Breakdown of "Economic Dynamics" responses by ownership category.

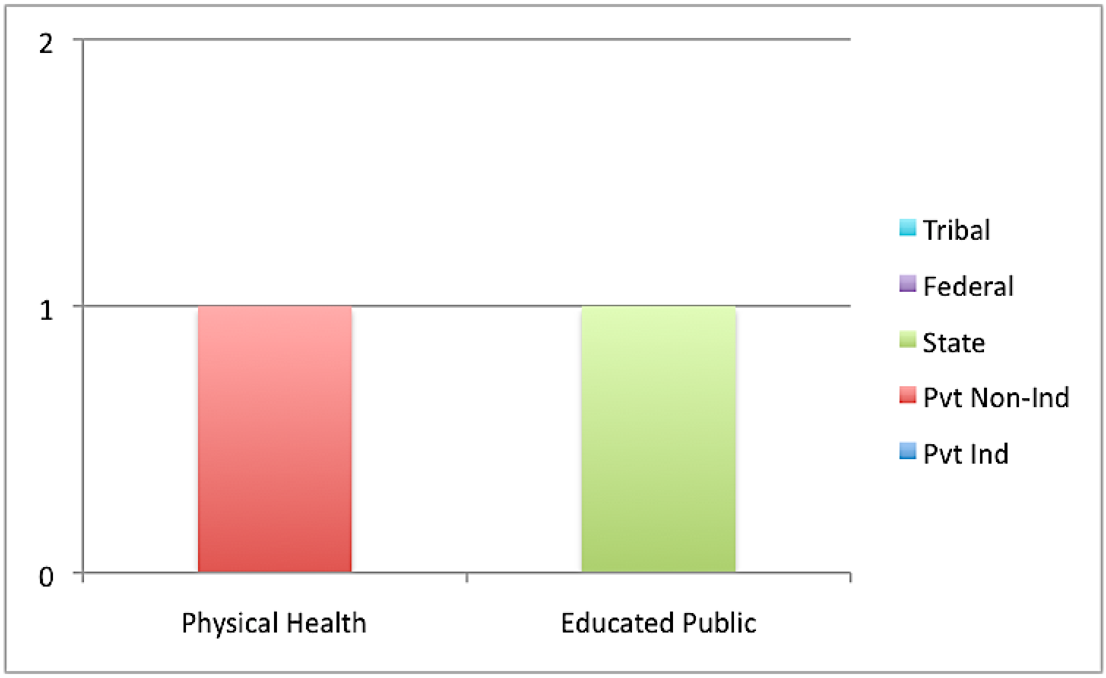


Figure 6.41. PNW Breakdown of “Individual Dynamics” responses by ownership category.

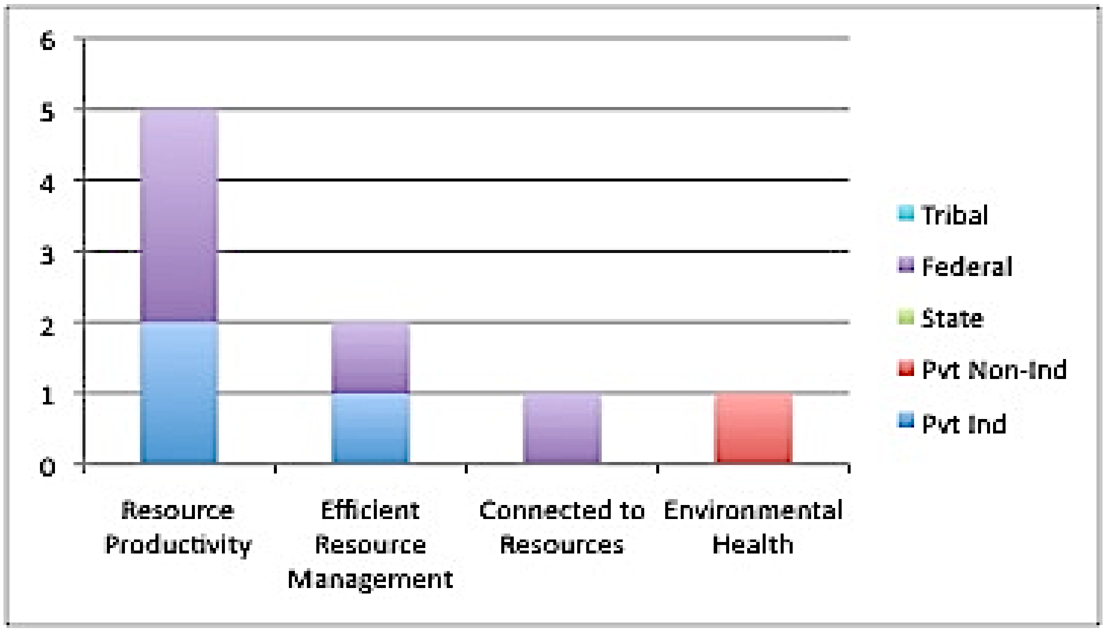


Figure 6.42. PNW Breakdown of "Environmental Dynamics" responses by ownership category.

British Columbia Question Thirteen (b) Results

Managers in BC provided a total of 10 responses to question 13b that could be coded as “Social Dynamics”. The majority of participants indicated that societal resilience could be attributed to a society’s ability to adapt to change and to recover from crises in order to survive (Figure 6.43). Other respondents indicated that effective governance, from the national to the local scale, could lead to societal resilience. As in the PNW, a sense of community, with harmony between different groups, was also important to societal resilience.

The “Economic Dynamics” code was used for seven responses. Within this code, responses indicated that diverse and stable economies, with local employment opportunities, contribute to resilient societies (Figure 6.44). Six responses from BC managers were coded as “Individual Dynamics”. For some, societal resilience could be attributed to the physical health and wellbeing of its citizens, with access to health care services for everyone. An educated public was seen as a contributor to societal resilience. According to one individual, resilient societies result from the flexibility of its citizenry, as flexibility leads to an openness and willingness to accept a variety of opinions and approaches to new situations (Figure 6.45). Eleven responses fit the “Environmental Dynamics” code (Figure 6.46). Respondents attributed societal resilience to the sustainable, long-term management for multiple values of natural resources. In addition, while it was important for some to be able to extract resources from the land in order to create resilient societies, it was also important that forests be kept healthy and that people got out into the forests.

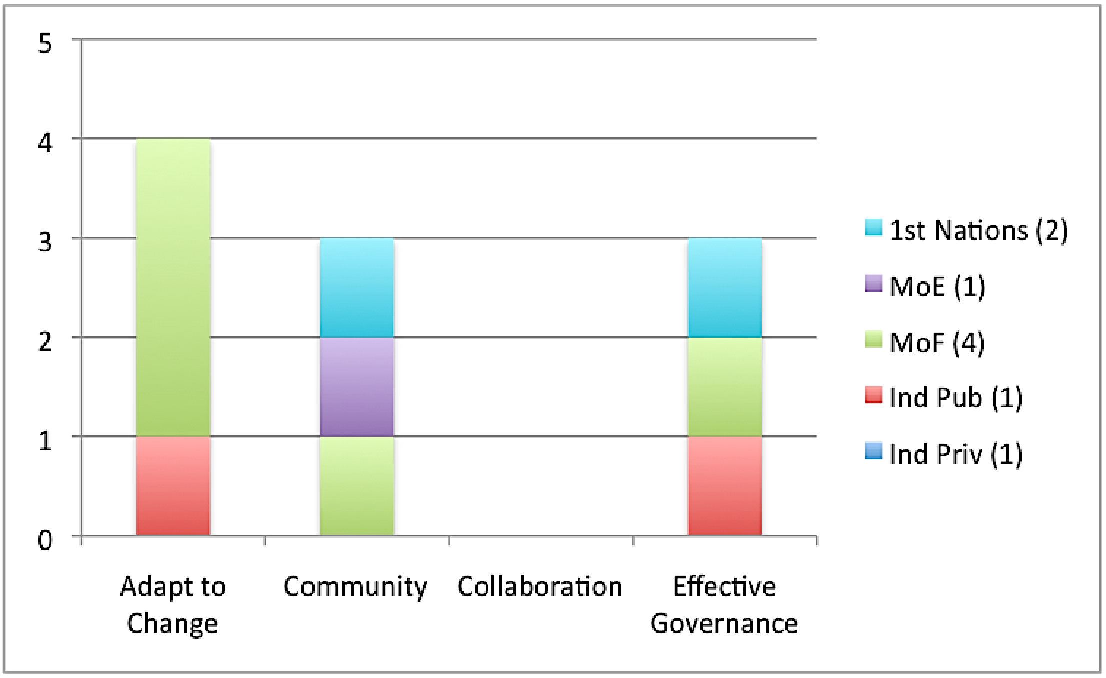


Figure 6.43. BC Breakdown of “Social Dynamics” responses by ownership category.

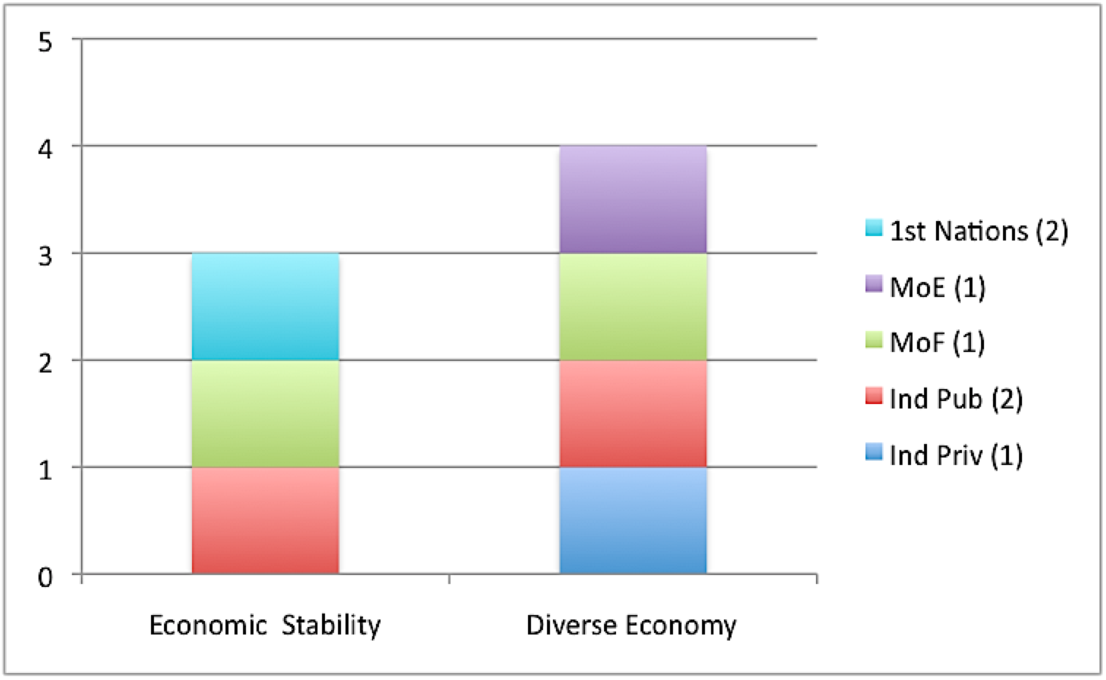


Figure 6.44. BC Breakdown of “Economic Dynamics” responses by ownership category.

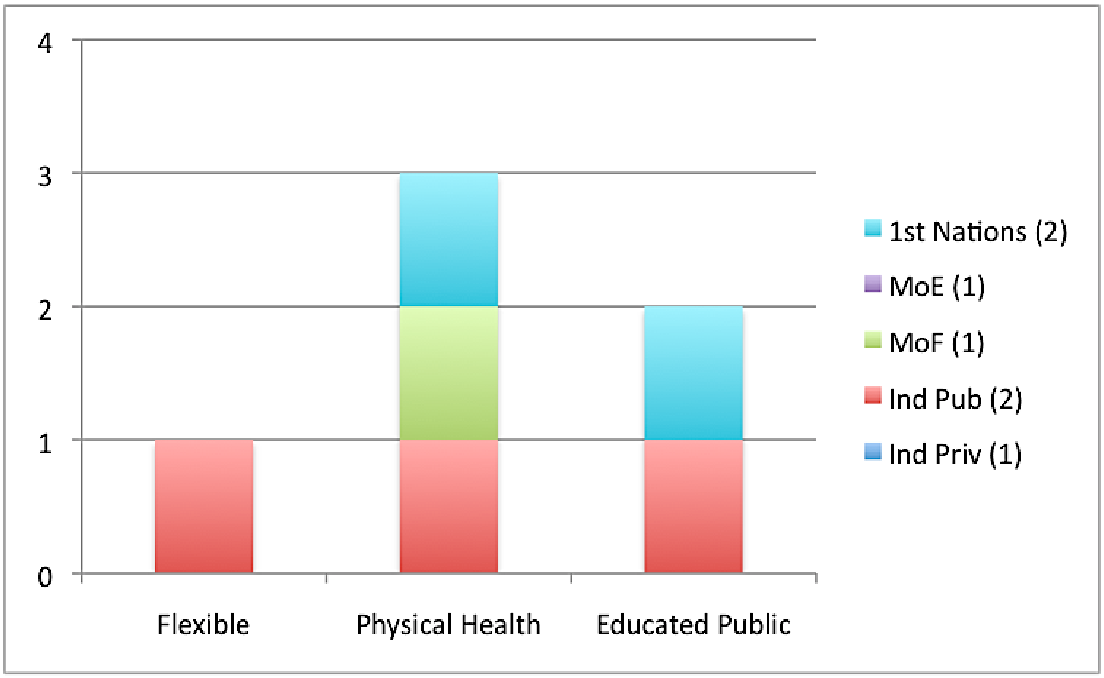


Figure 6.45. BC Breakdown of “Individual Dynamics” responses by ownership category.

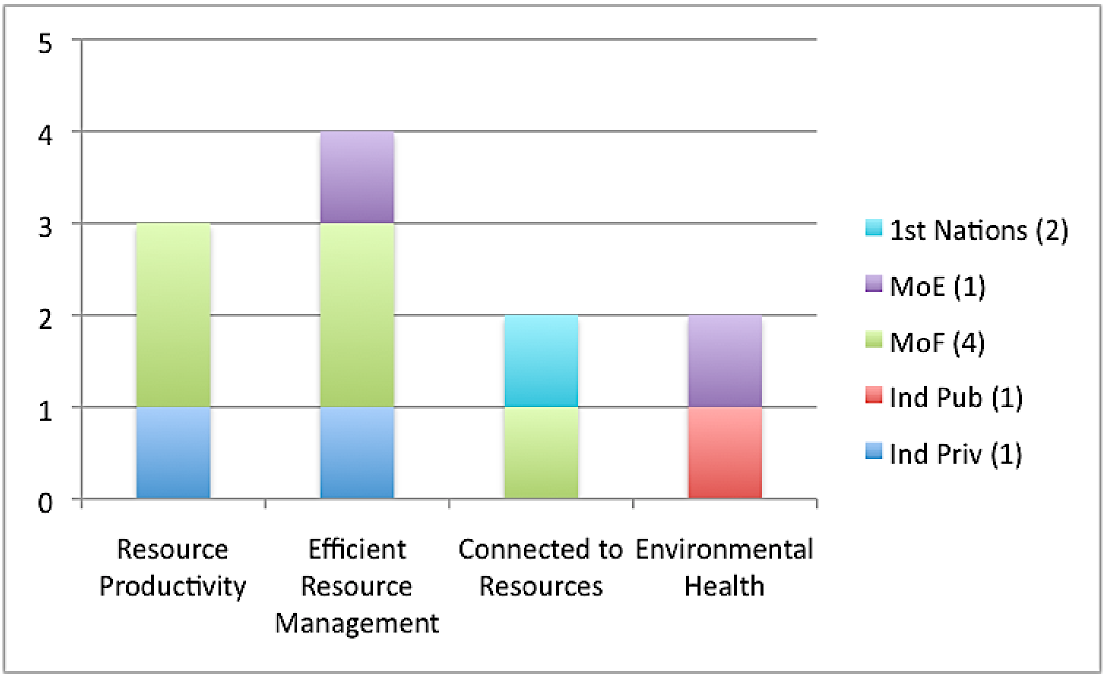


Figure 6.46. BC Breakdown of “Environmental Dynamics” responses by ownership category.

Pacific Northwest and British Columbia Question Thirteen (c) Results

When presented with the question of whether or not resilient forests and resilient societies could exist simultaneously, nearly all participants from both the PNW and BC stated that, yes, they could exist simultaneously (Figures 6.47). In the PNW nine of the ten who provided responses to this question said that resilient forests and resilient societies could exist simultaneously, as did 11 of the 12 respondents from BC (Figures 6.48). One federal manager from the PNW indicated that he/she did not know if both could exist simultaneously, while one Ministry of Forests manager indicated that they could not.

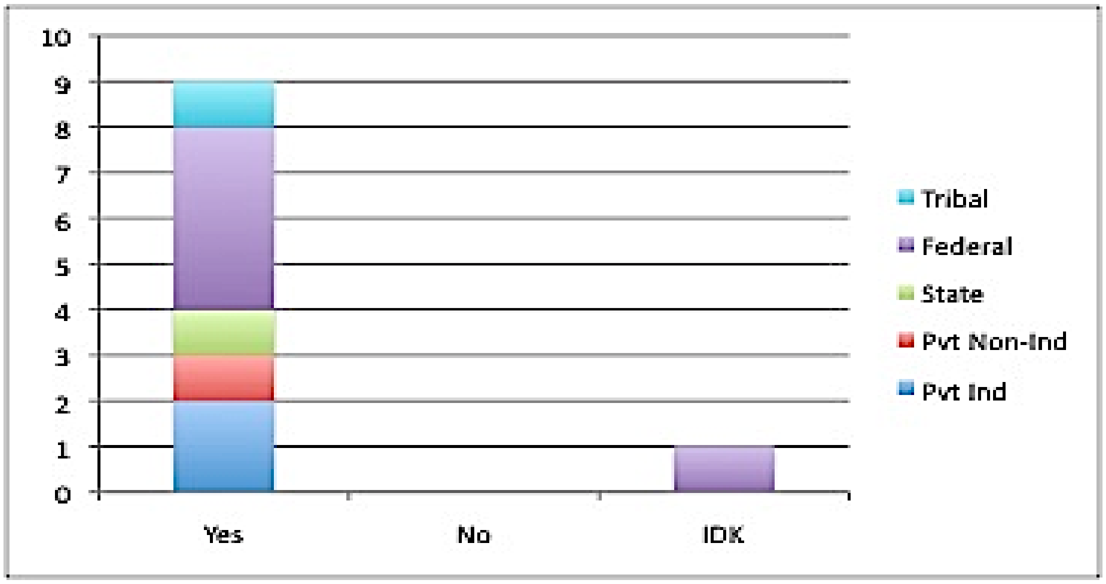


Figure 6.47. PNW Breakdown of Question 13c responses by ownership category.

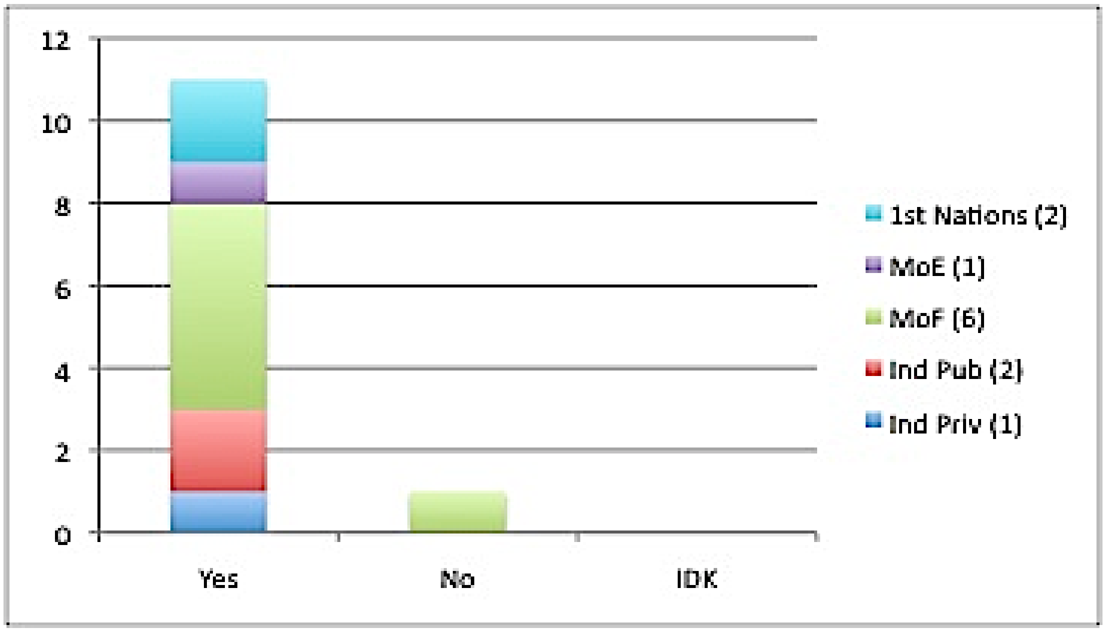


Figure 6.48. BC Breakdown of Question 13c responses by ownership category.

Summary

The participants in the semi-structured interviews in both regions came primarily from the public sector, though many had had experiences in both private and public sector forest management. The managers in both regions had, for the most part, obtained an education in forestry, and sometimes in other fields, that contributed to their perspectives on forest management and to their initial management practices in the field. In addition to education and training, experience and exposure to other professionals contributed to foresters' changing perspectives. The responsibilities of the forestry professionals interviewed varied between regions due to differences in institutional structure. These differences also led to variations in the amounts of forestland for which each individual was responsible and in the policies and regulations that guide those responsibilities.

In spite of some of the differences between the two regions, goals for management were similar and included multi-values management using a combination of extractive and protective techniques as a dominant approach in both regions. The implementation of ecosystem management generally influenced managers' perspectives and practices, primarily by influencing the managers to implement prescriptions for protection or to approach management from a multi-values perspective. However, there were some for whom the implementation of ecosystem management had no effect, though the majority of these cited that they held an ecosystem perspective prior to its implementation as the reason.

When asked about forest resilience, the majority of respondents from both regions attributed forest resilience to a biological mechanism. In the PNW, more respondents indicted that forests are inherently resilient than they did any other biological response, while in BC, the majority attributed resilience to either biodiversity or to the ability to maintain processes and functions. Respondents across both regions attributed societal resilience to societal dynamics, and, within that category, primarily to a society's ability to adapt to change. Within each region, 11 out of 12 participants felt that it was possible to concurrently have resilient forests and resilient societies, while one from the PNW was unsure if it were possible and one from BC felt that it was not possible.

This chapter has consisted of the content analysis of the semi-structured interviews. The forthcoming chapter is dedicated to the analysis of land-cover change. The first section consists of the results from ERDAS Imagine and ArcGIS 10.0 processing, and also provides a visualization of forest cover in each of the years of interest for both regions as well as composite maps that visualize changes in forest cover over time. The second part of the chapter consists of the results from the zonal statistics and the Wilcoxon signed-rank statistical test.

CHAPTER SEVEN

ANALYSIS OF FOREST COVER CHANGE

This chapter presents the results from the forest cover change analysis. The first section contains the results of the ERDAS Imagine 9.2 and ArcGIS 10 processing, using maps to display the output visually. The results of the zonal statistics are presented in the second section, which provides information on area and hectare measurements for each year analyzed within the areas of interest.

Change Detection Mapping

The outcome of the change detection processes in ERDAS Imagine 9.2 and ArcGIS 10 is a series of maps depicting forest cover change in the areas of interest. The first map set displays the forested areas for each year examined in each study area. The second map set includes the overlaid layers of forest cover between two selected years (the start year and the year of policy implementation, the year of policy implementation and the year of the second policy implementation (in BC only), between the year of policy implementation and the end year, and then the change from the first and last years.

Pacific Northwest Map Results

The central coastal region of Oregon lost forest cover from 1984 to 2008. The amount of existing forested land has changed dramatically from 1984 to 1995 and from 1995 to 2008 (Figures 7.1, 7.2 and 7.3). Visually examining the images reveals less forest cover in each successive image, with 2008 appearing to have the least. Zonal statistics, discussed in a later section, provide indications of forest cover change across ownership categories.

To examine the difference in forest cover between 1984 and 1995—the year after the implementation of the NWFP—the layers from both years were overlaid (Figure 7.4). Visual appearances again indicate less forest cover in 1995 than in 1984, resulting in a loss of total forest area over the 11-year period. The layering of the years 1995 and 2008 (i.e. from the commencement of the NWFP implementation to the beginning of the economic downturn) also portrays a loss of forest (Figure 7.5). It is once more visually apparent that the central coastal region of Oregon again experienced a decrease in forest cover between the years 1995 and 2008.

