THE UNIVERSITY OF CALGARY

From Suppression to Prescription:
An Evaluation of the Fire Management Program
in the Lake Louise, Yoho and Kootenay National Parks Field Unit

by

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ABSTRACT

FROM SUPPRESSION TO PRESCRIPTION:
AN EVALUATION OF THE FIRE MANAGEMENT PROGRAM IN
THE LAKE LOUISE, YOHO AND KOOTENAY NATIONAL PARKS FIELD UNIT

By Amber Stewart

A Master's Degree Project prepared in partial fulfillment of the requirements
for the degree of Master of Environmental Design (Planning)

Supervised by Dr. M. Quinn

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Wildfire is a powerful natural force that has shaped the landscape of the Canadian Rocky Mountains for thousands of years. Fire management activities in the Rocky Mountain national parks have traditionally been oriented towards the protection of people, built assets, neighbouring lands and rare or sensitive ecological and cultural resources from unwanted wildfire. More recently, Parks Canada has pursued a policy to maintain or restore the ecological role of fire. In order to gain a better understanding of the issues surrounding implementation of fire management activities in national parks, a case study was undertaken of the fire management program in Yoho, Kootenay and Banff National Parks. An analysis of the issues surrounding fire management will assist Parks Canada in improving planning processes and more effectively implementing fire management initiatives.

A two-pronged approach was employed to evaluate the fire management program: 1) the program's performance over the last five years was assessed through an evaluation of outcomes, and 2) a process evaluation investigated the factors influencing this performance. Findings of the evaluation show that there is strong internal support for fire management goals and the approach adopted by the program. The challenge facing the program is to build on strong operational capabilities by developing competencies in other areas, such as communications, planning and constituency building, in order to

implement more complex landscape level projects. More resources, internal and public support are required to achieve program objectives.

KEYWORDS: program evaluation, fire management, performance measures, national parks, wildfire, prescribed burning, fuel management, facility protection, ecosystem management

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CHAPTER 1: INTRODUCTION

Fire management is an important activity in many of Canada's national parks, including the Rocky Mountain parks. The term 'fire management' refers to the suite of activities associated with the protection of people, property and neighbouring lands from unwanted wildfire, and the use of fire to achieve ecological objectives (Parks Canada, 2003a).

Wildfire is a powerful natural force that has shaped the landscape of the Rocky Mountains for thousands of years. Its potential to negatively affect scenic values and threaten human settlements was not lost on early visitors to the mountains. The establishment of national parks in the Rocky Mountains was followed by efforts to build an organization capable of suppressing wildfires (White, 1985a). The desire to control fire continues to be a key aspect of Parks Canada's fire management policy.

However, increasing recognition that many park ecosystems are fire-adapted, and that periodic fire is required for the regeneration or maintenance of vegetation communities (Van Wagner & Methven, 1980), prompted changes in national park policy in the late seventies. A new emphasis was placed on allowing ecological processes, such as fire, to play a role in modifying vegetation communities, provided that public safety, private property, park facilities and neighboring lands would not be negatively affected.

The possibility that the historic exclusion of fire was resulting in unnatural conditions in many forests provided a rationale for active management. Fire use would be permitted under certain conditions in order to meet specific goals for vegetation (Canadian Parks Service, 1988a). In the most recent park management plans for Banff, Kootenay and Yoho National Parks, targets have been set to restore 50% of the average annual area burned historically (Parks Canada, 1997a; Parks Canada, 2000a; Parks Canada, 2000b).

The mountain parks are grouped into field units for administrative purposes. Each field unit has its own fire management program; although all field unit fire management programs are supported by a national network. The strategy for achieving ecological gains, while minimizing social and economic impacts, is contained in each field unit's fire management plan.

In order to gain a better understanding of the issues surrounding implementation of fire management activities in national parks, this MDP presents a case study of the field unit that encompasses the northern portion of Banff National Park (including the Lake Louise area), Yoho National Park and Kootenay National Park. The field unit will be referred to throughout this document as the Lake Louise, Yoho and Kootenay National Parks (LLYK) Field Unit (see Figure 1.1).