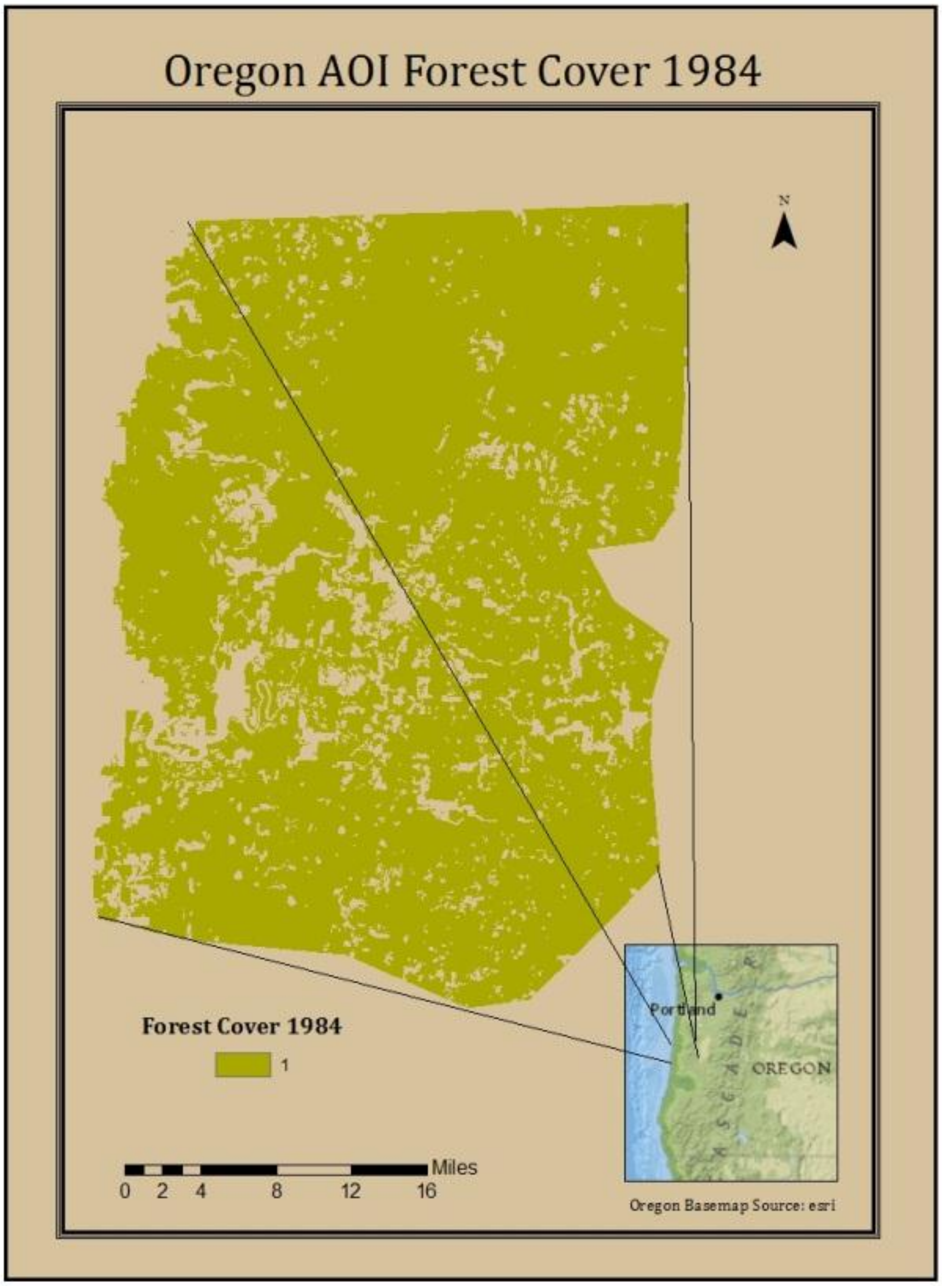


Figure 7.1. Forest cover in 1984 within AOI in Oregon.

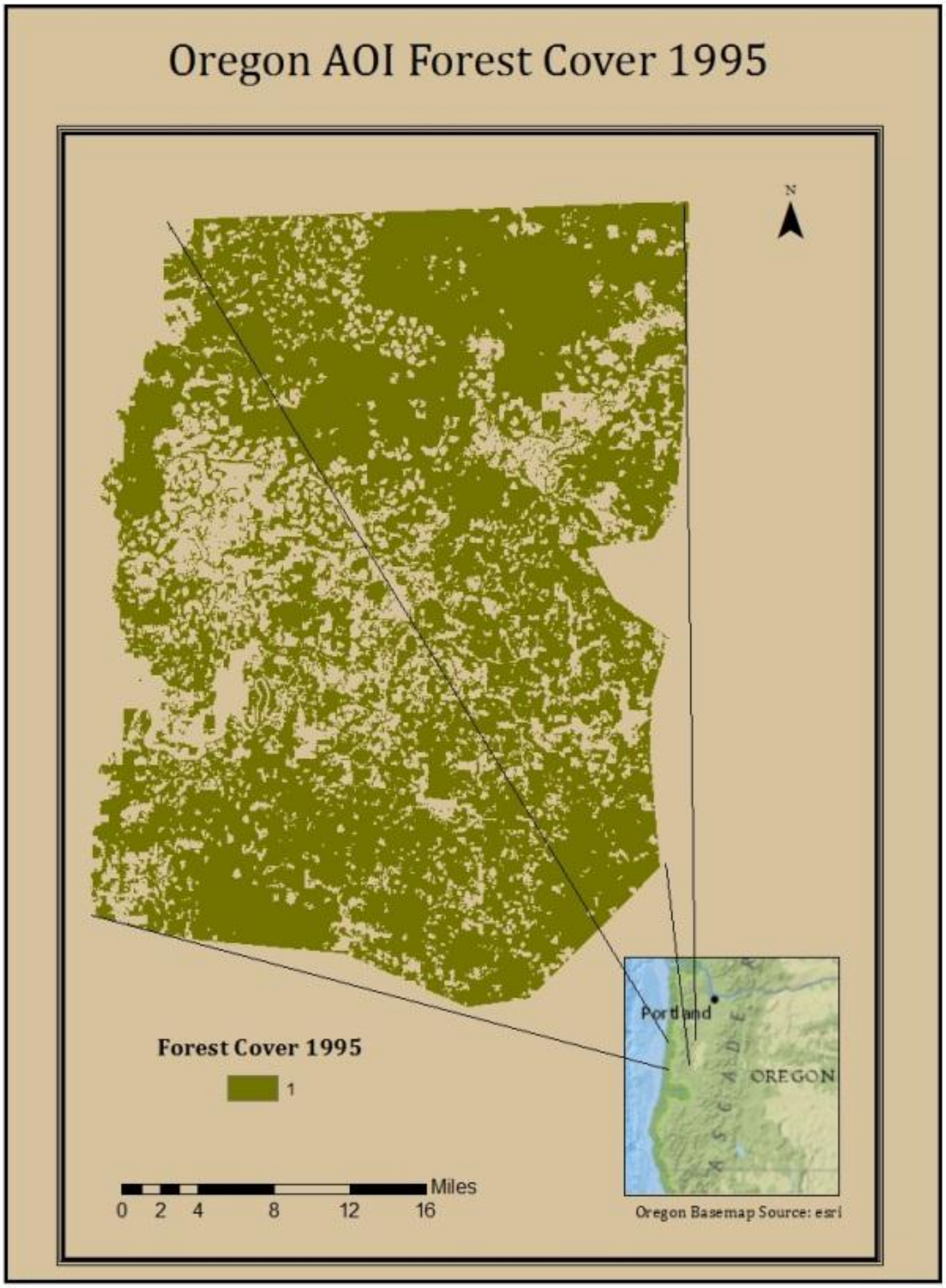


Figure 7.2. Forest cover in 1995 within AOI in Oregon.

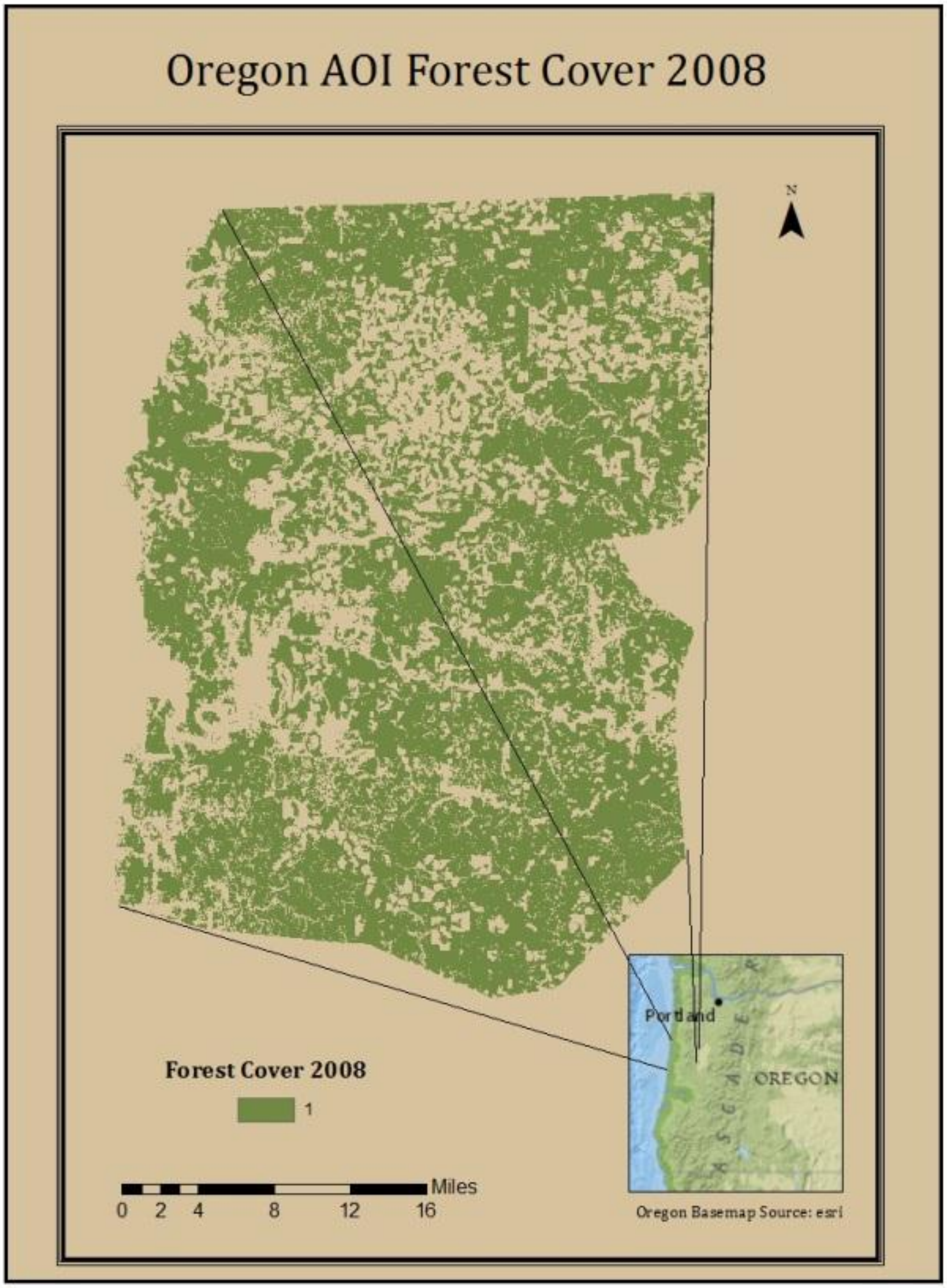


Figure 7.3. Forest cover in 2008 within AOI in Oregon.

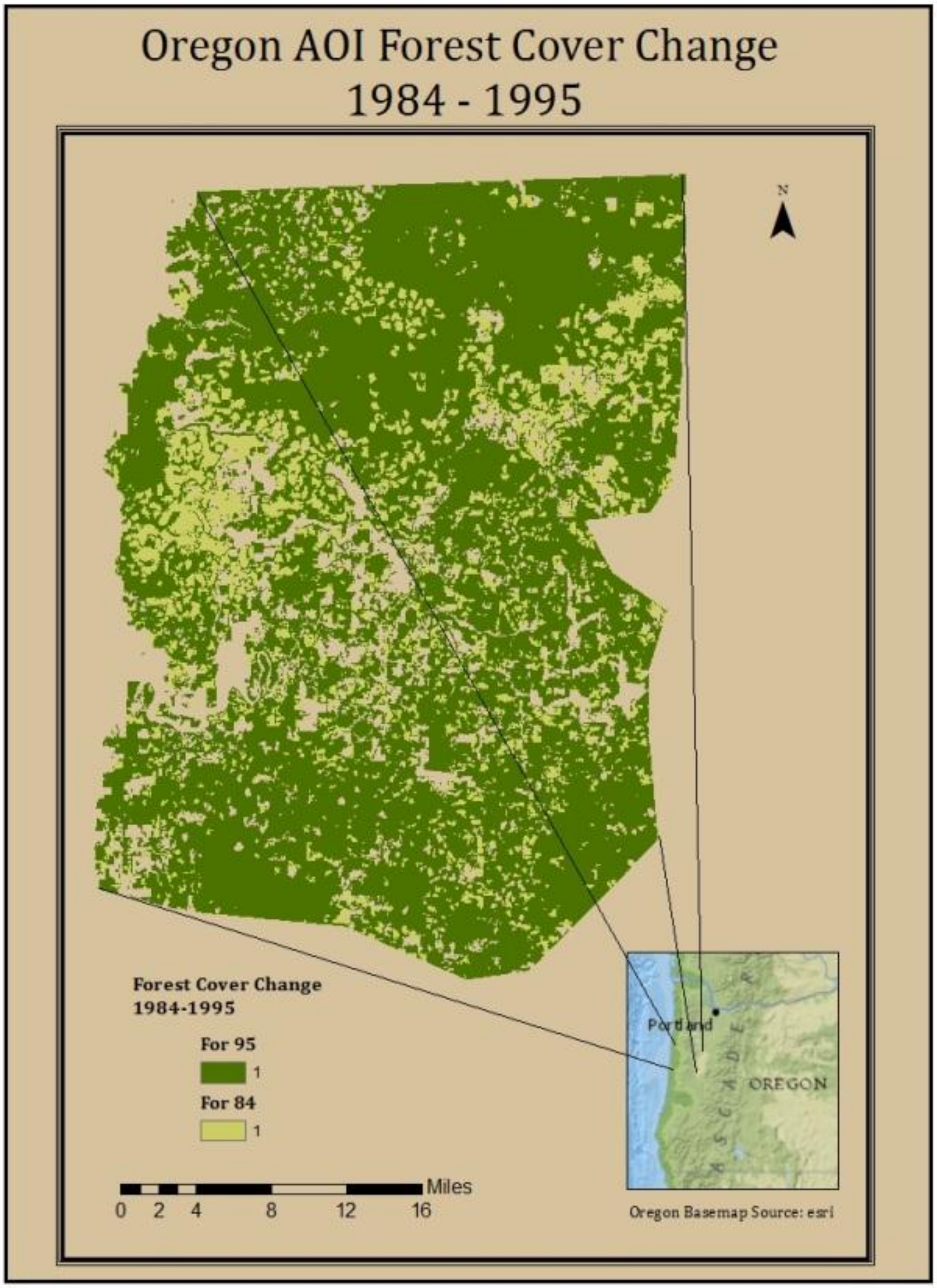


Figure 7.4. Forest cover change between 1984 and 1995 within AOI in Oregon.

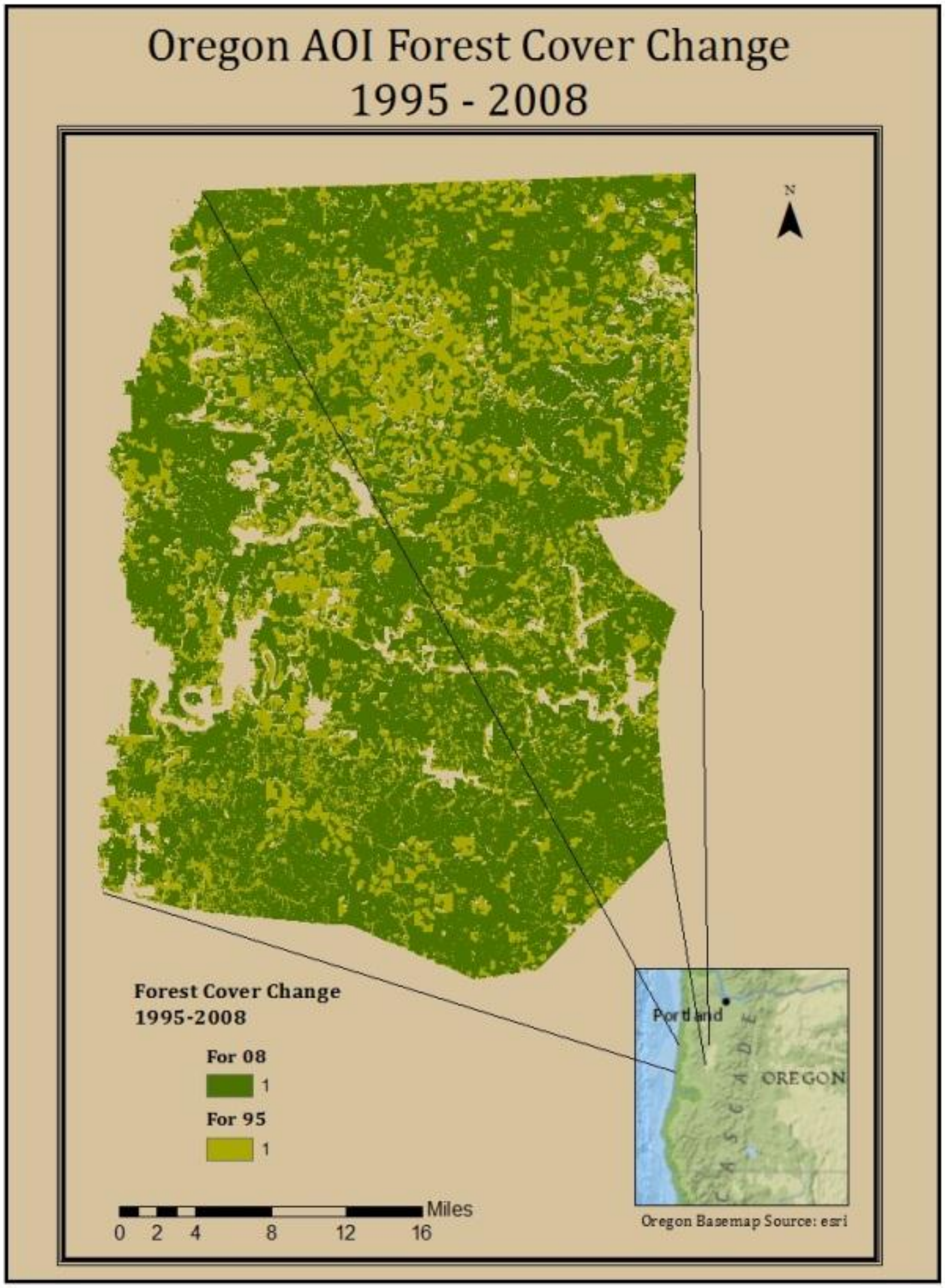


Figure 7.5. Forest cover change between 1995 and 2008 within AOI in Oregon.

To visualize the changes in forest cover over the entire study period, the images from 1984, 1995, and 2008 were stacked. This produced the single image of forest cover change between 1984 and 2008 (Figure 7.6). A visual examination of this photo indicates that 2008 had the least amount of forest cover, while 1984 had the greatest.

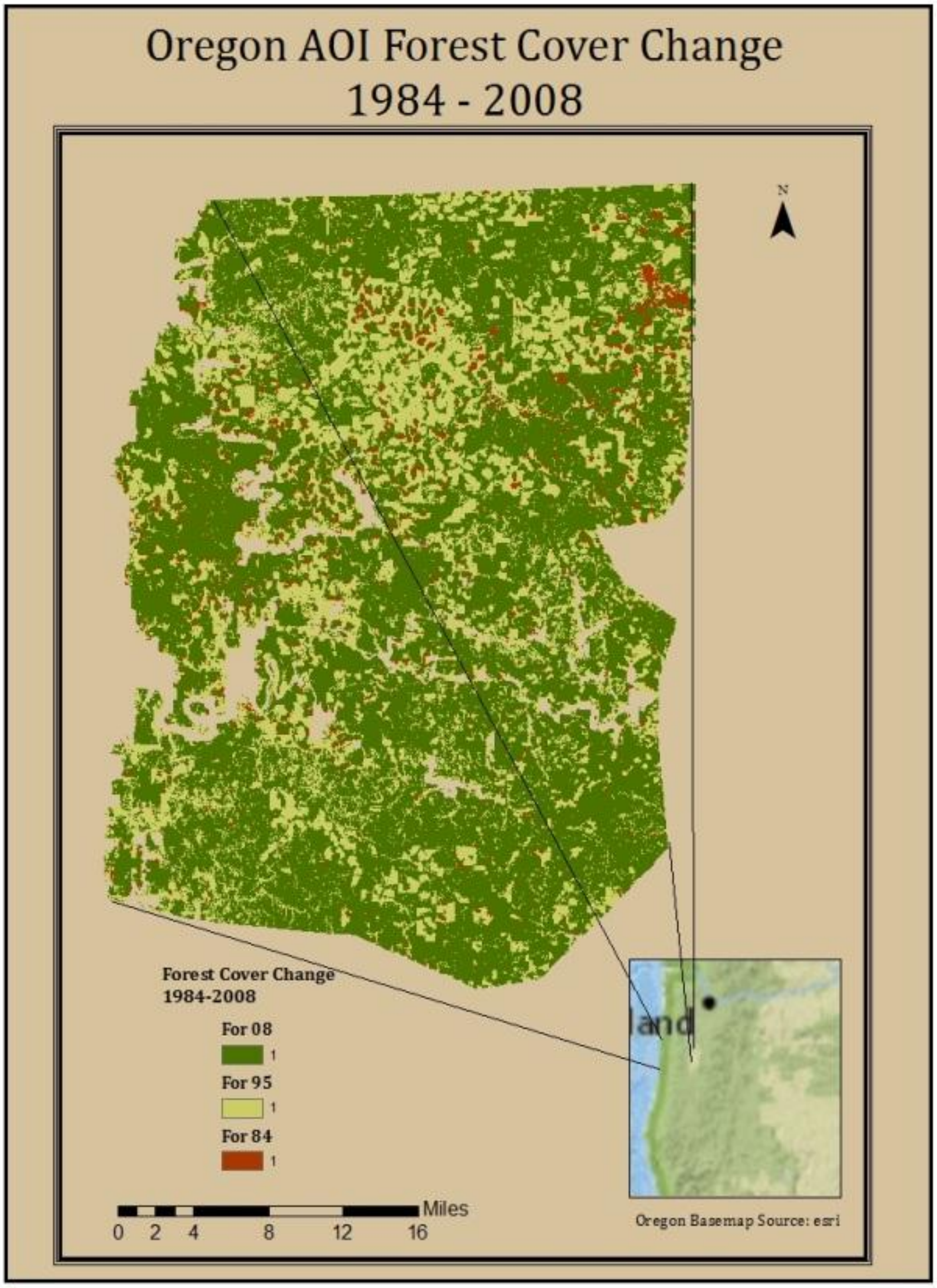


Figure 7.6. Forest cover change between 1984 and 2008 within AOI in Oregon.

Analysis of forest cover between 1984 and 2008 reveals that forest cover decline was also experienced in Washington's Olympic Peninsula region. A visual examination of the images for the years 1984, 1995, and 2008 seem to indicate less forest cover existed in each successive year (Figures 7.7, 7.8 and 7.9). Zonal statistics will be used to evaluate the amounts of forest cover change that occurred across owner classes and these will be discussed later.

The stacked 1984 and 1995 (the year immediately following the implementation of the NWFP) images display the changes in forest cover between the two years (Figure 7.10). The difference between forest cover in 1995 and forest cover in 2008—the time period of interest following the implementation of the NWFP—is similarly displayed in Figure 7.11. The image indicates a loss of forest cover between 1995 and 2008. The final, stacked, multi-temporal image (Figure 7.12) represents forest cover change in the Washington AOI between 1984 and 2008. As with the similar analysis of the central coastal region of Oregon, there appears to be a successive decline of forest cover over the 24-year period examined in this study.

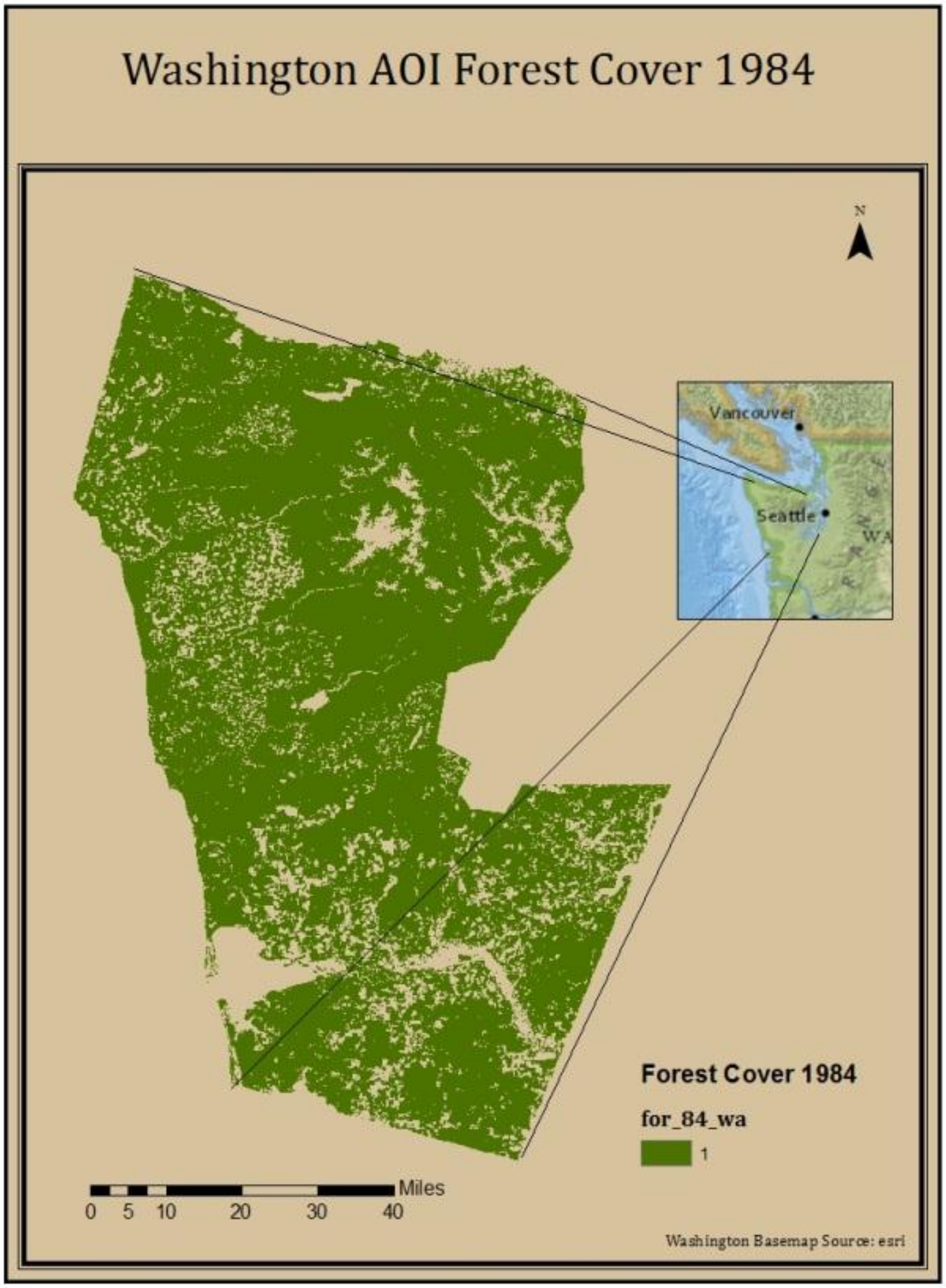


Figure 7.7. Forest cover in 1984 within AOI in Washington.

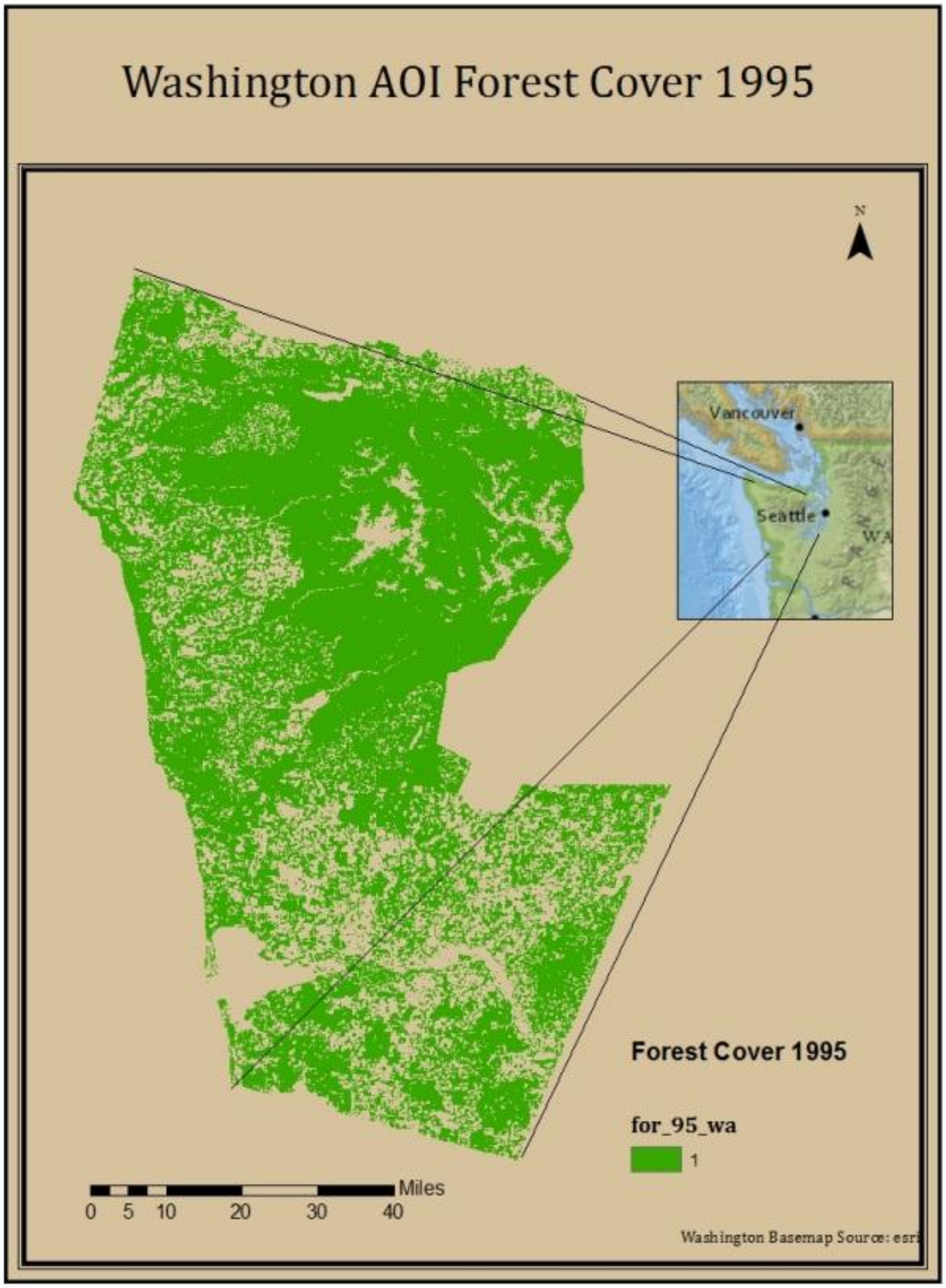


Figure 7.8. Forest cover in 1995 within AOI in Washington.

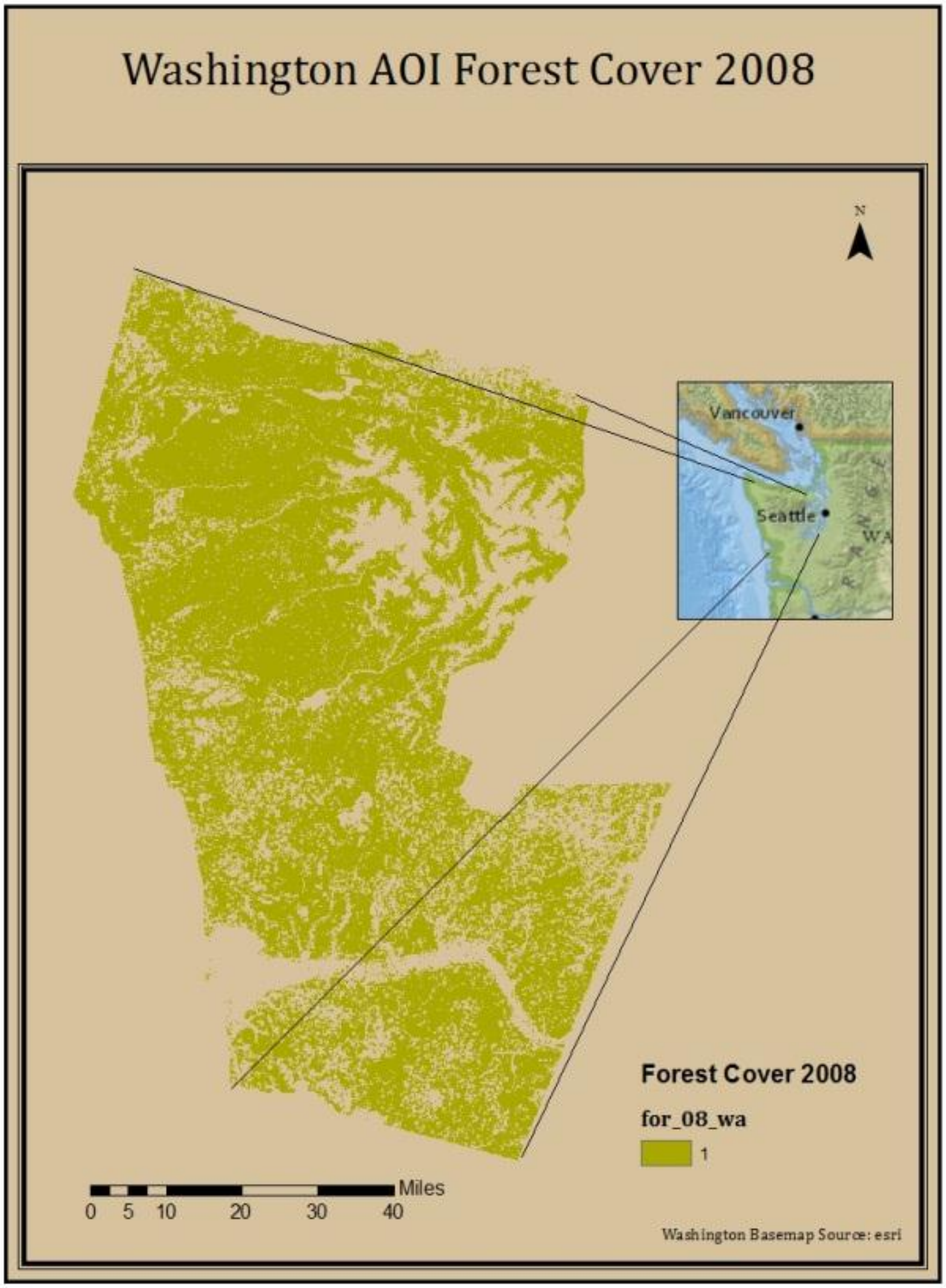


Figure 7.9. Forest cover in 2008 within AOI in Washington.

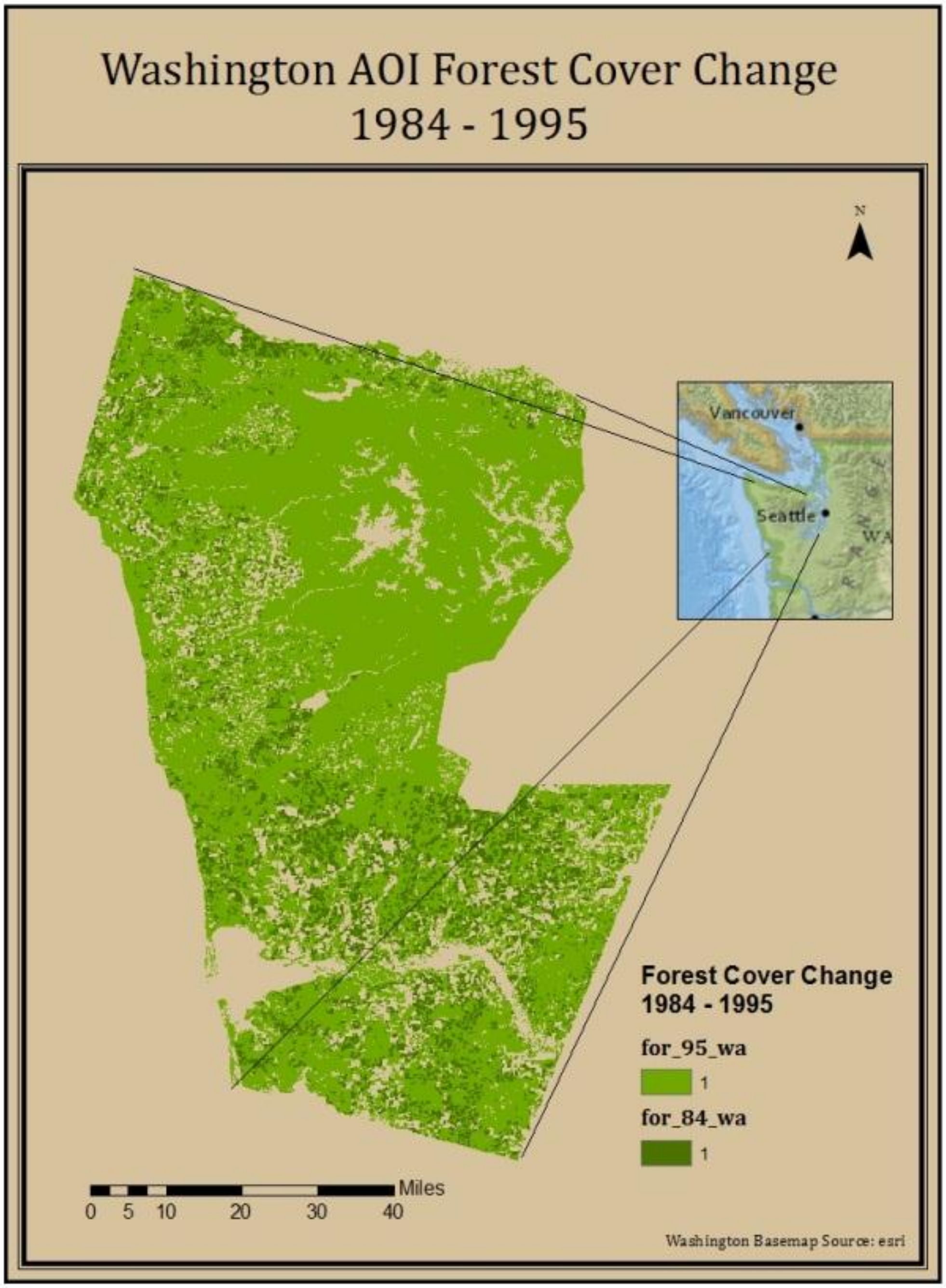


Figure 7.10. Forest cover change between 1984 and 1995 within AOI in Washington.

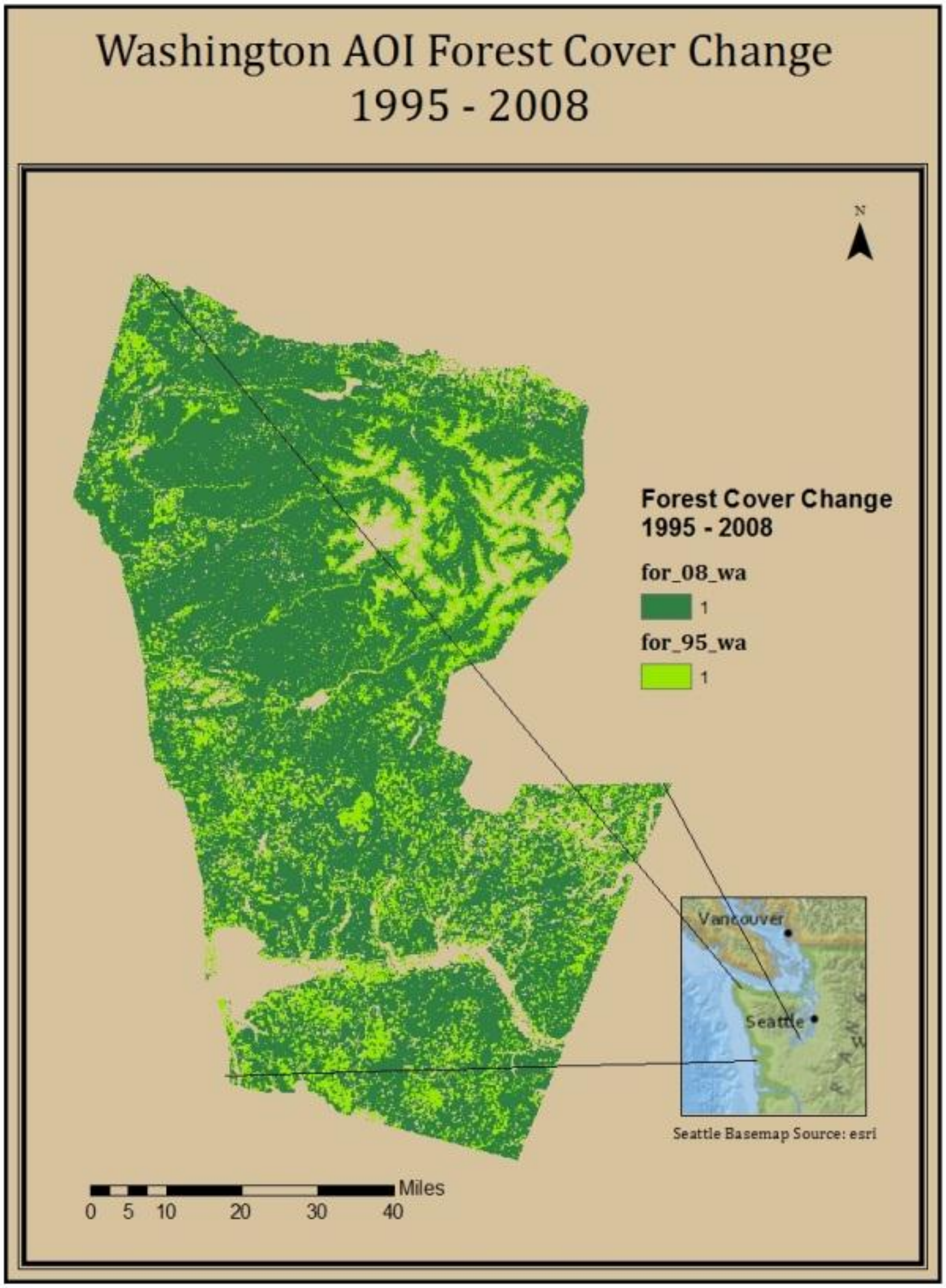


Figure 7.11 Forest cover change between 1995 and 2008 within AOI in Washington.

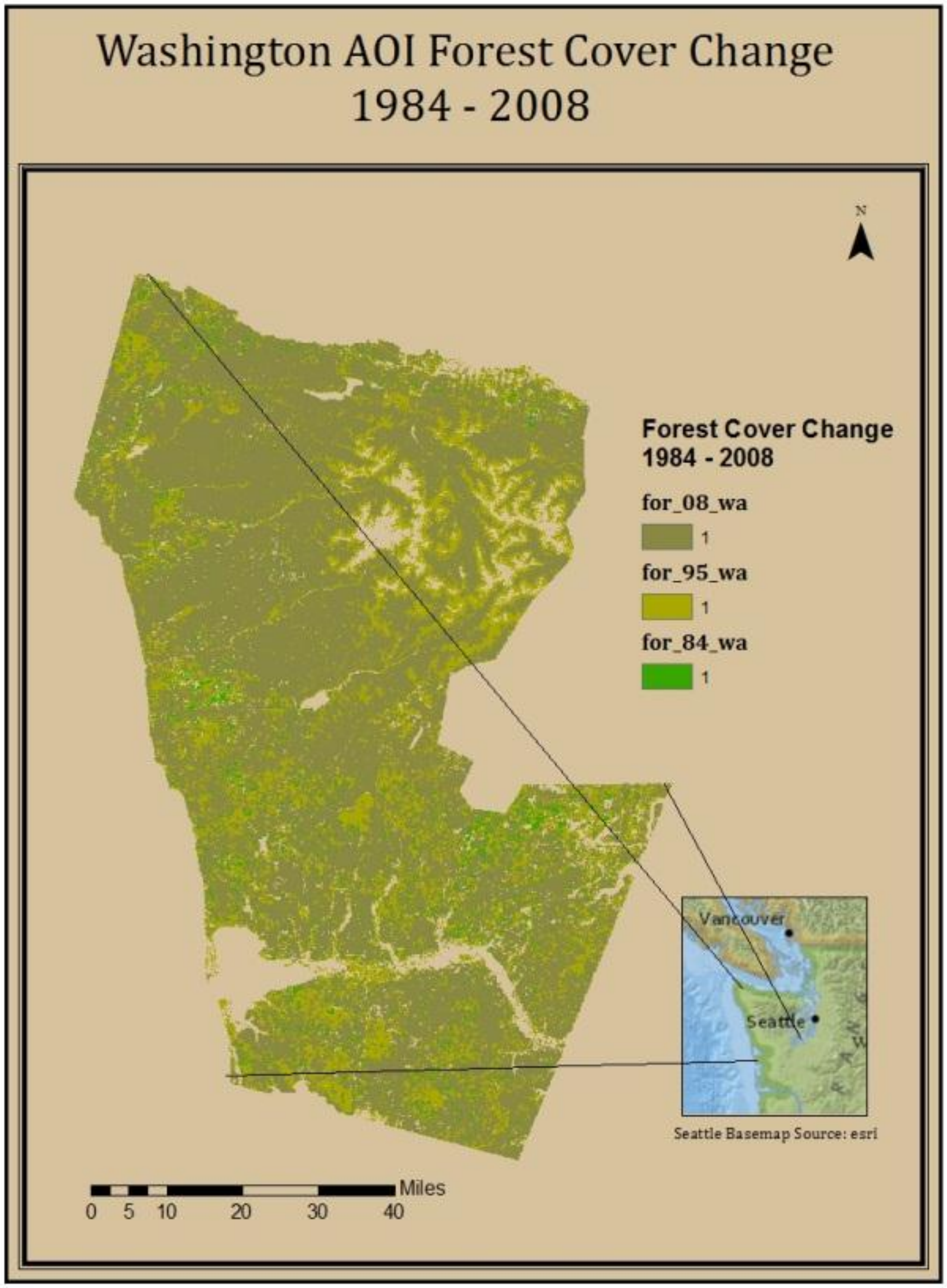


Figure 7.12. Forest cover change between 1984 and 2008 within AOI in Washington.

British Columbia Map Results

BC experienced two changes in forest management policy during the period of this study. As such, forest cover change was assessed prior to and following both policies. Analysis reveals a less straightforward trajectory of change from 1985 to 2008 in BC. The forest loss over time is less apparent in BC than it was in the PNW (Figures 7.13, 7.14, 7.15 and 7.16).

The first change of policy in BC occurred in 1995, with the implementation of the FPC, while the second change occurred with the implementation of the FRPA in 2005. To visualize the differences in forest cover in 1985 and in 1994, just prior to the implementation of the FPC, the two images were stacked (Figure 7.17). The same was done for the 1994 and 2005 images; the latter was the year FRPA was implemented (Figure 7.18). It is more apparent that forest cover did decline over these first two time periods than over the next. The period following the implementation of FRPA is much shorter than the previous two periods and perhaps the result is that forest change between 2005 and 2009 seems significantly lower than what is seen in the previous two comparisons (Figure 7.19). The loss of forest cover in the study area in BC over the entire study period (1985 to 2009) is displayed in Figure 7.20. This image reveals a successive decrease in forest cover after 1985. Zonal statistics disclose the distribution of these changes across ownership types.

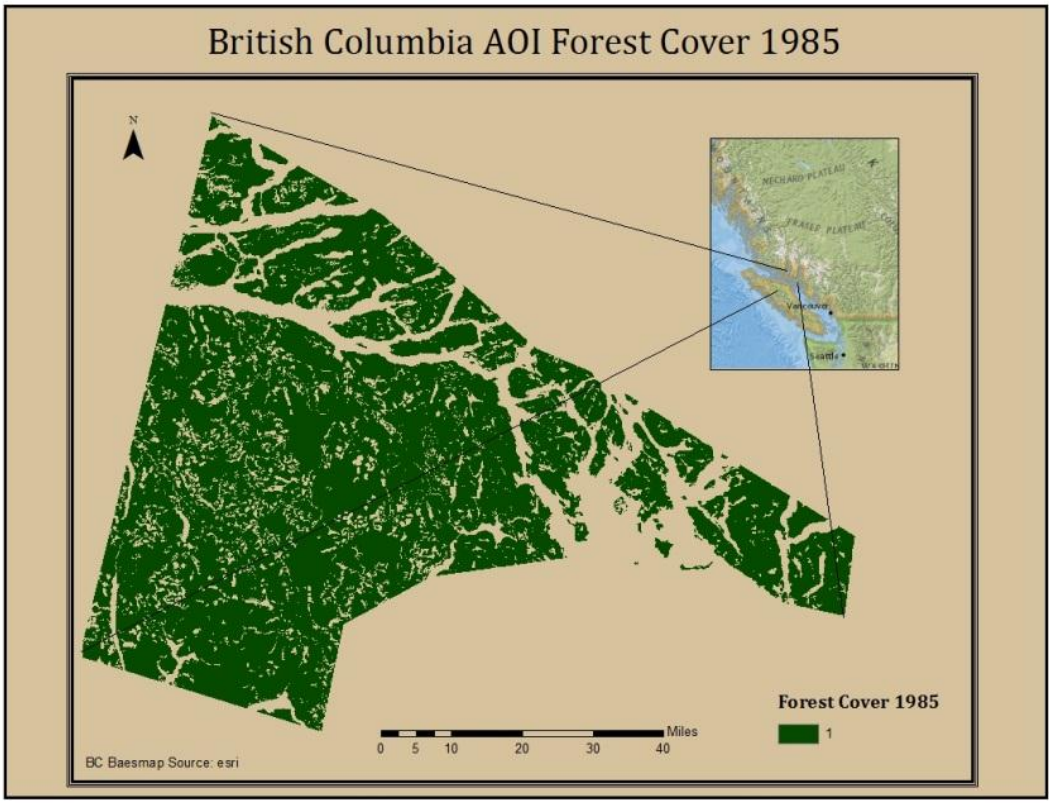


Figure 7.13. Forest cover in 1985 within the AOI in BC.