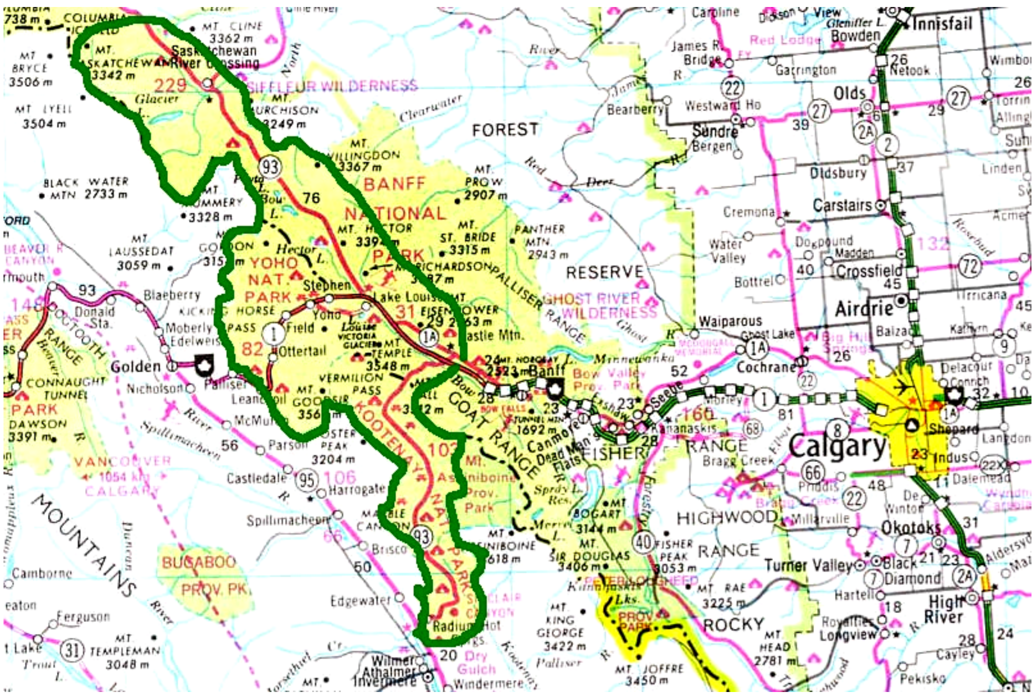

Figure 1.1 Geographic location of the Lake Louise, Yoho and Kootenay National Parks Field Unit (LLYK Field Unit)

Located approximately 150 km west of Calgary in the Canadian Rocky Mountains, the LLYK Field Unit includes Kootenay and Yoho National Parks (located in the province of British Columbia), and the northwestern portion of Banff National Park (located in the province of Alberta).

The LLYK Field Unit is of interest because: 1) natural ignitions occur frequently in the area, 2) there have been very active fire seasons recently, 3) fire management staff are starting to plan and implement more complex prescribed fire and fuel management projects, and 4) a landscape with significant human development presents some interesting challenges. The most recent fire management plan for the field unit was written in 1998 (Walker & Irons, 1998a).

Informal conversations with fire management staff suggested that they have been unable to implement some of the plan's objectives. There was interest in assessing the program's performance over the past five years, and the reasons for that performance, as a basis for updating the fire management plan. An analysis of the issues surrounding fire management in the LLYK Field Unit will help Parks Canada to improve planning processes and more effectively implement fire management initiatives in the future. The objectives of this MDP are to:

- evaluate implementation of the LLYK Field Unit Fire Management Plan between 1998 and 2003,
- identify factors influencing the implementation of fire management activities,
- develop specific recommendations for a revised fire management plan for the LLYK Field Unit and more general recommendations to improve the fire management program.

The MDP will also contribute to the growing field of program evaluation as it relates to natural resource and park management.

Outline of document contents:

Chapter 1: Introduction and problem definition
Chapter 2: Review of context for fire management
Chapter 3: Evaluation methodology
Chapter 4: Outcome evaluation results
Chapter 5: Process evaluation results
Chapter 6: Discussion and recommendations

As with any government program, a review of the broader context within which the program is operating is the first step to understanding the goals of the program and the rationale for service delivery. Chapter 2 explores some of the ideas that have shaped the fire management program through a review of key scientific findings, conceptual frameworks for the management of wilderness areas, and economic and social factors that have influenced policy development.