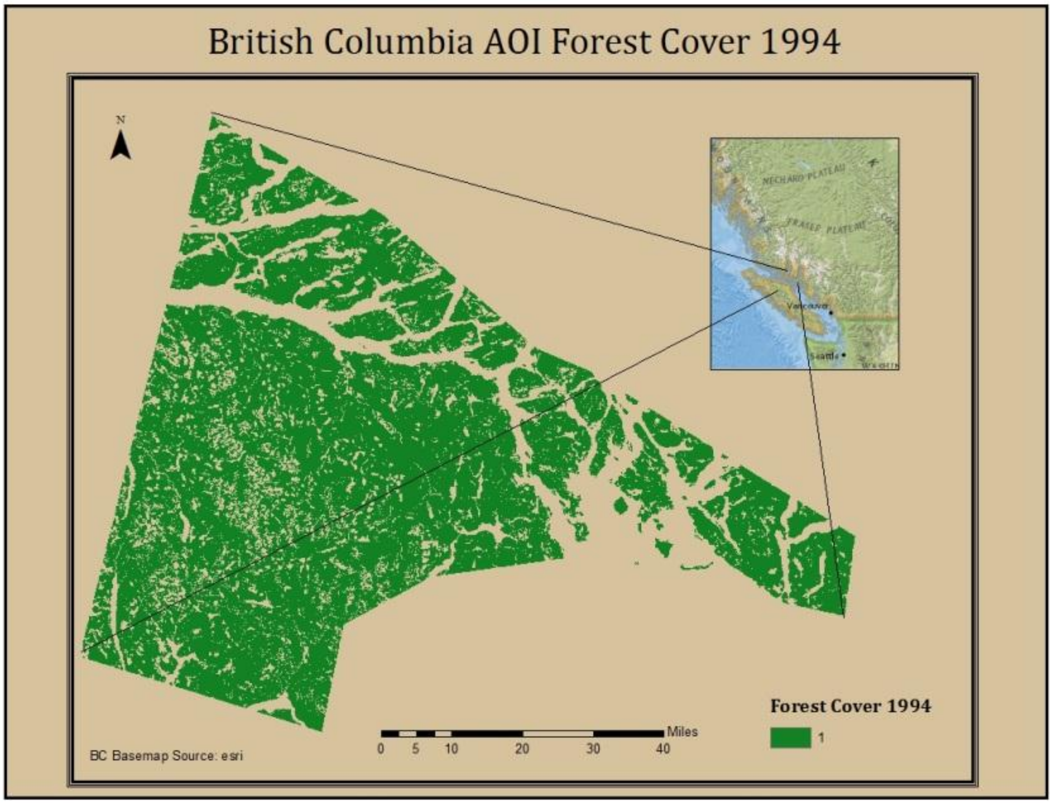


Figure 7.14. Forest cover in 1994 within the AOI in BC.

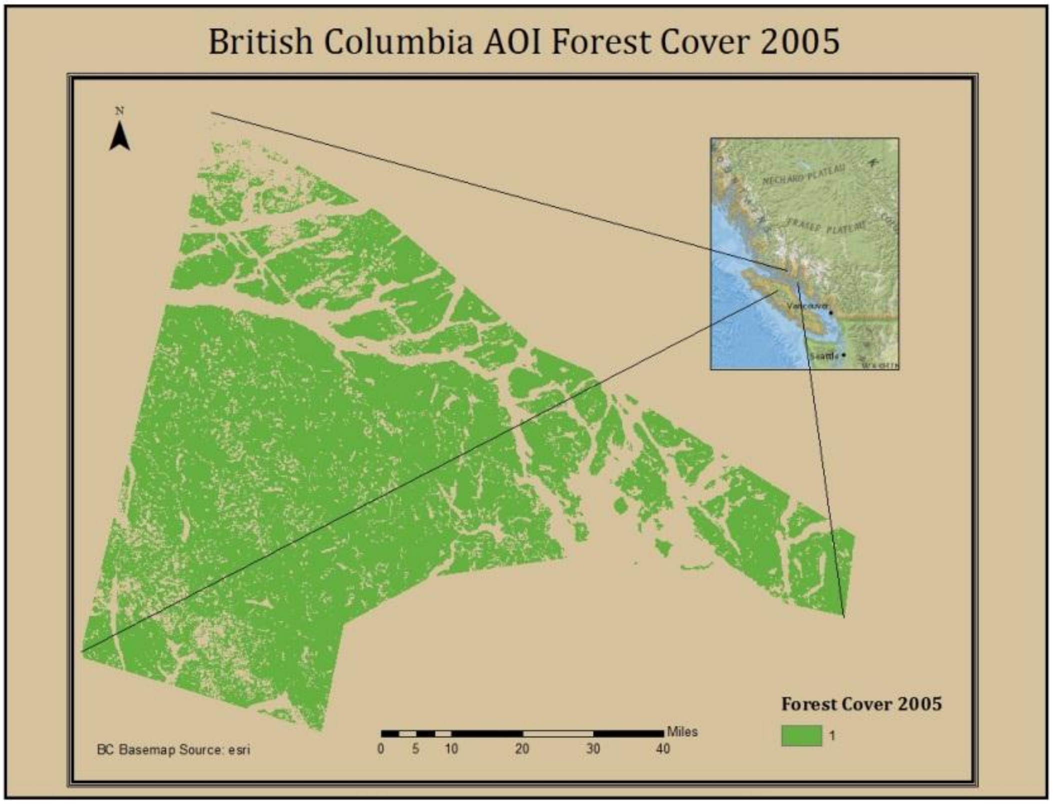


Figure 7.15. Forest cover in 2005 within the AOI in BC.

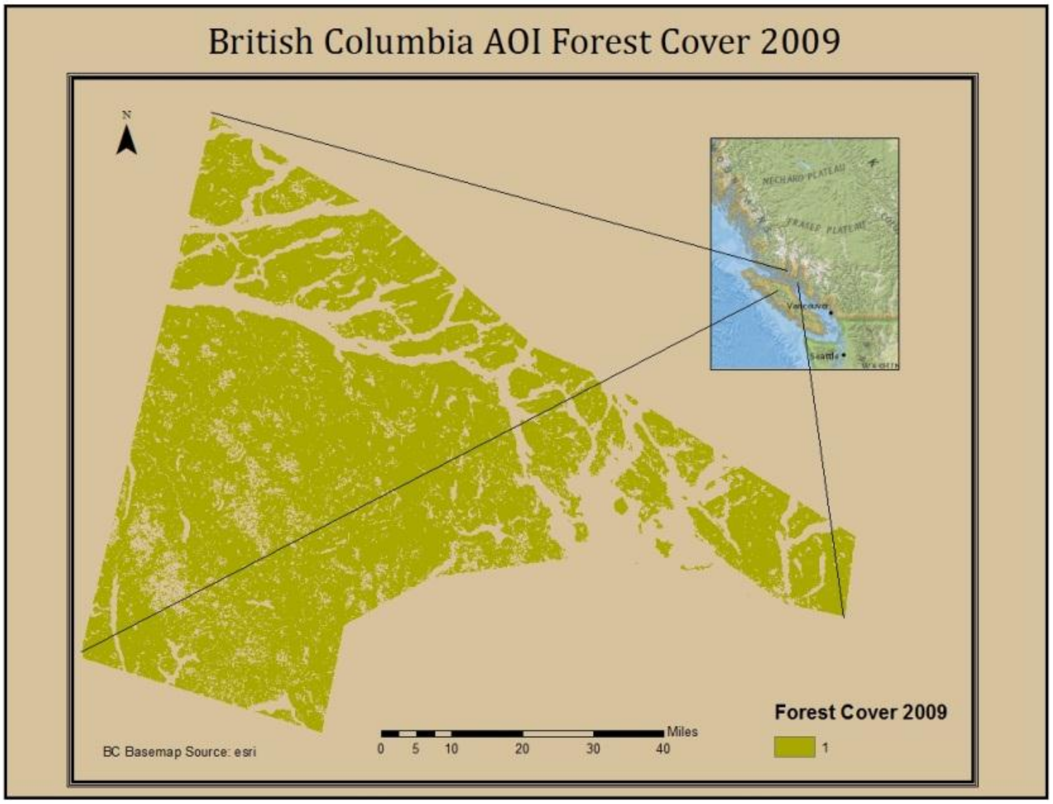


Figure 7.16. Forest cover in 2009 within the AOI in BC.

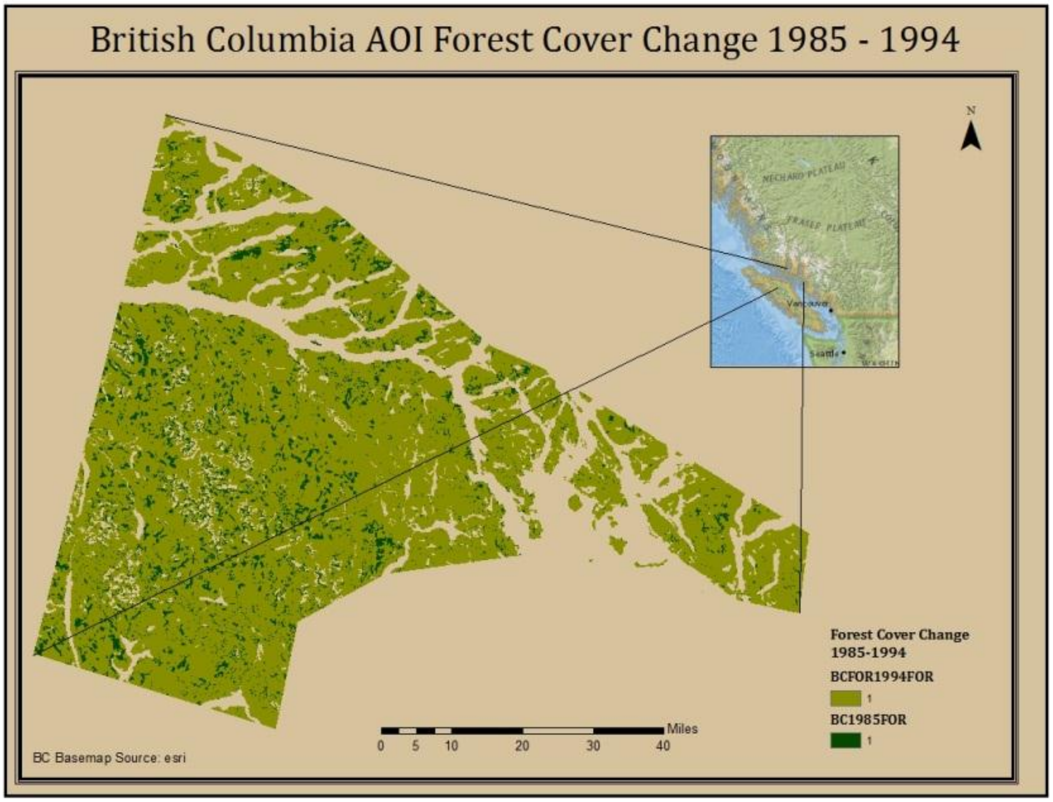


Figure 7.17. Forest cover change between 1985 and 1994 within the AOI in BC.

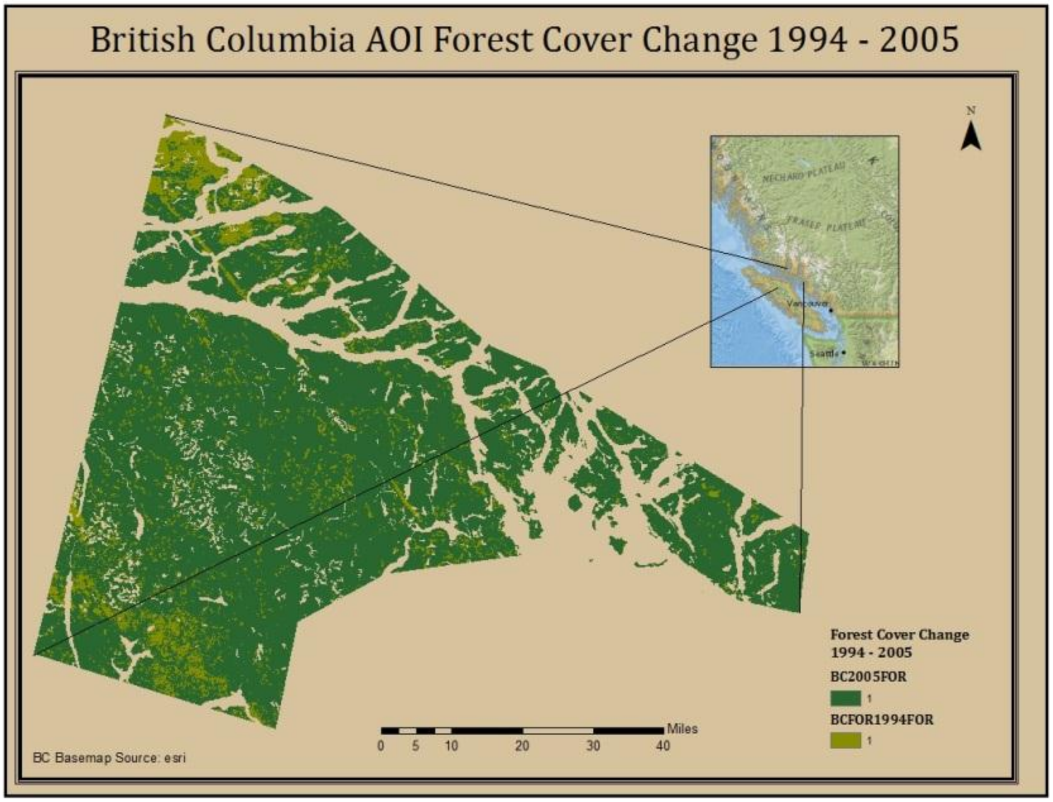


Figure 7.18. Forest cover change between 1994 and 2005 within the AOI in BC.

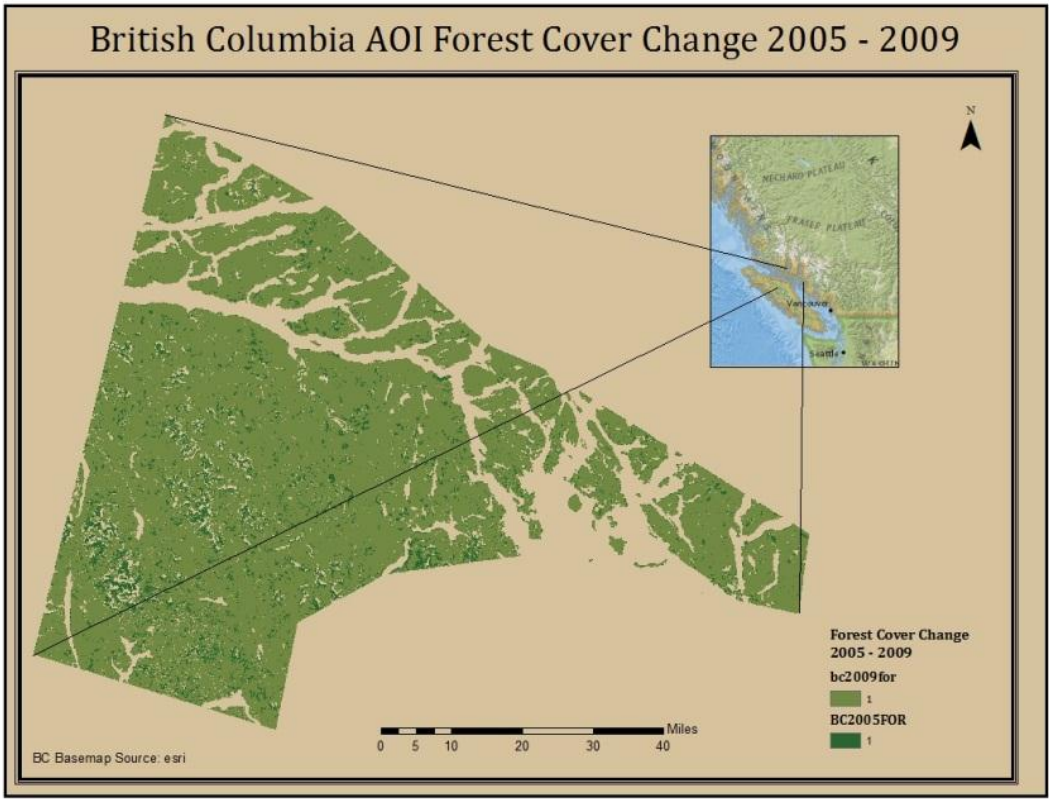


Figure 7.19. Forest cover change between 2005 and 2009 within the AOI in BC.

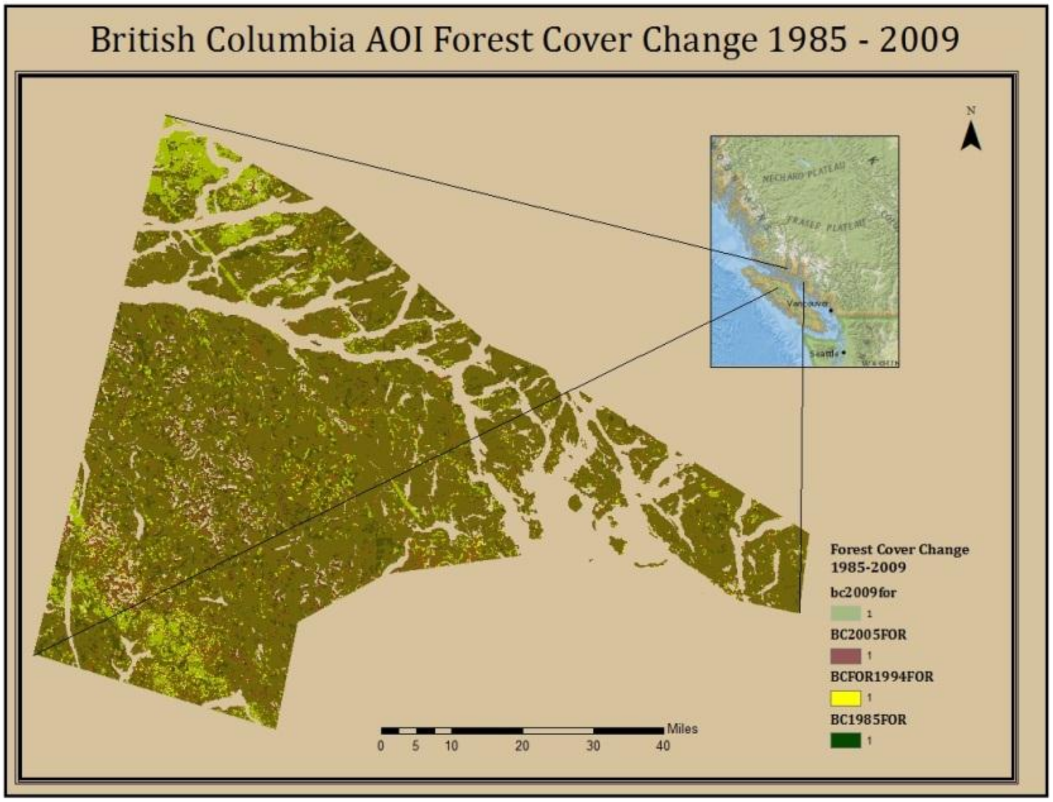


Figure 7.20. Forest cover change between 1985 and 2009 within the AOI in BC.

Pacific Northwest Zonal Statistics Results

Zonal statistics were calculated using the ownership layers and the reclassified forest layers for Oregon and Washington. Zonal statistics measured the area of forest canopy cover (determined, again, from pixel values with a disturbance index of <0) under each ownership variable for each date. The differences between the areas measured from one date to the next express the loss or gain of forest canopy area over time for each of the owner/tenure classes.

Forest canopy cover (in hectares) was determined for each ownership type in Oregon for 1984, 1995, and 2009, as was the percentage of canopy cover for the forest landbase in the AOI under each owner class (Tables 7.1, 7.2, and 7.3). Change, annual average change, percent change, and annual average percent change from 1984 to 1995 and from 1995 to 2008 are displayed in Table 7.4. In Oregon, according to these calculations, the BLM, the state, and private non-industrial owner classes gained forest cover during the period 1995 to 2008. The USFS lands lost forest cover during both periods, though the annual rate of change slowed slightly. The average annual rate of change also decreased on the private industrial land subsequent to the implementation of the NWFP. In terms of percentage of the ownership landbase, federal forestlands, and more specifically USFS and BLM lands, maintained a higher percentage of the forest base over the time period of this study, with the exception of PNI lands, which represent an insignificant portion of the total study area forestbase. Of the owner classes with a significant presence on the landscape, private industrial forestlands experienced the greatest loss of forest

Table 7.1. 1984 Forest Cover in Oregon AOI.

Owner	Total Forestland Hectares	Canopy Cover Hectares	% Canopy Cover
USFS	39373	36585	92.92
BLM	28469	26864	94.36
BIA	1443	1317	91.27
STATE	14848	13395	90.21
PI	185848	165829	89.24
PNI	31	18	58.06

Table 7.2. 1995 Forest Cover in Oregon AOI.

Owner	Total Forestland Hectares	Canopy Cover Hectares	% Canopy Cover
USFS	39373	34209	86.88
BLM	28469	24891	87.43
BIA	1443	913	63.27
STATE	14848	11175	75.26
PI	185848	130096	70.00
PNI	31	14	45.16

Table 7.3. 2008 Forest Cover in Oregon AOI.

Owner	Total Forestland Hectares	Canopy Cover Hectares	% Canopy Cover
USFS	39373	31679	80.46
BLM	28469	25486	89.52
BIA	1443	835	57.87
STATE	14848	11261	75.84
PI	185848	113747	61.20
PNI	31	25	80.65

Table 7.4. 1984-2008 Forest Cover Change in Oregon AOI.

Owner	Δ 84-95 (ha)	Ave Ann Δ 84-95 (ha)	% Canopy Cover Δ	Ave Ann % Can CovΔ	Δ 95-08 (ha)	Ave Ann Δ 95-08 (ha)	% Canopy Cover Δ	Ave Ann % Can CovΔ
USFS	-2376	-216	-6.04	-0.55	-2530	-195	-6.42	-0.49
BLM	-1973	-179	-6.93	-0.63	+595	+46	+2.09	+0.16
BIA	-404	-37	-28	-2.55	-78	-6	-5.4	-0.42
STATE	-12278	-1116	-14.95	-1.36	+87	+7	+0.58	+0.04
PI	-35733	-3248	-19.24	-1.75	-16349	-1258	-8.8	-0.68
PNI	-4	-.36	-12.09	-1.17	+11	+4	+35.49	+2.73

cover as a percentage of owner landbase.

Similarly, zonal statistics were used to evaluate changes in forest canopy cover from 1984 to 1995 and from 1995 to 2008 by owner type in Washington as well, both in total hectares and as percentages of the owner landbase (Tables 7.5, 7.6, 7.7 and 7.8). No owner class in the Washington study area exhibited a higher average annual rate of change following the NWFP than before its implementation. The BLM and BIA both experienced losses of forest cover, though to a lesser degree from 1995 to 2008 than 1984 to 1995. The USFS, USFW, state, and private industrial properties lost forest cover prior to the implementation of the NWFP, but forest cover increased following the implementation of the NWFP.

In examining the changes to percentage of canopy cover on the owner class landbase, USFS maintained the highest percentage of forest canopy cover on the landbase over the time period of interest. Thus, despite the higher rates of change in percentages seen on private industrial lands, the total percentage of canopy cover on these lands remained considerably lower than the percentage of canopy cover on USFS lands. In the time period from 1995 to 2008, canopy cover on state forestlands increased to nearly the same percentage of the landbase as was seen on USFS lands. By the end of the time period of interest for this study, BIA lands and private industrial lands contained similar percentages of canopy cover on each owner class landbase.

Table 7.5. 1984 Forest Cover in Washington AOI.

Owner	Total Forestland Hectares	Canopy Cover Hectares	% Canopy Cover
USFS	144265	128305	88.94
BLM	47	41	87.23
FWS	37	37	100.00
BIA	81006	72395	89.37
STATE	181865	150771	82.90
PI	586732	500908	85.37

Table 7.6. 1995 Forest Cover in Washington AOI.

Owner	Total Forestland Hectares	Canopy Cover Hectares	% Canopy Cover
USFS	144265	121457	84.19
BLM	47	39	82.98
FWS	37	22	59.46
BIA	81006	59860	73.90
STATE	181865	125737	69.14
PI	586732	360800	61.50

Table 7.7. 2008 Forest Cover in Washington AOI.

Owner	Total Forestland Hectares	Canopy Cover Hectares	% Canopy Cover
USFS	144265	126072	87.39
BLM	47	37	78.72
FWS	37	23	62.16
BIA	81006	54787	67.63
STATE	181865	156169	85.87
PI	586732	388462	66.21

Table 7.8. 1984-2008 Forest Cover Change in Washington AOI.

OWNER	Δ 84-95 (ha)	Ave Ann Δ 84-95 (ha)	% Can CovΔ	Ave Ann % Can CovΔ	Δ 95-08 (ha)	Ave Ann Δ 95-08 (ha)	% Can CovΔ	Ave Ann % Can CovΔ
USFS	-6848	-623	-4.75	-0.43	+4615	+355	+2.9	+0.22
BLM	-2	-0.18	-4.25	-0.39	-2	-0.18	-4.26	-0.33
FWS	-15	-1.36	-40.54	-3.69	+1	+0.08	+2.7	+0.21
BIA	-12535	-1140	-15.47	-1.41	-5073	-390	-6.27	-0.48
STATE	-25034	-2276	-13.76	-1.25	+30432	+234	+16.73	+1.29
PI	-140108	-12737	-23.87	-2.17	+27662	+2128	+4.71	+0.36

British Columbia Zonal Statistics Results

As with the PNW analysis, the ownership layer was laid upon the forest cover layers to calculate zonal statistics in BC. The changes detected from 1985 to 1994 and 1994 to 2005 revealed that the rate of change of non-leased public lands increased following the implementation of the FPC (Tables 7.9, 7.10, 7.11, 7.12 and 7.13). Private crown grant forests gained forest canopy cover prior to the implementation of the FPC, but lost forest canopy cover area after the implementation of the FPC. The average annual rate of forest loss diminished after the FPC on woodlots. Active licenses, community forests, and Indian reserves lost forest canopy cover prior to the implementation of the FPC and gained it following the FPC. In the time period preceding the FPC, active TSA/TFL lands lost a higher percentage of canopy cover on their forestbase, but regained some of that following the implementation of FPC. In the time period following FPC implementation, non-leased public lands lost a significant percentage of canopy cover on the landbase.

The rate of loss on non-leased public lands had increased dramatically following the implementation of the FPC, but that rate of loss diminished significantly after the implementation of FRPA (Table 7.14). Rates of loss increased on woodlots and private crown grant lands from 2005-2009. Indian reserves went from a slight gain to a slight loss subsequent to the implementation of FRPA. Active licenses increased forest gain rates, while community forests experienced diminished rates of gain following FRPA. After the implementation of FRPA, active TSA/TFLs and community forests continued to increase the amount of canopy cover

Table 7.9. 1985 Forest Cover in BC AOI.

Tenure	Total Forestlands Hectares	Canopy Cover Hectares	% Canopy Cover
Non-leased Public	293246	281073	95.85
Woodlot	10451	10278	98.34
Active TSA or TFL	53013	48005	90.55
Community Forest	13798	13414	97.22
Indian Reserve	2281	2257	98.95
Private Crown Grant	54982	49493	90.02

Table 7.10. 1994 Forest Cover in BC AOI.

Tenure	Total Forestlands Hectares	Canopy Cover Hectares	% Canopy Cover
Non-leased Public	293246	273329	93.21
Woodlot	10451	10156	97.18
Active TSA or TFL	53013	42191	79.59
Community Forest	13798	12953	93.88
Indian Reserve	2281	2151	94.30
Private Crown Grant	54982	49809	90.59

Table 7.11. 2005 Forest Cover in BC AOI.

Tenure	Total Forestlands Hectares	Canopy Cover Hectares	% Canopy Cover
Non-leased Public	293246	57855	19.73
Woodlot	10451	10119	96.82
Active TSA or TFL	53013	46497	87.71
Community Forest	13798	13466	97.60
Indian Reserve	2281	2158	94.61
Private Crown Grant	54982	49636	90.28

Table 7.12. 2009 Forest Cover in BC AOI.

Tenure	Total Forestlands Hectares	Canopy Cover Hectares	% Canopy Cover
Non-leased Public	293246	55678	18.99
Woodlot	10451	9871	94.45
Active TSA or TFL	53013	49374	93.14
Community Forest	13798	13504	97.87
Indian Reserve	2281	2129	93.34
Private Crown Grant	54982	47556	86.49

Table 7.13. 1985-2005 Forest Cover Change in BC AOI.

OWNER	Δ 85-94 (ha)	Ave Ann Δ 85-94 (ha)	% Can Cov Δ	Ave Ann % Can CovΔ	Δ 94-05 (ha)	Ave Ann Δ 94-05 (ha)	% Can Cov Δ	Ave Ann % Can CovΔ
Non-leased Public	-7744	-860	-2.64	-0.29	-215474	-19589	-73.48	-6.68
Woodlot	-122	-14	+.99	+0.11	-37	-3	-0.36	-0.03
Active TSA or TFL	-5814	-646	-10.96	-1.22	+4006	+364	+8.12	+0.74
Community Forest	-461	-51	-3.34	-0.37	+513	+47	+3.72	+0.34
Indian Reserve	-106	-12	-4.65	-0.52	+7	+1	+0.31	+0.03
Private Crown Grant	+316	+35	+0.57	+0.06	-173	-16	-0.31	-0.03

Table 7.14. 1994-2009 Forest Cover Change in BC AOI.

OWNER	Δ 94-05 (ha)	Ave Ann Δ 94-05 (ha)	% Can Cov Δ	Ave Ann % Can CovΔ	Δ 05-09 (ha)	Ave Ann Δ 05-09 (ha)	% Can Cov Δ	Ave Ann % Can CovΔ
Non-leased Public	-215474	-19589	-73.48	-6.68	-2177	-544	-0.74	-0.19
Woodlot	-37	-3	-0.36	-0.03	-248	-62	-2.37	-0.59
Active TSA or TFL	+4006	+364	+8.12	+0.74	2866	+719	+5.43	+1.36
Community Forest	+513	+47	+3.72	+0.34	38	+10	+0.27	+0.07
Indian Reserve	+7	+1	+0.31	+0.03	-29	-7	-1.27	-0.32
Private Crown Grant	-173	-16	-0.31	-0.03	-2080	-520	-3.79	-0.95

as a percentage of the landbase, while private crown grants, non-leased public lands, and woodlots all continued to decrease the percentage of the landbase with canopy cover.

Potential Weaknesses of Analyses

These last three chapters contained descriptions of the results of the three components of this study. Each type of analysis has its associated weaknesses and potential for error. Chapter 5 described current topics that were common to the conferences attended. An inherent weakness in this study rests in the number of conferences observed and the types of conferences attended. The number of conferences available was constrained by time, scheduling, and distance. Happenstance dictated the range of conferences available during this period and the period for study confined the selection even more. Attendance at more conferences outside of the period of residence in the region would have yielded more information on current forest management trends. In addition, several of the conferences were broadly focused on natural resource management and not specific to forestry, it is therefore possible that the assessment of current trends in topics important to forest management was inaccurate.

Semi-structured interviews and content analysis can contain opportunities for mistakes and misinterpretation. One opportunity resides in individual perceptions and definitions of terminology and even common language, which could affect the outcome of the content analysis. Further, the researcher can misunderstand the intended meaning of interviewee responses and this can also skew results. In addition, an inherent challenge in interviews is the potential for participants to provide what they believe is the “correct” answer, rather than offering their own perspectives. This can be especially true in a study such as this one, where the topic of interest can be contentious and where often it is perceived that there are only two—opposing—viewpoints. The risk, then, is that the participant desires to choose the “right” response based on their impressions of what the interviewer thinks about the topic at hand. Furthermore, the content analysis process can contain problems, especially because this project is work by a single-researcher the checks and balances that can ensure consistency and catch mistakes among a team of researchers is missing.

And finally, a weakness of the land cover analysis using Landsat imagery is one of resolution. Only the changes that were large enough to influence the disturbance values of pixels would be revealed in this analysis. The categories (forest and non-forest) are discrete and therefore partial changes within an area of 30 square meters on the Earth’s surface may not have been detected. Some harvesting methods, such as clear-cuts, tend to affect areas larger than the resolution however, and thus this method should be adequate in assessing major changes in forest cover that are a result of the most damaging forest management practices and should effectively distinguish trends in forest cover change. Another weakness is that the determination of the cut-off value for disturbance is based on the visual examination of satellite images and disturbance values to assess where the cutoff should be set. Of course, this is subjective and there is potential for error to be introduced in the process of classification. These weaknesses could result in miscalculations that would also affect the results of the zonal statistics.

Another limitation in the land-cover change analysis is that only two classes of landcover were utilized, forest and non-forest, and the span of time between the selected dates is long enough that disturbances which occurred in the very beginning of a time span could have regenerated sufficiently enough to produce a canopy that would then be considered forested rather than disturbed. Finally, this work examines only a subset of the forestbase in the coastal forest regions of the PNW and BC. It contains a sample of the various landowner classes, but some owner classes, such as the USFS are under-represented in the selected area. A study of the entire coastal region would provide a more complete picture of the changes in canopy cover across the forest landbase.

Summary

Analyses of forest canopy cover change indicated that there were variations in the patterns of forest-cover change that seemingly coincides with changes in policy in both the PNW and BC. Maps depicting a visualization of the changes in forest cover preceding and subsequent to policy changes reveal an overall loss of forest cover in the PNW and BC over the time period of interest in this study. The results of zonal statistics, however, indicate that the variations seen were dissimilar in the two regions and, also, between owner and tenure designations within each region.

In the PNW, rates of loss following the implementation of the NWFP diminished across all owner classes, with some owner classes experiencing a gain in forest canopy cover in the period from 1995-2008. In BC, the patterns of change following policy implementation were different than those seen in the PNW. With the implementation of the FPC, rates of loss diminished over four of the six owner classes, and notable increases in forest canopy cover occurred on active TSA and TFL lands. However, the rates of loss increased on private lands and, significantly, on public non-leased lands. Another change was observed following the implementation of FRPA. Rates of loss again increased on three tenure designations, and the rate of loss on public non-leased lands diminished from the period following the FPC. On active TSA and TFL lands, the rates of gain actually increased.

This study is comprised of three separate components: conference observations, content analysis of semi-structured interviews, and analysis of forest-cover change. With each component there is a risk of error and misinterpretation due to inherent factors in the processes used and to researcher error. Efforts have been made to ensure minimal error given the parameters of this project. Baring in mind these potential errors and misinterpretations, what follows in the next chapter is a discussion of the findings from all analyses. The findings will be presented individually, with conference findings in the first section, content analysis findings in the second, and forest-cover change findings in the third. Additionally, there is a final section that examines the relationships between interviewee responses and findings and the patterns of forest-cover change.

CHAPTER EIGHT

RESEARCH FINDINGS

This study has examined the effects of forest policy on managers' perceptions and practices and on forest-cover change prior and subsequent to policy change. In this chapter I will present my findings from the analyses presented in the previous three chapters. In the first section, I will convey my findings on the status of current perspectives in forestry as a whole from what I observed at forestry conferences. The next section will disclose findings from my analysis of semi-structured interviews with forestry professionals. In the third section of this chapter, I will present my findings on forest-cover change analysis. In addition, before closing the chapter with a summary, I will report on whether the trends that were examined in managers' responses can be linked to potentially shifting trends in forest-cover change following the implementation of new forest management policies in the PNW and BC.

Trends in Perceptions on Forest Management

Observations of meetings and conferences were intended to meet the third objective of this study: Determine how changing policies affect other stakeholder (i.e. non-owner and non-manager) perspectives about ecosystem management and resilience. Five of the six conferences involved multiple stakeholders, while the sixth was comprised of and targeted private landowners in the US. Within the six conferences, three trends emerged that reflect current perspectives in forest management, though they are not trends that necessarily reflect the manner in which changing policies affect non-owner and non-manager perspectives on ecosystem management and resilience. Only one conference, the Dry Forest Management conference in the PNW, had specific policy relevance. The remaining conferences were broader in scope and were not policy-focused, though there was discussion of the effects of results-based management on ecosystem protection at these meetings. The conference observations provide valuable information regarding the current state of stakeholder relationships and forest management that reflects multiple values.

All six conferences exhibited three broad, common themes amongst them, determined by examining the four general themes found within each region. It appears from these conferences that there are issues that are deemed important enough in forest management to warrant attention at conferences. The three themes that emerged at each of these conferences were management techniques and approaches, stakeholder relationships, and ecosystem protection. Regardless of the subject, presentation focus, or targeted audience of each conference, these themes arose consistently. Within the context of forestry, one would certainly expect conferences to consistently address management techniques and approaches, thus this finding would not be unexpected. However, there was some variation between conferences in the focus of this theme. The other two common themes might seem less likely to be common topics across conferences, speakers, and audiences, but they are reflective of the changes in perceived forest values from multiple stakeholders.

Trends in Management Techniques and Approaches

Two prominent trends emerged within the discussions of management techniques and approaches. The first of these is a consideration of the scale at which management planning and actions should occur, which appeared in four of the six conferences. At each of the four conferences in which the topic of scale in management approaches and techniques arose, emphasis was given to managing at scales that extend beyond the stand, and consideration of the management of stands within broader contexts, at either landscape or regional scales. Historically, management occurred most often at the stand level, as managers considered the impacts of management actions on the health of the stand, tree regeneration, future harvests and financial returns. These perspectives are still part of forest managers' analyses, however, scalar perspectives seem to be shifting and more managers have begun to consider of the effects of management actions on broader systems. The science behind forest management has evolved beyond the stand level effects of management practices to include utilizing principles of ecology to understand the effects of forest management on the ecosystem, including the linkages of management actions to effects seen at scales above and below the stand level. Thus, it is perhaps not surprising that the managers interviewed indicated that their perspectives on management now include landscape or regional considerations in management planning and implementation.

A second trend observed within the broad theme of management techniques and approaches is the inclusion of adaptive management techniques as a viable, or at least desirable, option in forest management. Adaptive management was a topic of discussion or presentation within four of the six conferences. At the root of adaptive management is the concept of flexible management that builds from scientific, experimental approaches to management whereby hypotheses are tested and knowledge gained is then used to adjust current management techniques and approaches accordingly (Johnson 1999). Adaptive management was built into the NWFP, which includes an "adaptive management area" land-use allocation. Thus, this topic perhaps should be expected at the Dry Forest Management conference, as the conference was specifically intended to address the management of forests within the region regulated by the NWFP. It is important to note, however, that in practice adaptive management as a component of the NWFP has not fulfilled the intended goals for its inclusion in the policy guidelines (see Stankey et al. 2003 for a discussion on the reasons for the failure of adaptive management in the NWFP). Despite the challenges the practice of adaptive management presents (Gunderson

1999), the notion appears to have a broader appeal, given that it emerged in three other conferences that were not specifically prompting evaluations of the management of NWFP forests.

Adaptive management can be a contentious topic, evidenced during a field trip to an experimental forest in the PNW. Field trip participants represented numerous stakeholders (including environmental organizations). Some voiced criticism of activities within the experimental forest, and were distrustful of any activity that involved any tree removal. Though anecdotal, this is indicative of the tension that still exists between stakeholders in the region, and, further, demonstrates the lack of trust in forest management practices, even when stated goals are congruent with the desires of non-manager stakeholders. This may be one of the reasons that the relationship between stakeholders is another prominent theme in each of the attended conferences.

Trends in Stakeholder Relationships

Public perception of forest, and indeed other natural resources, values has changed over time, leading to an increase in the participation of stakeholders in setting the agenda for forest management as stakeholders attempt to influence the management of forest resources to reflect stakeholder-held values. Stakeholder participation can take the form of collaboration in policy decisions, consultation, through shared or co-management approaches, or legal actions. These changes are reflected in the emergence of stakeholder relationships as a prominent theme in conferences on natural resource and forest management. In all but the Forest Landowners Association meeting, a broad range of representative stakeholders was present. Given that the term "stakeholder," as it relates to forest management, can refer to anyone with a stake in what happens in and with the nation's forests, the topic of stakeholder relationships can refer to relationships with a number of different stakeholder groups. The focus on which particular stakeholder relationships—tribes, citizens, NGOs, government agencies or others—were discussed did vary somewhat between and within the six conferences.

Despite the different types of stakeholders that were discussed, there seems to have been an interest in addressing stakeholder participation in forest management planning. Collaboration is a key issue, and conference presenters addressed both successful collaborative efforts and the need to increase collaborative efforts. The degree of desirable involvement and collaboration ranged from equal participation in the planning process between multiple stakeholder groups to provision of outlets for public input and consideration of public concerns in the policy and planning process. Equalization of input was discussed much more frequently with reference to tribal, scientist-manager, inter-agency, cross-owner, and cross-border relationships. Citizen- or NGO-collaboration or participation was most often described in terms of multi-values management and forums for public opinions and inputs. However, two conferences in particular addressed citizen collaboration or participation in manners that were more closely aligned with equal participation.

The Mountain Climate Conference approached consideration of stakeholders' knowledge and citizen-scientists' observations as having potential for contributing to management planning and to understanding the effects of climate change on local systems. Similarly, presenters at the Human Dimensions of Natural Resource Management conference discussed shared knowledge, multiple ways of knowing, and public involvement in the decision-making process. As such observations demonstrate, stakeholder relationships and stakeholder involvement are important for forest management planning, though there the level of involvement and the degree of consideration deemed necessary or even possible varied widely.

Trends in Ecosystem Protection

Ecosystem protection was a key element to all six conferences, indicating the general importance of ecosystem protection to contemporary forest management. As with the theme of management techniques and approaches, the ways in which ecosystem protection was discussed varied across the conferences. While its recurrence indicates a trend toward consideration of ecosystem protection in forest management, there are diverse opinions and perspectives on how ecosystem protection fits within forest management. There are two general trajectories of thought: ecosystem protection—in the form of maintaining or restoring ecosystem services—as a forest management outcome and ecosystem protection—in the form of reducing practices harmful to habitat or water—as a component of extraction considerations.

The concept of ecosystem protection as a management outcome was more prevalent at the conferences than was ecosystem management as a component of extraction. This is not entirely surprising given the foci of the conferences and the intended audiences. At the Forest Landowners Association meeting, which was attended primarily by private landowners, the discussion of ecosystem protection only occurred within the context of extraction and certification for sustainable-harvest practices. Given that the private landowners participating were primarily from industrial timber companies (i.e. businesses), it ought not be surprising that ecosystem protection was considered primarily within the context of the business of extraction. Discussions surrounding ecosystem protection were framed positively inasmuch as the participants spoke of efforts they were making toward ecosystem protection. The tone was, however, more negative during discussions of the EPA under President Obama and the guidelines set for the Forest Stewardship Council's (FSC) certification standards. Landowners could not be certified under FSC standards, though several were certified under the Sustainable Forestry Initiative (SFI), an industry-originated certification program.

The Integrating Opposing Land Issues conference in Canada was similar to the Forest Landowners Association meeting in that presenters derived primarily from natural resource companies. As such, the majority spoke of ecosystem protection within the framework of extraction processes. There were differences however. Many speakers discussed efforts in habitat protection and in ecosystem restoration following extraction activities. Perhaps this contrast stems from the ownership differences between the US and Canada. Companies operating on "public" lands in Canada work under different expectations set by provincial or national policies regarding natural resource extraction. Thus the focus of this conference was not just timber extraction, but included other extractive industries as well. Regardless of the type of natural resource industry, policy set by the government does seem to set some parameters for mitigation and for restoration expectations. There were, however, discussions as to the manner in which results-based policy might positively or negatively affect restoration efforts, with opinions voiced from both ends of the spectrum. Additionally, some of these industries had completed extraction projects in protected areas, such as national parks, thus the mitigation and restoration requirements are even more stringent.

The remaining four conferences were not focused on extractive industries, thus the conversations on the topic of ecosystem protection were about protection as a management outcome. Even within the Dry Forest Management conference, which was hosted by government agencies in the PNW, the conversations framed protection as management outcomes. Discussions centered on maintaining species and their habitats, encouraging and protecting old growth forest conditions, and creating resilient forests through active management practices. This is certainly due to the fact that the implementation of the NWFP shifted the focus of BLM and USFS goals in this region towards protection more than extraction. It is also reflective of the general shift in management of federal lands, and specifically USFS lands, towards landscape-level management to "maintain and restore ecosystem and watershed health and resilience (ecological integrity)" (USDA Forest Service 2012). The two Canadian conferences dealt with protection in the context of human-environment interactions and citizen engagement in the protection process. The Mountain Climate Change conference, on the other hand, framed protection within the context of predicting and mitigating the effects of climate change.

Different Contexts, Similar Trends

The six conferences ranged widely in terms of subject matter, purposes, and target audiences, and differences in the details of discussion topics were very apparent. In spite of the differences, however, three prominent themes emerged: management techniques and approaches, stakeholder relationships, and ecosystem protection. These themes indicate current trends on important topics within forest management and provide an indication of the climate and organizational dynamics of forest management. There is a shifting scale at which management is occurring and seems to be a desire to better understand forest systems and to learn new ways of managing through adaptive management techniques. While the efforts to include a broader range of stakeholders in the planning, and sometimes the execution processes, seem to be sincere, there is still tension between stakeholders, particularly those with opposing values and goals for forest management. These conferences indicate that forest management and the timber industry do not operate in vacuums where stakeholder interests are concerned. At every conference, the topic of ecosystem protection arose signaling that forest management perspectives currently involve consideration of multiple value spectra across a broad range of operators. Thus, given the tension that still exists between the range of stakeholders and their goals for the forests, it appears that while the "battle" seems to have been reduced to a "skirmish," the "War in the Woods" is not over.

Perspectives and Practices: Trends Within and Across Types of Ownership

Apart from acquiring information on the general demographics of interviewees, interview questions were intended to provide information that meets the first two goals of this project:

- Objective 1: Determine how changes in federal forest policy in the PNW and crown forest policy in BC have affected management practices across ownership groups in the coastal forests of both regions.
- Objective 2: Determine how changing policies affect forest managers' decisions and perceptions about ecosystem management and resilience.

Interviewees consisted of cross-sections of landowner and tenure types in the PNW and BC, though the primary representation in both regions was from federal/provincial government agencies. The interviews provide insight into current perspectives and practices across ownerships and can contribute to explanations of the patterns of forest cover change observed on the landscape. There have been no studies in the PNW and BC based on in-depth, semi-structured interviews of forest managers.

Respondent Demographics: Indications of a Changing Field

The majority of the interviewees are degreed professionals who have studied forestry in college and have worked in the forest industry for a number of years. Few of those interviewed were new to the field and this is true in both the PNW and BC. Several participants voiced concerns regarding the implications of the paucity of new entrants into forestry. They also indicated that fewer people are interested in entering the field, therefore the workforce is growing older, and there seems to be few workers to fill in behind them as they leave. Lost too will be the invaluable knowledge that is gained by long experience in the profession. There is concern about diminishing expertise because the experienced will retire at rates far greater than the greatest possible replacement rate. According to several participants, schools now teach forestry using an ecosystem model, which reflects modern changes in the scientific understanding of forest systems and the changes in societal perspectives. However, book-learning and theoretical-learning typical in an undergraduate education do not easily replace the experiential-learning of seasoned professionals.

Many current forest managers have learned forestry using the model for sustained yield, plantation forestry, though most had adapted to the newer paradigm of ecosystem management. This is especially apparent with federal forest managers in the PNW. Apparently, many who did not want to work within the framework of the NWFP found employment elsewhere or retired. One person of this type, who is still active in the forestry community but who had retired from federal employment shortly after the implementation of the NWFP, was a member of the interview pool.

Among those with years of experience in forestry, managers often moved between public and industrial forest management at some point in their careers; several participants indicated that they had worked within a sector of forestry different from their current sector of employment. More from federal/provincial agencies stated that they had previously worked in industrial forestry; however, it should be emphasized that this could simply result from the substantial bias of interviewees coming from the public sector than from the private sector. This movement between forestry sectors might yield different types of knowledge, scientific understandings, and experiences to be dispersed between and across the various sectors of forestry, affecting forest managers' perceptions and practices regardless of the policies that are in place within each sector.

Trends in Management Practices Across Ownership

Again, the majority of the respondents worked in the public sector of forestry, either for a federal agency in the PNW or for a provincial agency in BC. The structure of ownership and institutional organization leads to differences in management practices. In the PNW, federal managers are active in managing federal forests, thus the units of land for which they are responsible are smaller, on average, than those for which BC provincial managers are responsible, as BC managers fill more of an oversight role and generally do not actively engage in managing provincial forests. Private industrial managers in BC were responsible for slightly more forestland than the private industrial managers in the PNW. In addition, there are differences in the dominant species managed in each region, with Douglas fir dominant in the PNW and hemlock and cedar dominant in BC. The differences observed between the PNW and BC in regards to management responsibilities and forestland size and composition could shape institutional management practices, based on differences in policy framework, interactions between members of various sectors of forestry, and the general structure and composition of managed forests.

Policy certainly seems to have had an effect on institutional forestry practices. More policies affected more respondents in the PNW than in BC, but the majority of respondents in the PNW indicated that the biggest role of policy was to supervise management practices rather than compelling or constraining actions. While the NWFP certainly both compels and constrains action within the federal forests in the region, respondents were asked to consider the range of policies affecting forest management. A majority of respondents indicated that policies provided some level of oversight for management actions at the regional, state, or national level. Thus, given that PNW managers listed more policies that affected their management practices than did BC, their responses likely reflected the manner in which the range of these policies affected management practices. In BC, however, managers listed far fewer policies that affected their management practices. Respondents in BC were more inclined to view policy as compelling action. This is possibly due to the greater influence of one primary policy (first the FPC and then

FRPA and, for some participants, Ecosystem Based Management) on the management practices of all but one of the participants.

In both regions, however, it seems that the impression held by most managers is that over time, policy has become more stringent and has thus affected forest management practices across most sectors. The two exceptions to this general trend are private industrial forest management on private lands in BC and tribal lands in the PNW (and somewhat in BC as well). Within BC, however, the dominant view is that with the implementation of the FPC policy became much more stringent only to loosen up again with the implementation of FRPA. However, even with FRPA policy requirements are still viewed as more stringent that they were prior to the FPC, when regulations seem to have been structured more around tenure designations and stumpage than specific management behaviors and goals.

It is interesting that the discussion of management constraints and policy were not typically about specific policies, but rather about some degree of stakeholder influence on the process. In both regions, tribal rights influenced management actions in a manner that forest managers deemed restrictive. The influence seems more prevalent in BC, where First Nations are successfully using the court system to gain rights to forestland and to obtain co-governance authority over what happens in the forests. FRPA requires consultation with any First Nations groups who are likely to be affected before any activity takes place on the ground (Ministry of Forests and Range 2005).

In the PNW, the biggest effects of stakeholder influences can be seen in the use of policy (most notably the ESA, but also the NWFP) to support legal action in the courts. Environmental and citizen groups have successfully used the court system to inhibit management actions on the grounds that those actions result in timber extraction. According to both interviewees and the NWFP ten-year report (Haynes et al. 2006), legal actions have most frequently been taken against federal agencies and have resulted preventing federal agencies from extracting the NWFP-allotted amount of timber. While court actions are predominantly aimed at federal agencies in the PNW, one conference attendee in the PNW revealed that there have been successful actions against private industry as well, though in these situations, it seems they are more likely to work out some compromise without going to court. It is likely that this is due to the degree of regulation of private lands versus public lands in that environmental and citizen groups would likely have more standing in cases against federal agencies than against private industry and thus they therefore might be more willing to work with corporations outside of the courtroom. Another contributing factor is that old growth forests, which are the forests at the center of the conflict, are located on federal lands, while private industrial lands consist entirely of second growth, younger forests. Additionally, the organizational structure of federal lands allows for a much higher level of public participation in determining management goals for the forests. These factors taken together make the federal forestlands a much bigger target for court action.

Likewise, within industrial practices, the influence of consumers of timber products and the environmental community is seen in industry’s voluntary compliance with restrictive policies for sustainable harvest certification. This is especially true in BC. One of the interviewees in BC concurred with what (Cashore et al. 2001) indicated in a review of the role of environmental activists in changing forestry practices in BC. The environmental NGOs' successful campaign to boycott BC timber products because of what they deemed to be unsustainable practices had an influence on changing the manner in which BC forest managers managed their forests, above and beyond the influence of government policy. One of the outcomes of this battle, at least in BC, seems to be a willingness within industry to comply with more stringent guidelines for sustainable harvest certification. Industry in the PNW, on the other hand, seems more reluctant to participate in sustainable harvest certifications, and those that do are more inclined to submit to the less stringent guidelines set by the Forest Stewardship Council than the more stringent guidelines set by the Sustainable Forests Initiative.