Chapter 3 describes the two-pronged approach employed to evaluate the fire management program. An evaluation of outcomes was used to assess progress in

implementing planned activities over the last five years. A process evaluation was used to investigate the factors influencing implementation.

Outcome evaluation is a results-based approach that links performance measures to program outputs (the most immediate results of program activities) and outcomes (the longer term results of program activities). Six key activities were assessed: fire control, fire use, facility protection, research and monitoring, communications and interagency coordination. Performance measures from the 1998 fire management plan were assessed for use in this evaluation. In most cases these performance measures proved insufficient for the purposes of the evaluation and new performance measures were developed.

Data for the performance measures were collected and analyzed, and the results of this analysis are discussed in Chapter 4. This part of the evaluation provides a good indication of the extent to which the program has met expectations, but does not assess the factors affecting performance. In order to determine *why* the program failed or succeeded in certain areas, it is necessary to move into the realm of process evaluation. Process evaluations examine the underlying institutional, political or social factors that affect program implementation.

In order to collect information for the process evaluation, semi-structured interviews were conducted with forty Parks Canada employees involved with the LLYK field unit fire management program. A questionnaire containing both quantitative and qualitative questions was developed. The objectives of the questionnaire were to:

- understand how fire management is perceived by Parks Canada staff,
- characterize the state of fire management in the field unit,
- identify factors affecting program implementation in general and the implementation of specific activities.

Questionnaire data were analyzed using non-parametric statistics and content analysis. Chapter 5 describes the results of the questionnaire.

The results of this evaluation show that there is both strong agreement with the goals for fire management as stated in the 1998 plan and most of the concepts underlying the general approach to fire management. Respondents share similar ideas about program priorities and the amount of work required in areas such as prescribed burning

and facility protection. This suggests that there is a strong internal base of support upon which the program can build.

The challenge facing the LLYK Field Unit program is to rise above operational competency in fire control and to develop competencies in other areas, such as communication, planning and constituency building, in order to implement more complex, landscape level projects. This will ultimately require additional resources or support from outside the field unit, which is a challenge given the current fiscal restraint climate within Parks Canada.

Chapter 6 contains recommendations for improving the fire management program, with an emphasis on the role that planning can play in facilitating the implementation of program activities. A revised fire management plan should respond to emerging issues in the field unit, connect broad program direction to individual projects, outline internal processes for project planning and implementation and fill in policy gaps. A broad cross-section of field unit staff needs to be involved in plan development, so that the objectives and priorities of other programs are incorporated into the new plan. Opportunities for the public to learn about and comment on the fire management plan should be provided. At the very least, the new plan will be a valuable communication tool that will initiate more dialogue about the direction the program is headed and the measures required to advance program objectives.

CHAPTER 2: THE CONTEXT FOR FIRE MANAGEMENT IN THE LLYK FIELD UNIT

2.1 Background

Why choose the LLYK Field Unit fire management program for a case study in program evaluation? There are many agencies involved in fire management across Canada. Compared to provinces like Alberta or British Columbia, Parks Canada's fire management program is small. However, Parks Canada has a different mandate from other resource management agencies: to ensure the long-term ecological health of the national parks, while providing Canadians with opportunities to experience these places. This mandate has resulted in the development of a unique program, which has taken a leadership role in using fire to meet both ecological and social objectives. The LLYK Field Unit is of interest because: 1) natural ignitions occur frequently in the area, 2) there have been very active fire seasons recently, 3) fire management staff are starting to plan and implement more complex prescribed fire and fuel management projects, and 4) significant human development on the landscape presents some interesting challenges.

As with any government program, a review of the broader context within which the program is operating is the first step to understanding the goals of the program, and the rationale for service delivery. While the fire management plan is the seminal document guiding the program at the field unit level, it does not exist in isolation. The plan receives direction from higher order plans, such as the field unit's vegetation management plan, relevant park management plans and national policy documents, including *Keepers of the Flame* (Canadian Parks Service, 1988a), the *National Fire Management Directive 2.4.4* (Canadian Parks Service, 1988b), and *Parks Canada's Guiding Policies and Operational Guidelines* (Parks Canada, 1994). These documents are in turn influenced by: new scientific information about the role of fire in ecosystems, new conceptual frameworks for the management of wilderness areas and changes in public expectations and the complexity of the economic and social context within and surrounding national parks. The purpose of this chapter is to explore some of the ideas

that have shaped the fire management program and to describe the social and economic factors influencing its implementation.