Another stakeholder influence is revealed in stated company or agency goals. In both regions, the primary goal identified by respondents was to achieve a balance among the multiple values of stakeholders. It is important to note that this goal is not regulatory; none of the policies specifically state that a balance of values need be met, though management for multiple values is implied in such policy outcomes as, for example, maintaining viewscapes (a goal identified in the BC policies). Regardless of the fact that management for a balance of values is not provided for in policy, interviewees stated that this was a goal for their agency or company. In the PNW, this goal was the most common goal across ownerships. In BC, it was most frequently identified by provincial managers, but by only one manager of private industrial forest on public lands, and was not mentioned by the manager of private industrial forest on private lands. This is an interesting result, though an expected one given that the NWFP does not affect private or state lands and that private land management does not stipulate a multi-values management requirement in the PNW, while in BC, FPC and FRPA both impact private industrial operators on public lands.

In addition to management for multiple values, habitat protection and forest restoration were goals listed for public and tribal lands in the PNW, but not for private lands, though both Oregon and Washington's Forest Practices Acts—which regulate management on private lands—indicate that soil, water, and wildlife habitat need be protected in the timber production process. Responses in BC were similar in that provincial managers and tribal representatives indicated they sought to maintain habitat and restoration forests, but the private industrial managers did not despite the FRPA requirements for habitat protection in BC.

The discrepancy between stated goals and policy requirements in BC is diminished by techniques used to meet goals, as private industrial managers on both public and private lands indicated that they, at a minimum, maintained habitat and stream buffers. Thus, while habitat protection was not a stated goal, managers still engaged in practices designed to protect habitats. In the PNW, where all categories of landowners indicated that management for multiple values is a goal and where private industry managers did not specify company goals to protect habitats, all respondents did indicate that their company or agency engaged in practices designed to protect habitats.

In both regions, participants indicated timber production, working-forests maintenance, and profit goals. Respondents across ownerships in both regions stated such goals as well, though in BC fewer provincial managers identified these three than they did the two previously mentioned goals. These goals imply that extractive activities are vital to their achievement, and they are reflected in the naming of extractive techniques by nearly all participants. Though the NWFP has reduced the importance of timber extraction on public lands in the PNW, and lawsuits have severely hampered extraction activities, most respondents are from the BLM. As such, these goals seem to be directed at fulfilling O & C Act requirements, though the primary technique used to meet these goals through extraction is thinning. Several participants indicated that the reason thinning is the predominant form of extraction on BLM lands is to try to avoid likely lawsuits that would occur should they engage in any other form of extraction. Clear-cutting, which is perhaps the most contentious extractive technique among stakeholders, is still used in both regions, though PNW managers identify it as used less often than do BC managers (clear-cutting is a technique that is no longer used on USFS lands in the PNW).

Perhaps the greatest influence that policy has on forest management is revealed in the interviews. Policy and regulations are as often identified as the drivers of forest management as are economics, public pressure, and conservation and stewardship. While all of these drivers were named a relatively equal number of times, policy and regulation was named the primary driver as frequently as economics in the PNW and only one less time than economics in BC. Throughout the study area, economics and policy and regulations seem to be primary drivers more than are public pressure and conservation and stewardship. It is possible that the effects of public pressures work through the policy process, including the use of policy to support legal action, and are therefore subsumed in that driver. Likewise, conservation and stewardship are drivers that are implemented through policy rather than operating as discrete and purely voluntary agency or industry actions.

Trends in Managers' Perceptions and Practices

The majority of participants in this study had at least some college education in the field of forestry. Education provided the base upon which initial perception of forest management practices, and sometimes on the values of forests, was formed. The education in forestry that many participants received influenced not only their career paths, but also what they thought about forests and forestry and the manner in which they approached decision-making. There were some differences between early-career and late-career participants in that neophytes tended to have received educations focused on ecosystem approaches rather than the traditional sustained-yield approaches to forestry. However, there were also a few late-career participants who had more interdisciplinary educational experiences or who had obtained graduate degrees providing interdisciplinary exposure. One participant from BC had an advanced degree in forest ecology, while one in the PNW had an advanced degree in forest ecology, another in forest biology, and another a PhD in forestry with an undergraduate degree in natural sciences. Several participants in both the PNW and BC indicated that their training produced interdisciplinary perspectives or had at least resulted in an appreciation of sustainable management for multiple forest values.

Beyond formal education, many participants related early influences on the values they assigned to forests or desires to build careers in forestry came from family, from childhood experiences in the woods, and from travel. Early life experiences in combination with education shaped participants' views of forests and forest management prior to their entrance into the workforce, though these perspectives were not necessarily static after they began working in forestry. New influences and experiences often altered respondents' perspectives.

One of the biggest changes that occurred over the course of the careers of many of the participants had been the gradual inclusion of experts from other fields in the decision-making process. Even within private industry, biologists, wildlife experts, ecologists, and hydrologists were hired on as employees. The inclusion of other experts was not necessarily solely the result of policy implementation, and sometimes even preceded policy changes in both regions. Rather, the wider array of experts seems to have resulted from the evolving scientific understanding of forestry, though policy changes did occasionally force expert collaboration where it had not previously existed. Foresters were occasionally required to consult with experts as part of the decision-making process. As such, many participants indicated that their perspectives broadened over time because of the knowledge they gained working with a broad array of people with different specialist backgrounds. Often, these working relationships were mutually beneficial, as experts learned from each other, but many expressed that this was not necessarily easy to adjust to. Working with experts within and outside of forestry were the two biggest influences on participants once they began their careers and led to broader perspectives and collaborative problem-solving skills.

Another influence on changing perspectives was interaction with community members and from exposure to changing societal perspectives on the value of forests. Out of these interactions arose an appreciation for balancing multiple interests and forest values and for the community perspective. It is interesting to note that in both the PNW and BC, participants most frequently related that the their perspectives changed as a function of increased understanding and appreciation of other perspectives and values, and that these changes were reflected in the outcomes of their management decisions and actions.

This study is intended to understand the effects codification of ecosystem management within regulations would have on the perspectives and practices of forest managers. The answers received from BC respondents when inquiring about the influence of ecosystem management on individual perspectives and practices was unexpected. The recent implementation of a new agreement along the central coast of BC called Ecosystem Based Management (EBM) was not known prior to the study. While FRPA had set an expectation that forests would continue to be managed as ecosystems, EBM took it further and, according to some participants, looked more like the prescriptive regulations found in the FPC. However, the concept of ecosystem management still seemed to have influence on the interviewees in BC, as in the PNW.

Nearly half of the participants indicated that the implementation of ecosystem management in policy had an effect on forest management perceptions and practices. Ecosystem management seems to provide some managers with a different means of approaching forest management, whether through collaborative problem-solving, implementing protective measures, examining multiple issues, or managing for multiple values. In addition, ecosystem management also seems to have affected the scale of management decision-making. The effects of management decisions on the broader landscapes and among different management techniques are being considered in diverse ecosystems. In the U.S., state and private industrial managers indicated they are making efforts to emulate the natural succession of forests at the landscape scale. The remaining portion of respondents indicated that the implementation of ecosystem management through policy had little effect on their forest management perceptions and practices. Half of those, however, had ecosystem management views prior to the new policies. The implementation of ecosystem management through policy seems to have shaped forest managers' perspectives and practices within the study area.

One of the goals to managing forests as ecosystems is to encourage forest system resilience, and to some managers, resilient forests are the result of management practices. To others, forests are resilient as long as they maintain value to society and provide society with services, which provides an assurance that they will remain as forests and not be torn down to make way for some other societal service. Manager-respondents in the sample examined here, whose companies operated as Timber Investment Management Organizations (TIMOs) or Real Estate Investment Trusts (REITs), indicated that there was a general concern that these types of forest investments would result in the paving over of forests for other social values. According to these managers, however, the investments made in forests in the form of TIMOs and REITs are made because of the relatively stable, long-range returns on forests. Once the forests are paved over for other uses, the returns go away, thus, there is an investment in maintaining working forests. Therefore, to some managers, these investments would ensure that forests maintain their resilience.

The majority of managers framed forest resilience primarily as a biological function. To some, especially in the PNW, forests (especially the coastal forests) have an inherent resilience. The belief is that the trees will always grow back, though not necessarily in the timeframe society prefers or deems convenient. A few who claimed inherent resilience also acknowledged that humans could disrupt the system, causing enough damage to inhibit forest regeneration and leading to environmental degradation. To most, however, forest resilience is the result of diversity, both in species and ages of vegetation, and is also a product of a forest that is flexible and capable of maintaining functions and processes following disturbances. Defining resilience in terms of diversity and functional capacity following disturbances reflects an ecological understanding of resilience, as first described by Holling (1973).

Social resilience, on the other hand, is generally not considered a function of human biology, though there were a few who indicated the importance of the population's physical health to the resilience of society. Most managers believe that society's resilience is dependent on the interactions, or dynamics, of its members. The ability to adapt to changes, effective leadership, and a sense of community ensure the continuation of society in the face of disruptions. To many of the participants, economic conditions also contribute to society's resilience. Many of these managers have seen the decline of towns dependent solely on the timber industry for survival. The towns that could not diversify and stabilize their economy and adapt to the changes brought forth by the changing timber industry, haven't survived. Those that adapted and diversified have fared better. Managers' responses reflect what has been happening locally throughout the PNW and BC. In spite of these challenges and changes, many managers still feel that a societal connection to and management of its natural resources increases that society's resilience.

The changes in the timber industry in the PNW and BC, as well as society's changing values, have created tension between society's need and desire for timber products and society's need and desire for the other values and services forest systems provide. Despite the tug-of-war between opposing interests, all but two managers remain hopeful. Twenty participants feel that it is possible to simultaneously have resilient forests and resilient societies, and many feel that there are present-day examples of resilient co-existence.

Trends in Forest Cover Change Across Ownerships

A visual examination of the forest cover maps in both the PNW and BC show that both regions lost forest cover over the timeframe of this study. This visual examination demonstrates that overall rates of the re-establishment of canopy-cover (as indicated in this study by a disturbance index value of <0) have not currently caught up to the rates at which canopy loss (indicated by disturbance values >0) has occurred in the coastal forests of the PNW and BC. For the first time period in this study, from 1984-1995, this finding substantiates, and extends to the Oregon study area, the findings of Bolsinger et al. (1997), which reports that the combination of higher cut rates in industrial forests than growth rates and the higher percentage of industrial ownership west of the Cascades in Washington will lead to cut rates that were higher overall than growth rates in the coastal forests of Washington. However, from 1995-2008, the amount of forest canopy cover on Washington industrial forestlands increased, rather than decreased. In Oregon, the pattern of loss of forest canopy cover out-pacing growth on industrial forestlands continues in the second time period of this study.

The coastal environment is conducive to fast-growing forests, and within the study area, the loss of forest cover was not due to wildfires. However, that these forests regenerate quickly makes them desirable for timber harvest, as shorter rotations can lead to greater long-term profits. The Earth's rare temperate rainforest ecosystem also holds (because of the rarity of it) a wide range of non-timber values for many stakeholders who have, in turn, had an effect on shaping policy in both regions. The NWFP in the PNW and the FPC and FRPA in BC are differentially applied to the land. Results from the zonal statistics analysis elucidate the nuances of the manner in which policy changes affect forest-cover change across ownerships.

The Effects of the NWFP on Forest-Cover Change in the Pacific Northwest

In the period prior to the implementation of the NWFP (1984-1995), both Oregon and Washington experienced disturbances that reduced forest canopy cover across all ownership types except BLM lands in Washington (of which there is very little). Those losses, however, were not equally distributed. Within the Oregon portion of the study area, private industrial lands contained more land than any other owner category, and therefore in 1984 this class of ownership had more forested canopy cover than the other owner types. Lands managed by the USFS and BLM made up the next largest area of forests, though altogether they amounted to less than half of those owned by private industry. State forests comprised 1/6 of the forest landbase managed by the USFS and BLM together and the forest landbase of the BIA and private non-industrial lands was nominal. In Washington, the total forest landbase for the USFS equaled approximately 1/4 of the hectares of private industrial forestlands, while BLM forests in the Washington study area were nominal. BIA lands were more substantial here than in Oregon with half as many hectares as USFS forest lands. The state forest landbase was approximately equal to forest cover on USFS lands. In 1984, the canopy cover, as a percentage of the landbase, was similar on USFS, BLM, state, and private industrial lands. However, by 1995, canopy cover on state and private industrial forestlands had decreased as a percentage of the total landbase to levels substantially below those seen on USFS and BLM lands in both Oregon and Washington.

As previous studies have found, ownership is a predictor of forest-cover change prior to the implementation of the NWFP (Wimberly and Ohmann 2004; Kennedy and Spies 2004; Kennedy and Spies 2005). From 1984 to 1995, in terms of ownerships having significant presence in the study area, private industrial land had the highest percentage of canopy cover loss, reducing the canopy cover on the landbase by 24% over the 11-year period in Washington and a 19% in Oregon. The next highest loss during the period was on state forestlands, with a 15% loss in Oregon and a 14% decline in Washington. USFS lands experienced a loss of 5% of canopy cover on the landbase in Washington and 6% in Oregon. BLM gained forest cover equal to 4% of the forest landbase in Washington and lost 7% in Oregon.

During the second time period, which follows the implementation of the NWFP, ownership continued to be a predictor of forest cover change as Nonaka and Spies (2005) and Johnson et al. (2007) predicted, although the rates of forest cover loss have overall decreased compared to the time preceding the NWFP. In

Washington, the greatest losses are seen on BIA lands, where there was a decline in canopy cover equal to 6% of the landbase from 1995-2008. The remaining significant ownership categories increased in forest cover; a 17% increase on state lands, a 5% increase on private industrial lands, a 3% increase on USFS lands. In Oregon, private industrial lands lost 9% of forest canopy on the landbase from 1995-2008, and USFS lands lost 6%. BLM lands forest cover grew by 2% and state lands increased their forest cover by <1%.

Though the second time frame was established to coincide with the implementation of the NWFP, the increases seen in forest canopy cover on state (in both Oregon and Washington) and private industrial (in Washington) lands cannot be said to be a result of the implementation of the NWFP, as those forests are not regulated by the NWFP. While a state forestry professional in Oregon indicated that the NWFP influenced changes to the management of state forests (at least for the time period considered in this study), the Washington state forestry professional did not offer a similar observation. As for the increase in canopy cover seen on private industrial forestlands, it is quite probable that factors other than the influences of the NWFP had an affect on the patterns of forest canopy cover changes. For example, there is the potential that available forestland for harvesting during this time period effected where and how much timber was extracted due to locations and levels of harvest in previous years.

Forest canopy cover changes following the implementation of the NWFP are most likely overstated and further analysis would likely reveal less forest canopy loss and higher gains than what the current results demonstrate. Data from the LARSE team were used to analyze forest-cover changes from 1984-1995. The 2008 image used to analyze forest cover-change for 1995-2008 was processed using the same methods as the LARSE study, with the exception of hand-editing landslides, river edges, and parcels of de-forestation too small to have been caused by harvest. As a result, some areas deemed to have forest in the LARSE study were classified as non-forested in the 2008 image, though the change was not due to harvests. Hand-editing, with the ability to field-verify, would increase the accuracy of these results. Further analysis would improve the accuracy across ownership categories, and it would most likely produce more pronounced differences for federal lands, especially USFS lands, as those lands tend to be comprised of more difficult to harvest areas and areas along more streams and waterways, and thus more prone to landslides, due to the historical practice of the government ceding the best lands first to settlers and private industry because of the ease of harvest. Hand edits could ultimately result in substantially decreased rates of canopy loss or increased rates of canopy gain on federal lands.

Nevertheless, the results provide a good indication of the effects of the implementation of the NWFP on forest canopy cover changes on federal lands. These results are further substantiated by the changes in timber production numbers for federal forestlands in the region following the implementation of the NWFP. In the Region 6 National Forests (which includes the study area) timber production began to decline significantly in 1989-1992. In 1988, the Washington Region 6 forests produced 1,276.6 million board feet of timber, which dropped to

885.2 million board feet in 1990 (all timber production numbers are from an unpublished document provided by the USFS Region 6 Office). In 1991, Oregon Region 6 forests produced 2,378.4 million board feet, which decreased to 1,626.5 million board feet in 1990. By the time the NWFP was implemented in 1994, timber production had dropped to 230.3 and 896.7 million board feet in the, respectively, Oregon and Washington National Forests. From 1994 to 2008, production numbers fluctuated only slightly, and in 2008, production was at 282.2 and 126.1 million board feet for the Oregon and Washington National Forests.

The volume of timber harvested can also be used as a proxy for understanding the changes in forest canopy cover on private industrial and state lands. In the western Oregon counties of Lincoln, Polk, Benton, and Lane (which essentially encompass the study area), combined timber harvest volumes from private industry forestlands were at 679 million board feet in 1985, and at the time of the implementation of the NWFP in 1994, combined timber harvest totals were at 634 million board feet, demonstrating little change from the 1985 figures (Andrews and Kutara 2005). By 2004, the volume of timber harvested off of private industry lands in the four counties in Oregon had increased to 888 million board feet. The year-to-year trends show some fluctuations, but do not seem to vary widely either before or following 1994, with the exception of some significant reductions in harvest volumes in Lincoln in several of the years between 1994 and 2004. Regardless, the findings in this study for changes in the percentage of the private industrial forest landbase in Oregon could potentially be accounted for through fluctuations in timber production, combined with high rates of forest growth in the region, rather than as a result of changes in forestry practices that were occurring around the time the NWFP was implemented.

State lands in the same four Oregon counties harvested 49 million board feet of timber from state forests in 1985, with volume decreasing to 19.4 million board feet in 1994 and increasing to 24.8 million board feet in 2004 (Andrews and Kutara 2005). For state forestlands in the four counties, the volume of timber harvested fluctuates widely across the years; thus, figures for individual years do not provide a complete picture of harvest trends on Oregon state forestlands in these four counties. As such, a comparison of trends in timber harvest volumes with the forest canopy cover changes found in this study would require a much more in-depth analysis that can be provided within the parameters of this study.

In Washington, four counties encompass the study area: Clallam, Grays Harbor, Jefferson, and Mason. Within those four counties, the total amount of timber harvested on private industrial lands in 1985 was 802 million board feet, which fell by nearly half to 445 million board feet at the time the NWFP was implemented in 1994 (Washington State Department of Natural Resources n/d). During this first time period, this study found that forest canopy cover on private industrial lands had declined by 24%, which does not seem to correlate with the declining rates of timber harvest during the same time period. It is possible, however, that the majority of the loss occurred during the beginning of the time period, when extracted volumes were higher. By 2008, timber harvests in the four counties of the Olympic Peninsula increased to 551 million board feet (Washington State

Department of Natural Resources n/d), which again does not seem to correspond to the increase in canopy cover found in this study for the same time period.

The harvest figures in the first time period do seem to reflect an overall trend for production in the western forests, though the increase seen in the 2008 figure differs slightly from the overall trends of the western private industrial forests. Prior to 1992, harvests in the western counties generally totaled approximately 2,400 million board feet; however, after 1992, totals dropped to approximately 1,500± million board feet (Washington State Department of Natural Resources n/d). The drop in timber harvests on private industrial lands in these four counties preceded the implementation of the NWFP by approximately two years. Thus, the drop in production cannot be attributed specifically to the NWFP, but could be related to changes in forest management during that period of time. Additionally, however, the changes in the harvest numbers can also be attributed to other causes, such as the availability of harvestable timber decreased following years of higher extraction rates because harvest rates exceeded forest growth rates.

On state forestlands in the four counties of the Olympic peninsula, timber harvest volumes in 1985 equaled 518 million board feet, which then increased to 718 million board feet at the time the NWFP was implemented in 1994. Thus, during the first time period of this study, timber extraction on private industrial lands declined, but on state forestlands, extraction rates increased in the four counties of the Olympic Peninsula. However, the trend for the entire western portion of the state shows a steady decline for the same time period. By 2008, extraction in the four counties declined to 134 million board feet. The trend of the western forests during this time was a slight increase in harvest rates on state forestlands.

The results of this study demonstrate that, since the implementation of the NWFP, there has been a decrease in disturbance of forest canopy cover across the region. This could possibly indicate that harvest practices are changing across ownerships, though further research and analysis is needed to substantiate this possibility. It is also possible, and probable, that there are other contributing factors, and that changes occurring in forestry around the time of the implementation of the NWFP might be only one of many factors affecting disturbance patterns on a broader scale than the federal forestlands affected by the NWFP.

The Effects of Policy Change on Forest-Cover Change in British Columbia

In BC, the forest-cover change analysis includes two changes in policy. The first change involved the implementation of the FPC in 1995. In the time period leading up to the implementation of the FPC, from 1985-1995, all lease and owner types demonstrated forest cover loss, except private lands, which gained 1% of its forest over the ten-year period. The initial allocation of forest cover shows that non-leased public land contained the greatest number of forested acres, followed by private lands and active TSAs or TFLs. Woodlot and community forest areas comprised a relatively small portion of forests and Indian reserve allocations are nominal within the study area.

Tenure designation and ownership type predict forest-cover change prior to the implementation of the FPC, as it did in the PNW. The greatest losses in forest cover from 1985 to 1995 were seen on TSA/TFL lands, with 12% lost in the ten-year period. Five percent was lost from the small number of hectares of forests designated as Indian reserves. Both non-leased public lands and community forests exhibited 3% declines. Woodlots lost 1% of forest cover during this time. The implementation of the FPC redistributed forest-cover changes and shifted the effects of owner and tenure on forest-cover change.

The greatest losses in forest cover from 1995 to 2005 occurred on non-leased public lands, with a surprisingly large 79% decline in forest cover over the 10-year period. The reason for this loss is unclear, and it seems possible that this could be an unusual occurrence. There is potential that this was due to some error in processing or classification; however, that error would have had to occur either in both the first and second image or in both the second and third image. There is also a possibility that there is some other explanation for this large drop in canopy cover between the second and the third image. No large fires seem to have occurred in this region during the period, so further investigation is needed to explain the large decline. The only two other tenure or ownership designations to experience losses in forest cover from 1995 to 2005 were woodlots and private lands, both losing less than 1% of their forests. The largest gains in forest during this period were on active TSA/TFL lands, which stands to reason given the parameters set by the FPC and the guidelines and prescriptions for management and harvest. The shift from forest cover loss to significant gains following the implementation of the FPC could be due to the time needed to meet the administrative requirements, to changes in harvest practices, or to a combination of factors. Community forests gained 4% during the period and Indian reserves gained less than 1% from 1995 to 2005.

With the second change in policy in 2005 to FRPA, there were more shifts in the declines and increases, though the trends for losses or gains on a particular owner or tenure designation remained essentially the same as for the period following the implementation of the FPC. The lesson of the analysis is that the distribution of forest-cover changes across owner or tenure designations from the FPC to FRPA was more predictable than from the period preceding the FPC to the time period following its implementation. The greatest declines in forest cover from 2005 to 2009 were on non-leased public and on private lands with both losing 4% of their forests. This is a significant decrease in the rate of forest-cover loss on non-leased public lands and supports the notion that previous losses were due to some sort of unusual event. Woodlots lost 2% of forest during the four-year period, and Indian reserves lost 1%. Active TSA/TSL lands gained 6% of their forests in approximately half the period of time that it previously took to gain 10% after the implementation of the FPC. This indicates that harvest practices on TSA and TFL potentially remained the same in the study area during the period between the implementation of the FPC and following the implementation of FRPA. If harvest practices did indeed change, they changed in a manner that still allowed for increasing canopy cover during both time periods. The harvest practices and/or extraction rates that were evident after the implementation of the FPC, and continued following the implementation of FRPA, did not seem to exist prior to the changes in policy in BC. Community forests also gained less than 1% of their forest during the four-year time period. This is a slight reduction in the rate of gain on community forestlands from the FPC to FRPA. An attempt to compare the results of this study to timber harvest volumes was unsuccessful due to the reporting metrics used for harvest data in British Columbia, which did not readily align with the tenure classifications used in this study over the entire time period of interest.

As with the analysis of the PNW data, the accuracy of the analysis of the BC data could be improved by hand-editing of the imagery and with field verification of landslides, river and waterway edges, and parcels of forest loss unlikely to have been produced by harvests. However, unlike the analysis of the PNW, all image processing to produce the BC data was performed identically by the researcher. Therefore it is likely that most of the pixels associated with landslides, river and waterway edges, or small parcels were consistently designated as non-forested on all images. As such, these results should provide a good indication of the effects of policy on the distribution of forest-cover changes across owner and tenure designations from 1985 to 2009, particularly in BC.

Comparing Results from the Pacific Northwest and British Columbia

Prior to the implementation of new forest policies in the mid-1990s in both regions, forest-cover losses from disturbances were evident across owner and tenure designations, with the exception of BLM forestlands in Washington and private forestlands in BC. Implementation of policy did correlate with changes in the distributions of losses and gains in forest-cover in both regions. Within the PNW, there was a reduction in the amount of forest-cover decline overall, and across ownership categories. Increases in forest cover occurred following the implementation of the NWFP on federal lands in both Oregon and Washington, on state lands in Oregon and Washington, on private industrial lands in Washington, and on private non-industrial lands in Oregon.

In BC, however, there was no corresponding reduction in the rates of forest-cover losses or in forest-cover gains across all owner and tenure types with the implementation of the FPC. There was a change from a loss of forest cover to a gain in forest cover on active TSA and TFL forestlands and on community forestlands and a change from a slight loss in forest cover to a slight gain in forest cover on Indian reserves after the implementation of the FPC. On non-leased public lands, which represent a significant portion of the land in the study area, the percentage of forest cover lost in the 10 years following the implementation of the FPC *increased* by 76% over the amount of forest cover lost in the 10 years preceding the FPC. The changes in percentages of losses or gains in forest cover across most owner or tenure designations following the implementation of FRPA were similar to those seen in the implementation of the FPC. The exception is, again, on non-leased public lands, where the percentage of forest cover lost averaged 1% per year versus the 8% per year average decline in forest cover following the implementation of the FPC.