2.2 Ecological Context

The development of Parks Canada's fire management policies should be viewed in the context of broader developments in the field of ecology. Ideas about the nature of ecosystems, disturbance dynamics and natural variability have all influenced the direction taken by fire management in the national parks. The literature on appropriate management systems for wilderness areas has led managers to ground program design in concepts such as ecosystem and adaptive management.

2.2.1 A Brief History

Early fire management in the mountain parks was characterized by the desire to suppress all wildfires. Fire was perceived to be a destructive force that needed to be controlled, a view that was pervasive in western North America. Park officials commented frequently on the devastating impacts of wildfire in reports to Ottawa around the turn of the last century.

> In past years forest fires have ravished portions of the Park and left spots of desolation and extensive bands of dead timber, disfiguring the natural beauties of certain tracts (Department of Interior, 1888, as cited in White, 1985a, pp. 28-29).

Money was solicited from Parliament in 1909 to establish a force capable of combating wildfires; this marked the beginnings of the warden service (White, 1985a). Fire suppression has been a cornerstone of Parks Canada policy since those early days.

The first serious challenge to the conventional wisdom that fire needed to be excluded from wilderness areas came with the release of the Leopold Report in the United States in 1963 (Agee, 2000). For much of the 20th century, the dominant view among ecologists had been that ecosystems progressed naturally and predictably towards climax communities (Sprugel, 1991). This fit well with a metaphysical conception of the balance of nature, where harmony and orderliness reigned in the natural world (Wu & Loucks, 1995). Communities were believed to be closed, self-regulating systems,

moving through fixed pathways of succession towards a single equilibrium state or end point, the climax community. Natural disturbance was viewed as uncommon. Where communities existed in transitional states, the influence of humans was commonly blamed. Ecosystems were most likely to flourish if they were left alone (Sprugel, 1991).

The Leopold Report reflected an emerging view that natural disturbance was, in fact, more common and widespread than previously thought (Agee, 2000). This view was still compatible with the idea that succession was reasonably predictable and that communities tended to develop towards a climax state. Natural disturbances simply knocked communities back to an earlier successional state, keeping them from reaching a state that was believed to be more stable and diverse (Odum, 1969). Many ecosystems had evolved with fire and some plant species required fire to prepare the seedbed for germination or eliminate competitors. The suppression of fire might actually be altering vegetation in an undesirable manner.

The first sign that the Parks Canada's fire policy was about to change came in the 1979 *Parks Canada Policy* (Canadian Parks Service, 1979). The policy puts a premium on managing national parks with "minimal interference to natural processes", but allows for some exceptions, where public safety, property or adjacent lands might be jeopardized, and where "natural processes have been altered by man and manipulation is required to restore the natural balance" (p. 41). In these cases, every effort will be made to "duplicate natural processes as closely as possible" (p. 41).

The stage was clearly set for fire to play a larger role than it had in the decades when suppression was the norm. Where fire had been excluded from ecosystems, the question would become, how best to reintroduce it? Fire could be reintroduced by allowing more naturally occurring fires (i.e. lightning fires) to burn, instead of suppressing them or through pre-planned management-ignited prescribed fires, i.e. fires lit by fire crews. The general consensus was that the reintroduction of fire should be predicated on an understanding of the effects of fire on vegetation and what vegetation was natural for an area (in other words, what vegetation Parks Canada should be managing for) (Loupoukhine, 1985).