Examining the change and the direction of change following FRPA compared to that which existed prior to the implementation of the FPC reveals that there has been no overall reduction in losses on non-leased public lands, private lands, or woodlots, but there has been a change from diminishing forest cover to increasing forest cover on TSA/TFL and community forest lands. This supports the view that the structure of ownership and institutional dynamics, coupled with changes in policy implementation, in the U.S. could have a greater effect on harvest practices across ownerships than the ownership structure, institutional dynamics, and policy implementation in BC. BC economy is resource-driven. As such, it behooves the government to ensure that profits on timber are maximized, even when attempts are made to change harvest practices to better reflect both science and stakeholder values. The timber economy certainly plays a significant role in the PNW, however there is more economic diversity in the region. Furthermore, within the PNW, stakeholders have widely used the court system to affect changes (indeed, the NWFP is the product of said efforts), a tactic used successfully by First Nations in BC, but not as often by other stakeholder groups. All of these factors might have affected the manner in which changes to the distribution of forest cover across owner and tenure types has occurred in the PNW and BC.

Linkages Between Interview Results and Changes in Forest Cover

The final objective of this project was to evaluate the manners in which the management approaches of diverse ownership groups in the coastal forests of the PNW, as well as the tenure types in the coastal forests of BC, contribute to the changing forest cover observed at the landscape scale. On the whole, the responses from managers regarding both perceptions and practices along with the overall decrease in the rates of forest-cover decline across the PNW and in BC following FRPA (and following the FPC in all but non-leased public lands) suggest that the changing trends in perceptions and practices in forest management correlate to the changing trends in the patterns of forest-cover change. It is of course important to remember that correlation does not mean causation; hence, the correlations reported in this section do not imply causation, but rather attempt to relate concurrent trends at different scales as a means to uncover potential connections and linkages.

In the PNW, the majority of managers across owner classes indicated that an agency or company goal is to balance multiple values and, furthermore, revealed that they engage management practices that are designed to protect habitats and ecosystems. Generally, federal and state managers indicated that they engage in more protective measures than extractive techniques. In Oregon, this trend seems to be evident in the overall decrease in the rates of forest-cover decline across ownerships. Additionally, within Oregon, the most significant changes are seen on federal and state lands, which correlates with the differences in protective versus extractive measures across ownerships revealed in the interviews. In Washington, the correlation in the trends is not as clear, as private industrial forests gained greater amounts of forest cover following the implementation of the NWFP than was evident on USFS or BLM lands. This discrepancy could disappear after hand-edits are completed, or it could be the result of examining only a portion of the region; hence, revisiting these findings after further analysis is warranted.

Managers in the PNW noted that their perceptions of forest management have changed over time, and have evolved to consider multiple values in the decision-making process and to examine impacts on a broader scale and farther into the future. In addition, just over half of the managers in the PNW noted that the implementation of ecosystem management within the NWFP had an effect on their perceptions and practices. Interestingly, this sentiment was truer for private industrial, state, and tribal managers than it was for federal managers.

All six participants from private industry, state agencies, and the tribal representative indicated that the implementation of ecosystem management in the NWFP impacted their perceptions and practices, whereas only one federal manager indicated a direct effect (three managers, including the retired manager who now owns a woodlot, held this perspective prior to the NWFP, and one “bought into it” at first, but grew to believe ecosystem management is an incomplete approach and that forests do not need to be managed to be healthy). The manager from Oregon’s Department of Forestry indicated that after the implementation of the NWFP, the state examined the new regulations and revised the state regulations based on their review of the NWFP. The state’s plan is different than the NWFP, but did employ concepts found within the NWFP in structuring the new state policy. It should be noted that the state’s plan changed yet again, a very recent change that occurred after the fieldwork for this study was completed.

It seems the changes in private industrial and state managers’ perceptions on ecosystem management correlate with the implementation of the NWFP. This trend also plays out in the reduction in the rates of forest-cover decline and in gains in forest cover on private industrial and state lands following the implementation of the NWFP, even though the NWFP does not have a direct impact on the management of either private industrial or state lands. On federal lands, there was also a reduction in the rate of forest-cover decline following the implementation of the NWFP; however, five of the six federal managers indicated that ecosystem management in the NWFP had no effect on their perceptions and practices, though three of these held ecosystem values prior to the NWFP.

The implementation of the NWFP resulted in a mandatory change in management actions on federal lands, thus, in this situation, it would not necessarily matter what the perceptions of the managers are, as the regulations impose requirements for management that have led to changes in patterns of forest-cover decline. It should be noted that the majority of federal respondents were from the BLM, where the implementation of the NWFP resulted in a complete shift in the mission of the agency and where tensions still exist regarding the competing mandates from the O & C Act and the NWFP. Even so, only two of the federal managers indicated that they did not agree with the concept of ecosystem management, while three of the remaining four already held an ecosystem perspective and, with the implementation of the NWFP, were thus better able to implement management plans congruent with already-held values.

In BC, the goal to balance multiple values was much more prevalent in provincial agencies and with First Nations than in private industry, with only one of the three private industrial managers signaling that managing for multiple values was a company goal. In spite of this fact, managers from all landowner and tenure designations revealed that they engaged in management actions designed to protect habitats or ecosystems. As was seen in the PNW, provincial and tribal managers indicated more protective practices than extractive, while private industry indicated more extractive practices than protective. However, the implementation of the FPC had a distinct impact on the rates of forest-cover decline on lands managed by private industry, where after its implementation lands managed under TSA and TFL tenures gained forest cover. The trend continued following the implementation of FRPA. There seems to be no correlation between the stated company goals of TSA and TFL managers and the corresponding changes in forest cover following the implementation of the FPC and FRPA.

There is a better correlation in the trends toward including protective measures in management techniques and the trends in forest-cover change following the implementation of the FPC and FRPA. However, only two managers from private industry on public lands were interviewed. Interviews of more managers from private industry on public lands would improve our understanding and further analysis of the relationships between company goals and management techniques and the patterns of changes in forest cover on TSA and TFL lands could be performed. From this analysis alone, it seems that the changes observed in the patterns of forest cover losses and gains correlate better with the requirements implemented in policy regulations and protective management techniques than they do with company goals.

Provincial managers who oversee the range of tenures did communicate the dominant agency goals for balancing multiple values and protecting habitats and ecosystems. These goals do correspond to the changes seen in community forests, where forest-cover prior to the FPC experienced a 3% loss and subsequent to the FPC experienced a 4% gain and approximately a 1% gain following the implementation of FRPA. However, the trends do not hold when comparing provincial manager responses for goals and techniques to the patterns of forest change seen on non-leased public lands or on woodlots.

The significant loss of forest cover on non-leased public lands following the FPC implementation does not correlate with the trends towards multi-value management and habitat protection indicated by provincial managers. The reason for this significant loss is unknown, and should the loss be due to some factor other than harvests any conclusions drawn about the lack of correlation between provincial managers' responses and patterns of forest-cover change would be erroneous. Following the implementation of FRPA, the rates of loss on non-leased public lands remained higher than prior to the FPC, but still significantly lower than during the timeframe following the FPC. However, there is still no correlation between provincial managers' responses on agency goals and management techniques used and the patterns of forest cover change found on non-leased public lands subsequent to the implementation of FRPA. There are no correlations between policy and change on woodlots, as there was little fluctuation in the patterns prior to and following changes in policy. More study could reveal more about correlations between trends in managers' responses and trends in forest cover change.

Like managers in the PNW, BC managers indicated that their perspectives have changed over time. The changes that were prevalent amongst private industrial managers on public land, provincial managers, and tribal representatives were tendencies toward broader perspectives, increased knowledge, collaboration, and systemic and landscape perspectives. In addition, one private industrial manager on public lands, three provincial managers, and one tribal representative indicated that the codification of ecosystem management into policy had an effect on their management perceptions and practices. Three of the remaining seven participants (one each from private industrial on public lands, provincial lands, and tribal lands) indicated that they had held ecosystem perspectives prior to its implementation through the FPC or FRPA. One provincial participant felt that ecosystem management, as it stands in FRPA, is not really ecosystem management, and that it is challenging to achieve ecosystem management when clear-cutting is still a dominant extraction technique.

Nearly half of the participants stated that they were influenced by the codification of ecosystem management. On lands that are managed under TSA and TFL licenses, forest-cover changes went from a loss in forest cover to a gain in forest cover following the FPC and continuing after FRPA. One manager who worked under both TSA and TFL licenses indicated that they had been influenced by the idea of ecosystem management, while the other held ecosystem management views prior to the FPC and stated, furthermore, that they had been involved in bringing ecosystem management practices into the agency for which they worked. From this small sample, there does seem to be a correlation in the responses from individuals operating under TSA and TFL licenses and the results of the change analysis. Interviewing more private industrial managers on public lands would further clarify the validity of this correlation.

It is again more difficult to draw any conclusions regarding a relationship between provincial managers' responses to the effects of ecosystem management on their own perceptions and practices and the results of the change analysis. Provincial managers do not directly manage, but they do influence what happens on the ground through their relationships with active forest managers. Correlations drawn here would be tenuous at best. A better approach would be to elicit from provincial managers their perceptions of the manner in which they have influenced operational managers across tenures to adopt ecosystem management practices and whether they feel they have been successful. In addition, it would be very beneficial to interview more managers who manage private industrial activities on public lands, community forests, woodlots, tribal lands, and non-leased public lands. While there were attempts to reach this demographic, it was difficult to obtain interviews. Achievement of this goal requires more time to get to know people with connections to these managers and personal visits to forest resource companies.

Summary

The five objectives of this study were met through an analysis of trends in forest management as seen through observations at meetings and conferences, through semi-structured interviews with forestry professionals, and through an analysis of forest-cover change prior to and following policy implementation in the PNW and BC. The results of the analysis of conference observations indicate that there are current trends in discussions of forestry issues including techniques and approaches to forest management, stakeholder relationships, and ecosystem protection. These topical trends prevailed at the conferences regardless of conference subject matter, presentation foci, or targeted audiences.

The trends seen in the topics of interest across the conferences were also seen in trends in management practices across ownership categories. Interviews with managers revealed important trends in collaborative efforts, stakeholder influences, regard for multiple values in the decision-making process, and incorporation of techniques designed to protect habitats or ecosystems. These trends were seen across owner and tenure designations in both the PNW and BC.

The results of the analyses of forest-cover change indicated that the implementation of policy affected the patterns of forest-cover change for the policies' targeted owner and tenure groups. There are some indications that changes also occurred during this time for other owner and tenure classifications, though those results were mixed, and the factors leading to these changes are likely multiple and complex. The effects observed in this study, however, were different in the two regions. Within the PNW, there was a reduction in the rates of forest-cover decline in all ownership classes, and, moreover, gains in forest cover were seen on federal and state land in Oregon and Washington, on private industrial lands in Washington, and on private non-industrial lands in Oregon. In BC, non-leased public lands experienced significant and substantial declines in forest cover following the implementation of the FPC and continued to experience decline, though at a much lower rate, following FRPA implementation. Forest cover of woodlots did not change much prior to and following policy changes. There were, however, increasing rates of reforestation of TSA and TFL lands and on community forestlands.

Correlations of managers' responses and patterns of change were stronger in the PNW than in BC. This is due in part because of the differences in who is managing the forests in each region and also because of the numbers of active managers interviewed. In the PNW, federal managers actively manage federal forest and this allowed an assessment of the relationship between their views and the trends in forest-cover change. In BC, however, only three active forest managers were interviewed, and such a small sample does not allow one to draw conclusions about the relationships between managers' views and trends in forest-cover change.

CHAPTER NINE

FUTURE STUDY

This project represented a mixed-methods approach to elucidate the effects of policy changes on managers' perspectives and practices and on forestation in the PNW and BC. It may be the first study of managers' perspectives and practices in the PNW and BC through in-depth interviews to understand the regional differences in managers' perspectives and practices and the relationships between managers' perspectives and practices and the patterns of forest-cover change observed on the landscape. The scope is broad. Both the methods used and the results of analysis yield directions for future research that could serve to both clarify and extend the study in both regions. This chapter will address potential directions for future study.

One of the objectives was to determine the effects of policy changes on stakeholder perspectives on ecosystem management and resilience. The conferences attended revealed these perspectives to some extent; however, more work could be done in this area. The professionals contacted during this study might enable better identification of the timing and location of important stakeholder meetings. Without the time constraints inherent to a dissertation project, data on stakeholder perceptions could be examined over a longer period. The NWFP was implemented nearly two decades ago, and thus specific stakeholder meetings relevant to the NWFP are less frequent. However, the relatively recent passage of FRPA and the early evidence of the impact of the implementation of the EBM agreement in the Great Bear Rainforest refresh the need for stakeholder meetings in BC.

The EBM agreement provides opportunity to study stakeholder involvement in a rather broad-scale and unique approach to forest management. The stakeholders involved in developing the EBM agreement were many: the provincial government, tribal governments, environmental NGOs, and industry have all been closely involved throughout the process. Implementation of the EBM was beginning during the research reported here. More stakeholder meetings will be likely as the region attempts to navigate the new approach. It would be interesting to not only observe the meetings, but to interview more people involved in the process.

A similar opportunity exists in Haida Gwaii where the Haida and the provincial government are co-governing the forests. Two provincial foresters had been interested in participating in this study and in exhibiting their management actions; however, time and travel constraints prohibited a visit to the islands. Case studies in the Great Bear Rainforest and in the Haida Gwaii regions could provide valuable insight into the relatively novel approaches to forest management and could reveal the potential for new approaches in other regions. While the conditions that have led to these new approaches are unique to these regions, there are still lessons for other areas looking to assuage multiple stakeholders. It would also be important to monitor the perceptions of success in these two regions and to examine forest-cover change following implementation of new management approaches in both regions.

Johnson (1999) surveyed non-industrial forest owners in Washington prior to the implementation of the NWFP and found that these owners would be willing to alter their management practices if doing so promoted healthier forests, but they would not give up their harvest rights. Given that the NWFP has been in place for nearly 20 years and that there have been more advances in the science and practice of ecosystem management, a survey of a wider array of forest owners could reveal changing perceptions across a wider assortment of people than in this study or in Johnson's (1999) study. Similarly, this could be extended to BC managers, who have now gone through two policy shifts.

One major challenge of this study was making contact with managers beyond those who worked for the federal government in the PNW and for the province in BC. Surveys—delivered both by mail and in-person—might generate a better response rate across owner categories and tenures. Another benefit to surveys is that they could yield volunteers for interviews as contact information would be widely available for those who were also interested in being interviewed. This could improve the pool of participants and could strengthen the confidence of the findings.

The structure of the NWFP requires continuous monitoring of the progress toward full implementation of the NWFP. This means that there is extensive and ongoing research in the PNW on forest management practices on the impacts of management on forest health, structure, density, and distribution. In addition, analysis of changes in forest cover across ownerships, such as those reported in Bolsinger et al. (1997), Wimberly and Ohmann (2004), Kennedy and Spies (2004), Kennedy and Spies (2005), are likely to continue. The results of the forest-cover change analysis across ownerships in the PNW that are reported here add to this body of knowledge, but also reveal some future directions for study.

As indicated in the previous chapter, the accuracy of the analysis could be improved through hand-editing the 2008 image, and through a structured accuracy assessment. This procedure would both clarify the amount of forest-cover change and could link the trends with managers' responses. Additionally, the previously named studies examined changes of forest cover throughout the region regulated under the NWFP. It would therefore also be beneficial to extend the analysis of 2008 land cover to the entire coastal forest region in Oregon and Washington and then compare these data to the LARSE data to examine change following the implementation of the NWFP for the entire range of the coastal forests.

The accuracy of the analysis in BC could also be improved through hand-editing all BC imagery and through an accuracy assessment of the results. Extension of forest-cover change analysis across owners and tenures to the remainder of the coastal region in BC would also be useful. This would involve an extensive mosaic of imagery, as multiple scenes cover the coastal forests of BC from the Washington border to the Alaskan border. However, analysis of the entire coastal forest region of the PNW and BC would reveal the geographic patterns of change in forest cover throughout a unique bioregion. Given that temperate rainforests are globally rare, understanding the manner in which the distribution of these forests are changing over time is important.

During the time spent in the PNW and BC, and through the interview process, there have been some apparent changes occurring in harvest practices in the patterns of individual harvests. The actual patterns of harvests are not necessarily straight-edged. Two participants indicated that there is often an attempt to harvest along the contours of the terrain to provide better viewscapes. Variable retention harvests also create variable patterns of edges and patches on the landscape. It would be interesting to use FRAGSTATS for to examine this further. FRAGSTATS is an open-source spatial-pattern analysis software program developed by Dr. Kevin McGarigal and Barbara Marks in 1995 at Oregon State University, and is now enabled to interface with ArcGIS 10 (University of Massachusetts Amherst 2000). FRAGSTATS would allow edge-effect analysis, evaluations of patch densities, and consideration of the structure of patches.

Summary

The current study suggests potential for future analysis. Future study in both qualitative and quantitative approaches would improve understanding of the effects of policy change on the perspectives of stakeholders and the perspectives and practices of managers from a wider range of owner and tenure designations in the PNW and BC. Surveys of stakeholders and forest managers and case studies of novel approaches in the Great Bear Rainforest and Haida Gwaii are examples of potential qualitative research prospects. Extending forest-cover change analysis to the entire temperate rainforest in the PNW and BC and using FRAGSTATS to assess the patterns of edges and fragmentation are examples of potential qualitative research prospects. Much work has been already been undertaken in the two regions, especially in the PNW, however as management under the NWFP and FRPA continues and as the science of ecosystem management evolves, research will serve to deepen our understanding of the effects of management perspectives and practices and stakeholder involvement on the patterns of forest-cover change in the temperate rainforests of the PNW and BC and contribute to improved management.

APPENDIX A

Pacific Northwest Interview Questions

1. Are the forests you manage under private industrial, private non-industrial, state, or federal ownership?
2. How many hectares of forest do you manage?
3. What types of forests do you manage?
4. Which policies/regulations affect the manner in which you manage your forests and how?
5. How have these policies and regulations changed during the time you've been a forest manager and what affect have these changes had on your management practices?
6. What role does the NWFP play in forest management for you?
7. What are your (company's/organization's) goals for managing your forests and what management techniques do you use to accomplish these goals?
8. What factors drive forest management for you (your company/organization), and which of these is the primary driving factor?
9. What type of training did you receive in forestry and forest management and how has that training affected your perspectives on forest management?
10. What factors other than your training have contributed to your perspectives on forest management and how have your perspectives changed over time?
11. How do your training and these other factors affect the management decisions you make?
12. Has the implementation of ecosystem management in the NWFP affected your own perspectives on forest management?

13. What makes a forest resilient? What makes people and society resilient? Is it possible to simultaneously create resilient societies and resilient forests?

British Columbia Interview Questions

14. What type of license does the owner of the forests you manage hold?
15. How many hectares of forest do you manage?
16. What types of forests do you manage?
17. Which policies/regulations affect the manner in which you manage your forests and how?
18. How have these policies and regulations changed during the time you've been a forest manager and what affect have these changes had on your management practices?
19. What role does the FRPA play in forest management for you? How is the FRPA different from the FPC in regulating forest management?
20. What are your (company's/organization's) goals for managing your forests and what management techniques do you use to accomplish these goals?
21. What factors drive forest management for you (your company/organization), and which of these is the primary driving factor?
22. What type of training did you receive in forestry and forest management and how has that training affected your perspectives on forest management?
23. What factors other than your training have contributed to your perspectives on forest management and how have your perspectives changed over time?
24. How do your training and these other factors affect the management decisions you make?
25. Has the implementation of ecosystem management in the FRPA affected your own perspectives on forest management?
26. What makes a forest resilient? What makes people and society resilient? Is it possible to simultaneously create resilient societies and resilient forests?

APPENDIX B

PNW forest ownership distribution among interviewees.

Question 1: Are the forests you manage under private industrial, non-industrial, state, or federal ownership?					
Interviewee	Private Industrial	Private non-industrial	State	Federal	Other
1	1				
2	1				
3	1				
4			1		
6		1		1	
7				1	
8					1
9				1	
10				1	
11				1	
12				1	
13			1		
14				1	
Total	3	1	2	7	1

BC forest tenure distribution among interviewees.

Question 1: What type of license does the owner of the forests you manage hold?						
Interviewee	TSA	TFL	Community	Tribal	Woodlot	Private
5	1	1	1	1	1	
14	1	1	1	1	1	
15	1	1	1	1	1	
16						1
17	1	1	1	1	1	
18a	1	1		1		
19	1	1	1	1	1	
20	1	1	1	1	1	
21	1	1				
22	1	1	1	1	1	
23	1	1		1	1	
24	1	1				
Total	**11**	**11**	**7**	**9**	**8**	**1**

Hectares of forestlands managed or overseen by respondents in the PNW.

Question 2: How many hectares of forest do you manage?	
Private Industrial	
1	109,265 hectares
2	N/A
3	50,000 hectares
Private Non-Industrial	
6	66 hectares (woodlot)
State	
4	
13	101,171 hectares
Federal	
6	10,117,141 hectares
7	809,371 hectares
9	60,703 hectares
10	121,605 hectares
11	890,308 hectares
12	DK
Tribal	
8	Tribal lands historically, 1,416 hectares, now 6,070 hectares

Hectares of forestlands managed or overseen by respondents in BC.

Question 2: How many hectares of forest do you manage?	
Interviewee	
Private Industrial (Pvt)	
16	258,000 hectares
Private Industrial (Pub)	
21	150,000 hectares
24	1,400,000 hectares
MoF	
5	15,000,000 hectares
15	1/6 of province
17	8,000,000 hectares
18	DK
19	DK
22	DK
MoE	
14	NA
Tribal	
20	~1,500,000 hectares
23	500,000 hectares in Haida, not sure in Campbell River

PNW managed forests species composition.

Question 3: What types of forests do you manage?						
Interviewee	Mxd Con/ Doug Fir, even aged	Mxd Con/ Mxd Age	Even-aged single species	Doug Fir	Hemlock	Other
Private Industrial						
1	1		1			
2	1		1	1	1	
3				1	1	1
Private Non-Industrial						
6	1	1		1		
State						
4		1				
13				1	1	1
Federal						
7			1			
9				1		
10			1	1		
11			1	1		
12				1	1	
Tribal						
8				1		
Total	**3**	**2**	**5**	**9**	**4**	**2**

BC managed forests species composition.

Question 3: What types of forests do you manage?						
Interviewee	Mxd Con/Doug Fir, even aged	Mxd Con/ Mxd Age	Fir	Doug Fir	Hemlock/ Cedar	Other
PI (Pvt)						
16	1					1 (old growth)
PI (pub)						
21			1	1	1	
24			1		1	1 (alder)
MoF						
5		1			1	1
15		1			1	1
17		1				1 (old growth)
18					1	
19	1	1			1	
22	1		1	1	1	1 (old growth & alder)
MoE						
14						Not able to manage: alpine to valley bottom eco-systems
Tribal						
20		1	1	1	1	1 (old growth)
23					1	1 (Sitka Spruce)
Total	**3**	**5**	**4**	**3**	**9**	**8**

Question 4a: Which policies/regulations affect the manner in which you manage your forests

Interviewee	ESA	CWA	FMA	NEPA	NWFP	O&C	Sustained Yield Act	Wilderness Act	FPA/FPR	CIPA	SFI
Private Industrial											
1				1					1	1	
2	1	1							1		
3									1		1
Total	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**3**	**1**	**1**
Private Non-Industrial											
6a/b	1	1	1								
Total	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
State											
4	1					1					
13	1	1							1		
Total	**2**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**
Federal											
7	1	1	1	1	1	1	1	1			
9			1		1	1					
10	1				1	1					
11	1	1	1		1	1					
12		1			1						
Total	**3**	**3**	**3**	**1**	**5**	**4**	**1**	**1**	**0**	**0**	**0**
Tribal											
8	**1**		**1**	**1**							
Total	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Question 4a: Which policies/regulations affect the manner in which you manage your forests?											
Interviewee	FRPA	Forest Act	Ministry of Forest Act	Foresters Act	EBM	SFI	Land Act	Water Act	Federal Species at Risk Act	Wildlife Act	Heritage Conser. Act
Private Industrial (Private)											
16				1		1					
Total	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Private Industrial (Public)											
21	1				1						
24	1										
Total	**2**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
MoF											
5	1	1	1								
15	1	1		1			1	1	1	1	
17	1				1						1
18	1	1									
19	1	1		1							
22	1	1									
Total	**6**	**5**	**1**	**2**	**1**	**0**	**1**	**1**	**1**	**1**	**1**
MoE											
14	1										
Total	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
First Nations											
20	1	1			1						
23	1	1			1						
Total	**2**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**

Question 4B: How?									
	Management Oversight				Management Constraints			Management Approach	
Interviewee	Local Oversight	Regional Oversight	State Oversight	Federal Oversight	Tribal Influence	Certification Compliance	Lawsuit Effects	Sustained Yield	Habitat/ Forest Protection
Private Industrial									
1			1						
2			1		1		1		1
3			1			1			
Total	**0**	**0**	**3**	**0**	**1**	**1**	**1**	**0**	**1**
Private Non-Industrial									
6b			1						1
Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
State									
4	1		1						1
13	1		1	1	1	1			1
Total	**2**	**0**	**2**	**1**	**1**	**1**	**0**	**0**	**2**
Federal									
6a		1		1					
7				1				1	
9				1			1		1
10				1			1		
11				1				1	1
12				1					
Total	**0**	**2**	**0**	**6**	**0**	**0**	**2**	**2**	**2**
Tribal									
8	1			1	1				
Total	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**

Question 4a: How?										
	Management Oversight				**Management Constraints**			**Management Approach**		
Interviewee	Local Oversight	Regional Oversight	Province Oversight	Profession Oversight	Tribal Influence	Cert Comp	Mgmt Structure	Mgmt Strategy	Forest Production	Habitat/ Forest Protection
Private Industrial (Private)										
16				1		1		1	1	
Total	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**0**
Private Industrial (Public)										
21		1	1							
24			1			1	1	1	1	1
Total	**0**	**1**	**2**	**0**	**0**	**1**	**1**	**1**	**1**	**1**
MoF										
5			1				1	1	1	
15			1	1			1	1	1	
17	1	1				1	1	1		1
18			1		1		1	1		
19			1	1				1		
22			1					1	1	1
Total	**1**	**1**	**5**	**2**	**1**	**1**	**4**	**6**	**3**	**2**
MoE										
14							1	1	1	
Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**
First Nations										
20	1	1	1		1		1	1	1	1
23	1	1			1		1			1
Total	**2**	**2**	**1**	**0**	**2**	**0**	**2**	**1**	**1**	**2**

PNW Policy and Regulation changes.

Question 5a: How have these policies and regulations changed during the time you have been a forest manager?			
Interviewee	No Change	More Stringent	Less Stringent
Private Industrial			
1	1	1	
2		1	
3		1	
Total	**1**	**3**	**0**
Private Non-Industrial			
6			
Total	**0**	**0**	**0**
State			
4		1	
13			
Total	0	**1**	0
Federal			
6		1	1
7		1	
9		1	
10		1	
11		1	
12		1	
Total	**0**	**6**	**1**
Tribal			
8			1
Total	**0**	**0**	**1**

BC Policy and regulation changes.

Question 5a: How have these policies and regulations changed during the time you have been a forest manager?					
Interviewee	**No Change**	**More Stringent**	**Less Stringent**	**Separated Components of Forestry**	**Land Classification**
PI (Priv)					
16		1			
Total	**0**	**1**	**0**	**0**	**0**
PI (Pub)					
21		1	1		
24	1	1	1		
Total	**1**	**2**	**2**	**0**	**0**
MoF					
5		1		1	1
15		1		1	
17		1			
18			1		
19		1	1	1	
22	1		1		
Total	**1**	**4**	**3**	**3**	**1**
MoE					
14			1	1	
Total	**0**	**0**	**1**	**1**	**0**
First Nations					
20		1	1		
23		1			
Total	**0**	**2**	**1**	**0**	**0**

NWFP influences in the PNW.

Question 6: What role does the NWFP play in forest management for you?				
Interviewee	**Direct**	**Indirect**	**Voluntary Compliance**	**No Effect**
Private Industrial				
1		1		
2		1	1	
3		1		
Total	**0**	**3**	**1**	**0**
Private Non-Industrial				
6b		1		1
Total	**0**	**1**	**0**	**1**
State				
4		1		
13			1	
Total	**0**	**1**	**1**	**0**
Federal				
6a	1			
7	1			
9	1			
10	1			
11	1			
12	1			
Total	**6**	**0**	**0**	**0**
Tribal				
8		1		1
Total	**0**	**1**	**0**	**1**

FRPA influences in BC.

Question 6: What role does the FRPA play in forest management for you?				
Interviewee	**Direct**	**Indirect**	**Voluntary Compliance**	**No Effect**
Private Industrial (Private)				
16		1		
Total	**0**	**1**	**0**	**0**
Private Industrial (Public)				
21	1			
24	1			
Total	**2**	**0**	**0**	**0**
MoF				
5	1			
15	1			
17		1		
18	1			
19	1			
22	1			
Total	**5**	**1**	**0**	**0**
MoE				
14	1			
Total	**1**	**0**	**0**	**0**
First Nations				
20	1			
23		1		
Total	**1**	**1**	**0**	**0**

Differences between the FPC and FRPA.

Question 6b: How is the FRPA different from FPC in regulation forest management?									
	FRPA				**FPC**				
Interviewee	**Results-Based**	**Delayed Enforcement**	**Industry Driven**	**Standardized Procedures**	**Prescriptive**	**Immediate Enforcement**	**Multi-Interest**	**Streamlined Process**	**No Diff**
Private Industrial (Private)									
16									1
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Private Industrial (Public)									
21	1	1			1	1			
24	1	1		1	1	1		1	1
Total	**2**	**2**	**0**	**1**	**2**	**2**	**0**	**1**	**1**
MoF									
5	1	1			1	1			1
15	1	1			1	1			
17	1				1				
18	1	1			1	1			
19	1				1				
22	1			1	1			1	
Total	**6**	**3**	**0**	**1**	**6**	**3**	**0**	**1**	**1**
MoE									
14	1		1		1		1		
Total	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**
First Nations									
20	1			1	1			1	1
23	1				1	1			1
Total	**2**	**0**	**0**	**1**	**2**	**1**	**0**	**1**	**2**

PNW Company/Organization Goals.

Question 7a: What are your (company's/organization's) goals for managing your forests?							
Interviewee	**Make money**	**Maintain working forests**	**Produce Timber**	**Balance multiple values**	**Maintain habitat**	**Restoration**	**Other**
Private Industrial							
1		1		1			
2			1	1			
3	1						1
Total	**1**	**1**	**1**	**2**	**0**	**0**	**1**
Private Non-Industrial							
6a/b	1(b)		1(a)	1(a)	1(a)	1(a/b)	1(b)
Total	**1**	**0**	**1**	**1**	**1**	**1**	**1**
State							
4	1		1	1	1	1	
13	1		1	1	1	1	
Total	**2**	**0**	**2**	**2**	**2**	**0**	**0**
Federal							
7		1	1	1	1		
9	1		1	1	1		1
10			1	1	1		1
11	1	1	1	1	1	1	
12	1 BLM		1 FS/BLM	1 FS/BLM	1 FS	1 FS	
14							
Total	**3**	**2**	**5**	**5**	**5**	**2**	**2**
Tribal							
8			1	1	1		1
Total	**0**	**0**	**1**	**1**	**1**	**0**	**1**

BC Company/Organization Goals.

Question 7a: What are your (company's/organization's) goals for managing your forests							
Interviewee	Make money	Maintain working forests	Produce Timber	Balance multiple values	Maintain ecosystem/ habitat	Compliance	Other
PI (Pvt)							
16	1	1	1				
Total	**1**	**1**	**1**	**0**	**0**	**0**	**0**
PI (Pub)							
21			1			1	1
24	1			1			1
Total	**1**	**0**	**1**	**1**	**0**	**1**	**2**
MoF							
5				1		1	
15				1			1
17				1	1		1
18						1	
19			1	1	1	1	
22	1	1	1	1	1		
Total	**1**	**1**	**2**	**5**	**3**	**3**	**2**
MoE							
14				1	1		
Total	**0**	**0**	**0**	**1**	**1**	**0**	**0**
Tribal							
20			1	1	1		1
23	1			1	1		1
Total	**1**	**0**	**1**	**2**	**2**	**0**	**2**

PNW Techniques used to Meet Goals.

Question 7b: What management techniques do you use to accomplish these goals?											
	Extractive Techniques										
Interviewee	**Spray**	**Clear Cuts**	**Thin**	**Legacy**	**Even-aged Mgmnt**	**Optimize Species Complex**	**Regen Harvest**	**Variable Retention Harvest**	**Decrease Rotation Time**	**Long-term harvest models**	**Cost-Benefits Analysis**
Private Industrial											
1											
2		1	1	1	1				1		
3						1				1	1
Total	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**1**
Private Non-Industrial											
6b			1				1				
Total	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
State											
4		1	1	1		1					
13			1					1		1	
Total	**0**	**1**	**2**	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**
Federal											
6a		1	1				1				
7			1		1						
9			1								
10			1								
11			1								
12			1							1	
Total	**0**	**1**	**6**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**
Tribal											
8	1	1									
Total	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

PNW Question 7b continued.

Protective Techniques										
Interviewee	**Increase Rotation Time**	**Decrease Density**	**Stream Buffers**	**Habitat Buffers**	**Habitat Building**	**Manage for Biodiversity**	**Patches**	**Create/Leave Snags and downed wood**	**Landscape Structural Diversity**	**Ecosystem Mgmnt**
Private Industrial										
1										
2	1		1					1		
3										
Total	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
Private Non-Industrial										
6b										
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
State										
4				1	1		1	1	1	
13		1		1	1			1		1
Total	**0**	**1**	**0**	**2**	**2**	**0**	**1**	**2**	**1**	**1**
Federal										
6a						1				1
7	1	1								
9					1					
10				1						
11				1	1				1	
12	1		1	1	1					
Total	**2**	**1**	**1**	**3**	**3**	**1**	**0**	**0**	**1**	**1**
Tribal										
8				1	1					1
Total	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**

BC Techniques for Meeting Goals.

Question 7b: What management techniques do you use to accomplish these goals?											
	Extractive Techniques										
Interviewee	**Spray**	**Clear Cuts**	**Thin**	**Legacy**	**Even-aged Mgmnt**	**Optimize Species Complexity**	**Regen Harvests**	**Variable Retention Harvest**	**Decrease Rotation Time**	**Green up/ Planting**	**Cost-Benefits Analysis**
Private Industrial (Private)											
16	1	1				1			1		
Total	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**
Private Industrial (Public)											
21		1				1	1	1		1	
24			1					1			
Total	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**2**	**0**	**1**	**0**
MoF											
5											
15											1
17											
18		1	1					1			
19						1		1			
22								1		1	
Total	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**3**	**0**	**1**	**1**
MoE											
14											
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
First Nations											
20		1	1	1				1			
23		1						1			
Total	**0**	**2**	**1**	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**0**

PNW Factors that drive forest management for company or organization.

Question 8: What factors drive forest management for you (your company/organization) and what is the primary driver?								
Interviewee	**Economics**	**Policy and Regulations**	**Politics**	**Societal Pressures**	**Timber Trade**	**Conservation Stewardship**	**Preservation**	**Other**
PI								
1	1, PD	1						
2	1, PD	1			1	1		
3	1, PD							
Total	**3, 3PD**	**2**	**0**	**0**	**1**	**1**	**0**	**0**
PNI								
6a/b				1(a)	1(a)	1(b), PD	1(a)	1(a/b), PD(a)
Total	**0**	**0**	**0**	**1**	**1**	**1, 1PD**	**1**	**1, 1PD**
State								
4	1	1, PD						
13	1 PD	1		1		1 PD		
Total	**2, 1PD**	**2, 1PD**	**0**	**1**	**0**	**1, 1PD**	**0**	**0**
Federal								
7		1, PD		1		1		
9	1	1, PD		1		1		
10	1	1, PD		1, PD		1		1
11	1	1, PD		1, PD		1		
12	1 BLM PD	1 FS		1 FS/BLM		1 FS PD		
14								
Total	**4, 1PD**	**5, 4PD**	**0**	**5, 2PD**	**0**	**5, 1 PD**	**0**	**1**
Tribal								
8	1				1	1	1	1, PD
Total	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**1, 1PD**

PD = Primary Driver

BC Factors that drive management for company or organization.

Question 8: What factors drive forest management for you (your company/organization)								
Interviewee	**Economics**	**Policy and Regulations**	**Public**	**First Nations**	**Industry**	**Conservation Stewardship**	**Preservation**	**Other**
PI (Priv)								
16	1PD							
Total	**1, 1PD**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
PI (Pub)								
21		1PD	1					
24	1PD		1PD			1PD		
Total	**1, 1PD**	**1, 1PD**	**2, 1PD**	**0**	**0**	**1, 1PD**	**0**	**0**
MoF								
5		1	1	1PD				
15	1		1			1PD		1
17	1	1PD	1	1	1	1	1	
18	1	1						1PD
19	1PD		1		1	1		
22	1	1	1PD		1	1		1
Total	**5, 1PD**	**4, 1PD**	**5, 1PD**	**2, 1PD**	**3**	**4, 1PD**	**1**	**3, 1PD**
MoE		1						
14								1
Total	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Tribal								
20	1	1PD		1	1PD	1		
23	1PD		1	1	1			
Total	**2, 1PD**	**1PD**	**1**	**2**	**2, 1PD**	**1**	**0**	**0**

PD = Primary Driver

PNW Education level of forestry professionals.

Question 9: What type of training did you receive in forestry and forest management					
Interviewee	No College	BS Forestry	MS Forestry	PhD Forestry	Other (specify)
PI					
1					MS Forest Ecol
2		1	1		Cont ed for cert
3		1			Cont ed for cert
Total	**0**	**2**	**1**	**0**	
PNI					
6		1			MS Admin of Forests
Total	**0**	**1**	**0**	**0**	
State					
4		1			Cont ed for cert and mgmt training
13					3 yrs undergrad in bio and econ + 2 yrs forestry tech
Total	**0**	**1**	**0**	**0**	
Federal					
7			1		Partial PhD
9		1			Cont ed for cert
10		1			MS Forest Bio + cont ed
11				1	BS natural science
12					Bachelors Bio and Math education, cont ed
14		1			MS Forest Ecol
Total	**0**	**3**	**1**	**1**	
Tribal					
8			1		Cont ed for cert
Total	**0**	**0**	**1**	**0**	

BC Education level of forestry professionals.

Question 9: What type of training did you receive in forestry and forest management					
Interviewee	No College	BS Forestry	MS Forestry	PhD Forestry	Other (specify)
PI (Priv)					
16		1			Registered Prof Forester
Total	**0**	**1**	**0**	**0**	
PI (Pub)					
21		1			Registered Prof Forester and a BSE
24		1	1 Forest ecology		BS Dual major forestry resource/enviro assess
Total	**0**	**2**	**1**	**0**	
MoF					
5		1			Silviculture diploma
15					Engineering technician/then entemology and r.s./gis
17					
18		1			Registered Prof Forester
19		1			MS silviculture
22		1			Registered Prof Forester
Total	**0**	**4**	**0**	**0**	
MoE					
14	1				Forest technician/on the job
Total	**1**	**0**	**0**	**0**	
Tribal					
20		1			
23					Resource management diploma
Total	**0**	**1**	**0**	**0**	

PNW Training effects on forest management perspectives.

Question 9b: How has that training affected your perspectives on forest management?

		Career		**Values**		**Approach**		
Interviewee	No Effect	Career Change	Prepared to Manage Resource	Interdisciplinary Perspective	Sustainable Management for Multiple Values	Landscape Perspective	Long term perspective	Holistic perspective
Private Industrial								
1		1						
2								
3	1	1						
Total	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
Private Non-Industrial								
6a/b				1				1
Total	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**
State								
4								
13			1					
Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Federal								
7			1		1			
9			1					
10					1	1		1
11			1					
12						1	1	
Total	**0**	**0**	**3**	**0**	**2**	**2**	**1**	**1**
Tribal								
8			1					
Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

BC Training effects on forest management perspectives.

Question 9b: How has that training affected your perspectives on forest management?

		Career			Values		Perspective			
Interviewee	No Effect	Career Change	Experiential Understanding	Prepared to Manage Resource	Interdisc Perspective	Sustainable Mgmnt for Mult Values	Specialized	Land-scape Persp	Long term Persp	Holistic Persp
Private Industrial (Private)										
16									1	
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
Private Industrial (Public)										
21	1		1							
24					1					1
Total	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
MoF										
5				1						
15						1				
17										
18								1	1	1
19					1			1		
22				1						
Total	**0**	**0**	**0**	**2**	**1**	**1**	**0**	**2**	**1**	**1**
MoE										
14			1			1				
Total	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
First Nations										
20					1	1				1
23					1					1
Total	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**2**

PNW Changing perspectives.

Question 10: How have your perspectives changed over time?										
	Objective			**Collective**				**Individual**		
Interviewee	Research to App	Long-term Persp	Local to Landscape	Broader Persp	Comm Persp	Balance of Interests	Collab Problem Solving	Knowledge increases	Increased Critical Thinking	Individual Landowner Perspective
Private Industrial										
1	1									
2				1						
3				1						
Total	**1**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
Private Non-Industrial										
6b										1
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
State										
4				1						
13				1		1				
Total	**0**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**0**
Federal										
6					1	1				
7				1				1		
9		1		1			1			
10	1			1						
11	1		1	1						
12				1					1	
Total	**2**	**1**	**1**	**5**	**1**	**1**	**1**	**1**	**1**	**0**
Tribal										
8				**1**	**1**	**1**				
Total	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**

BC Changing perspectives.

Question 10: How have your perspectives changed over time?

	Objective				**Collective**				**Individual**		
Interviewee	Research to App	Long-term persp	System Persp	Local to Landscape	Broad Persp	Comm Persp	Balance of Interest	Collab Prob Solving	Knowledge increases	Increase Critical Thinking	Individual Landowner Perspective
Private Industrial (Private)											
16											
Total											
Private Industrial (Public)											
21	1				1			1	1		
24					1			1	1		
Total	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**2**	**0**	**0**
MoF											
5		1		1	1				1		
15					1		1				
17											
18			1		1						
19			1	1	1			1	1		
22			1						1		
Total	**0**	**1**	**3**	**2**	**4**	**0**	**1**	**1**	**3**	**0**	**0**
MoE											
14			1	1					1		
Total	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
First Nations											
20									1	1	
23					1		1	1		1	
Total	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**2**	**0**

PNW Training effects on management decisions.

Question 11: How do your training and these other factors affect the management decisions you make?							
Interviewee	**Working forest management**	**Multi-value management**	**Management to balance goals/regs/environment**	**Ecosystem management**	**Collaborative Management**	**Manage with Integrity**	**N/A**
Private Industrial							
1	1	1					
2							1
3			1				
Total	**1**	**1**	**1**	**0**	**0**	**0**	**1**
Private Non-Industrial							
6a/b				1	1		
Total	**0**	**0**	**0**	**1**	**1**	**0**	**0**
State							
4	1	1					
13		1	1				
Total	**1**	**2**	**1**	**0**	**0**	**0**	**0**
Federal							
7		1			1	1	
9		1					
10	1	1		1	1		
11			1				
12	1			1			
Total	**2**	**3**	**1**	**2**	**2**	**1**	**0**
Tribal							
8	**1**	**1**					
Total	**1**	**1**	**0**	**0**	**0**	**0**	**0**

BC Training effects on management decisions.

Question 11: How do your training and these other factors affect the management decisions you make?

Interviewee	N/A	Climate Change Plan	Landscape Level Planning	Working Forest Mgmnt	Multi-value Mgmnt	Balance goals/ regs/ enviro	Eco-system Mgmnt	Collab Mgmnt	Admin Leader ship Skills	Manage with Integrity	Problem-Solving and Planning
Private Industrial (Private)											
16									1		
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
Private Industrial (Public)											
21		1	1		1		1				1
24					1		1	1	1		1
Total	**0**	**1**	**1**	**0**	**2**	**0**	**2**	**1**	**1**	**0**	**2**
MoF											
5								1	1		1
15					1	1					
17			1		1	1	1	1			
18					1	1			1		
19							1	1		1	1
22											1
Total	**0**	**0**	**1**	**0**	**3**	**3**	**2**	**3**	**2**	**1**	**3**
MoE											
14	1										
Total	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
First Nations											
20					1	1	1	1	1		1
23								1			1
Total	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**1**	**0**	**2**

PNW Ecosystem management effects on perspectives on forest management.

Question 12: Has the implementation of ecosystem mgmt in the NWFP affected your own perspectives on forest management?									
	Scale			**Approach**				**None**	
Interviewee	Landscape Mmgt	Mgmt Diversity	Shifting Mosaic	Prescriptions for Protection	Multi-resource/ value Mgmt	Examine multiple issues	Collaborative Mgmt approaches	Ecosystem Mgmt Unnecessary	No effect
Private Industrial									
1	1	1	1						
2	1		1	1					
3				1	1	1			
Total	**2**	**1**	**2**	**2**	**1**	**1**	**0**	**0**	**0**
Private Non-Industrial									
6a/b									1
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
State									
4	1	1	1	1	1				
13	1	1		1			1		
Total	**2**	**2**	**1**	**2**	**1**	**0**	**1**	**0**	**0**
Federal									
7									1
9					1				
10									1
11								1	
12									1
Total	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**
Tribal									
8	1	1			1		1		
Total	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**

BC Ecosystem management effects on perspectives on forest management.

Question 12: Has the implementation of ecosystem mgmt in the FRPA affected your own perspectives on forest management?									
	Scale			**Approach**				**None**	
Interviewee	Landscape Mmgt	Mgmt Diversity	Shifting Mosaic	Prescriptions for Protection	Multi-resource/ value Mgmt	Examine multiple issues	Collaborative Mgmt approaches	Ecosystem Mgmt Unnecessary	No effect
Private Industrial (Private)									
16									1
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Private Industrial (Public)									
21	1	1		1					
24									1
Total	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
MoF									
5									1
15									1
17	1	1		1	1		1		
18				1	1	1			
19								1	
22					1				
Total	**1**	**1**	**0**	**2**	**3**	**1**	**1**	**1**	**2**
MoE									
14									1
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
First Nations									
20									1
23	1	1							
Total	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

PNW Forest resilience thoughts.

Question 13a: What makes a forest resilient?											
	Biological						**Management**		**Societal**		
Interviewee	Inherent	Healthy Forest	Bio-diversity	Age Class Diversity	Maintain processes functions	Flexible Shifting system	Active Mgmnt	Keep Forests Working	Provide Service	Incentivise Protection	Educate Public
Private Industrial											
1				1				1		1	
2		1					1	1	1		
3	1						1				
Total	**1**	**1**	**0**	**1**	**0**	**0**	**2**	**2**	**1**	**1**	**0**
Private Non-Industrial											
6a/b	1		1								
Total	1	0	1	0	0	0	0	0	0	0	0
State											
4	1										
13		1			1	1	1				
Total	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**
Federal											
7	1						1				
9	1					1					
10		1	1	1					1		1
11					1						
12							1		1		1
Total	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**0**	**2**	**0**	**2**
Tribal											
8	1		1	1							
Total	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

BC Forest resilience thoughts.

Question 13a: What makes a forest resilient?											
	Biological						**Management**		**Societal**		
Interviewee	Inherent	Healthy Forest	Bio-diversity	Age Class Diversity	Maintain processes functions	Flexible Shifting system	Active Mgmnt	Keep Forests Working	Provide Service	Incentivise Protection	Educate Public
Private Industrial (Private)											
16							1	1			
Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**
Private Industrial (Public)											
21			1	1			1				
24			1	1	1		1				
Total	**0**	**0**	**2**	**2**	**1**	**0**	**2**	**0**	**0**	**0**	**0**
MoF											
5	1										
15	1		1	1							
17	1				1						
18	1										
19		1			1		1		1		
22			1		1	1					
Total	**4**	**1**	**2**	**1**	**3**	**1**	**1**	**0**	**1**	**0**	**0**
MoE											
14		1	1		1						
Total	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
First Nations											
20			1		1		1				
23			1		1		1		1		
Total	**0**	**0**	**2**	**0**	**2**	**0**	**2**	**0**	**1**	**0**	**0**

PNW Societal resilience thoughts.

Question 13b: What makes society resilient?													
	Social Dynamics					**Individual Dynamics**		**Economic Dynamics**		**Environmental Dynamics**			
Interviewee	Inherent	Adapt to Chng	Comm	Collab	Effect Gov	Phys Health	Educate Public	Econ Stability	Diverse Econ	Res Product	Efficient Resource Mgmnt	Conn to Res	Enviro Health
Private Industrial													
1									1	1	1		
2													
3	1	1							1	1			
Total	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**1**	**0**	**0**
Private Non-Indust													
6a/b						1		1					1
Total	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
State													
4													
13		1	1	1	1		1						
Total	**0**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Federal													
7					1					1	1		
9		1	1										
10										1		1	
11		1			1				1	1			
12	1	1	1	1	1								
Total	**1**	**3**	**2**	**1**	**3**	**0**	**0**	**0**	**1**	**3**	**1**	**1**	**0**
Tribal													
8									1				
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**

BC Societal resilience thoughts.

Question 13b: What makes society resiient?

	Social Dynamics				Individual Dynamics			Economic Dynamics		Environmental Dynamics			
Interviewee	Adapt to Chg	Com m	Collab	Effe ct Gov	Flex	Phys Health	Educate Public	Econ Stabil	Diverse Econ	Res Prod uct	Efficient Resourc e Mgmnt	Connect to Res	Enviro Health
Private Industrial (Private)													
16									1	1	1		
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**
Private Industrial (Public)													
21	1			1		1	1	1					1
24					1				1				
Total	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**
MoF													
5													
15	1												
17	1												
18		1		1		1				1	1		
19										1	1		
22	1							1	1			1	
Total	**3**	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**2**	**2**	**1**	**0**
MoE													
14		1							1		1		1
Total	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**
First Nations													
20		1		1		1	1	1					
23												1	
Total	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**

PNW Simultaneous resilience.

Interviewee	Yes	No	IDK
Private Industrial			
1	1		
2			
3	1		
Total	**2**	**0**	**0**
Private Non-Industrial			
6a/b	**1**		
Total	1	0	0
State			
4			
13	1		
Total	**1**	**0**	**0**
Federal			
7	1		
9			1
10	1		
11	1		
12	1		
Total	**4**	**0**	**1**
Tribal			
8	**1**		
Total	**1**	**0**	**0**

BC Simultaneous Resilience.

Question 13c: Is it possible to simultaneously create resilient societies and resilient forests?			
Interviewee	**Yes**	**No**	**IDK**
Private Industrial (Private)			
16	1		
Total	**1**	**0**	**0**
Private Industrial (Public)			
21	1		
24	1		
Total	**2**	**0**	**0**
MoF			
5	1		
15	1		
17	1		
18		1	
19	1		
22	1		
Total	**5**	**1**	**0**
MoE			
14	1		
Total	**1**	**0**	**0**
First Nations			
20	1		
23	1		
Total	**2**	**0**	**0**

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