An emerging interest in the landscape level of ecological processes added more complexity to theories about ecosystem equilibrium. Studies of the spatial patterns produced by disturbance suggested that succession could take multiple pathways following disturbance (Turner, Gardner, & O'Neill, 2001; Agee, 2000). This was consistent with an emerging view that equated ecosystems to complex systems, which are non-linear, hierarchical and self-organizing. Non-linear systems "behave as a whole", and "cannot be understood by simply decomposing into pieces which are added or multiplied together" (Kay & Regier, 2000, p. 3). Ecosystems are made up of hierarchical levels, such as gene, population and community, which interact with one another, so that study at multiple scales is required to understand the dynamics of these systems. Self-organizing systems do not require external stimulus to provoke a change; they are "characterized in part by goals, …self-reinforcing processes, emergent properties and surprise" (Kay & Regier, 2000, p. 3). There are no equilibrium points. Instead these systems have multiple steady operating states. Seemingly chaotic behaviour is the norm.

Another model that incorporates thinking about complex systems into a more comprehensive framework is proposed by Holling (2001). He suggests that ecosystems slowly accumulate capital (e.g. biomass, nutrients), which is stored in structural elements like vegetation, so that the system becomes more and more interconnected over time. Eventually the system becomes too rigid or over-connected. A sudden change will be triggered by a natural disturbance like fire, causing all the capital to be released in a very short period of time, and the structure to be lost. The next phase consists of rapid reorganization, the results of which are very unpredictable and are characterized by invention and recombination. Once the system is reorganized, growth starts again. The system needs good potential (e.g. biodiversity) to recover from the change. If its potential has been removed (e.g. species lost due to anthropogenic impacts), it will have difficulty recovering.

This new paradigm presents a real challenge for managers as they attempt to determine how best to manage park vegetation. Since "many types of vegetation are far less stable than they appear to be" (Sprugel, 1991, p. 13) and our ability to predict when ecosystems will change to a new state, or what that new state will be, is more limited than

under the old paradigm of constant, predictable progression towards a climax state (Kay & Regier, 2000), it is difficult to define a particular state or set of states for which to manage.

While it appeared that the concept of equilibrium might no longer apply to many ecosystems, some ecologists maintained that systems could still be in equilibrium at the landscape level, where the "creation of new patches" by disturbance was "balanced by the maturation of older ones" (Sprugel, 1991, p. 4). Much of the fire history research conducted over the last thirty years in the Canadian Rockies is based on this concept. Although the "vegetation present at individual points on a landscape may change over time as a result of natural disturbances, the proportion of the vegetation at each seral stage" is relatively constant (Turner et al., 2001, p. 190).

However there is evidence that some landscapes may never reach an equilibrium state, particularly where natural disturbances are large and infrequent (Sprugel, 1991). Crown-fire dominated ecosystems, such as those found in the Canadian Rockies are probably non-equilibrium landscapes (Turner et al., 2001). Surprise events (e.g. wind events) can also have dramatic impacts on vegetation, as can climatic variability (Sprugel, 1991).

This is not to say that managers should cease making decisions about how to manage ecosystems. The task of managers and scientists is to try to understand what factors cause sudden changes in ecosystems and what types and levels of anthropogenic stressors may cause a system to change states (Kay & Regier, 2000). Holling's (2001) work suggests that appropriate management objectives might target the maintenance of resilience - the adaptive capacity of a system to deal with disturbance. This adaptive capacity may be provided by biodiversity or the remaining biomass, which ensures that sufficient genetic information is available to allow the system to reorganize itself.

The next challenge is to determine what these objectives should be for a particular region. One approach has been to try to characterize the range of natural variability (also known as the historical range of variability or simply natural variability) observed in ecosystems in the past (Landres, Morgan, & Swanson, 1999).

2.2.2 Natural Variability

Natural variability can be defined as "the ecological conditions, and the spatial and temporal variation in these conditions, that are relatively unaffected by people, within a period of time and geographical area appropriate to an expressed goal" (Landres et al., 1999, p. 2). Knowledge of how ecosystems have varied historically can help managers to understand the structure and function of present-day ecosystems, set more realistic goals for ecosystem management, and predict future conditions. This type of knowledge can also assist managers in assessing whether current rates of change are the result of anthropogenic factors, other environmental factors such as climate or factors intrinsic to the system (Morgan et al., 1994; Landres et al., 1999).

This approach has been criticized for leading to overly prescriptive restoration initiatives that focus on a particular period in time. Some critics go further, questioning the relevance of the concept itself. Since every point in time and space is unique, a description of past patterns or processes may not help us determine what present-day or future patterns should look like (Swetnam, Allen, & Betancourt, 1999; Landres et al., 1999).

Following that line of reasoning, ecosystem management should be based on the maintenance or restoration of naturally occurring processes, rather than desired community structure (Swetnam et al., 1999). This was an important debate in fire management circles in the United States (Agee, 2000) and still resonates to some degree in discussions within Parks Canada. Supporters of a process-based approach maintained that "reintroducing the process of fire would eventually restore an uncertain but natural future set of ecosystem states" (Agee, 2000, p. 7). Detractors pointed out that ecosystems had been so altered in some cases that "reintroducing fire without attention to current structure could not result in a restored natural ecosystem" (Agee, 2000, p. 7).

2.2.3 Process-Based Approach Versus Structure-Based Approach

The emphasis on process or structure does have some impact on the strategy selected to reintroduce fire to ecosystems. Where the maintenance or restoration of naturally occurring processes is the preferred mechanism to achieve vegetation

objectives, a program might rely more heavily on naturally occurring fires. Efforts might then concentrate on defining the conditions under which these fires can burn and on developing the expertise to manage them appropriately. Management-ignited fires would play a secondary role, either to create firebreaks or meet very specific resource management objectives. This is the approach that predominates in the United States.

A structure-based approach would be more likely to use management-ignited burning to reverse the effects of ecosystem change, in order to move the system towards a more desirable state. This requires a thorough understanding of the disturbance regime and its effects on vegetation. Naturally occurring fires could play a role, once enough management-ignited burning had been carried out to allow these fires to take place under safer conditions, but they would not predominate in the early stages of the program. The fire management program in the Banff Field Unit (the south end of Banff National Park) is a good example of this type of program.

Both process and structure have been emphasized in Parks Canada policy, with little suggestion that there might be a conflict, or that one approach might be preferred. In an oft-cited discussion paper prepared for Parks Canada, van Wagner and Methven (1980) suggest that the goal of park managers should be to reproduce the vegetation mosaic that would have been created by the natural fire regime, since maintenance of the this regime is limited by public safety and other values-at-risk. This could be accomplished through management-ignited burning or naturally occurring fires.

Vegetation objectives were developed in more detail during the eighties. In the same vein as the 1979 *Parks Canada Policy*, a 1988 Vegetation Management Plan for the Western Canada Region stresses the maintenance of natural processes, in order to maintain vegetation features and elements that are representative of the Rocky Mountain Natural Region.

Ten years later, the *Banff National Park Management Plan* (1997) had relatively little to say about process maintenance. Most of the vegetation objectives in the plan relate to structure (e.g. determining appropriate age-class structure). The strategic goal for vegetation is to maintain "native vegetation communities … to reflect the long-term

ecosystem states and processes", not necessarily the processes themselves (Parks Canada, 1997a, p. 19).

In contrast, the 2000 Yoho and Kootenay National Parks management plans place more emphasis on natural processes. The strategic goal in these plans is for natural processes to "maintain the long-term composition and structure of vegetation communities" (Parks Canada, 2000a, p. 18). The field unit's 1998 Vegetation Management Plan also aims "to ensure the perpetuation of natural processes of vegetation disturbance" (Walker, 1998c, p. 3).

There seems to be a fair amount of room for individual parks or field units to interpret Parks Canada policy and to weight strategies towards:

a) creating conditions where natural processes can operate to the greatest extent possible and allowing these processes to structure vegetation communities, or
b) determining suitable vegetation patterns and then emulating naturally occurring processes to maintain or restore these patterns.

This allows field units to adapt their programs to local conditions. However, it can also create inconsistencies between field units that make coordination and communication about the programs more difficult. The social and economic context of a field unit may also influence strategy selection, a matter which is covered in more detail towards the end of this chapter.

2.2.4 Historic Fire Regimes

Whatever strategy is chosen, two key considerations in setting vegetation management objectives are the desired vegetation patterns and the nature and extent of the disturbance processes that shape these patterns. Although insects and disease play an important role in Rocky Mountain forests, wildfire is the disturbance regime with the greatest potential to change the landscape in a short period of time. Efforts in the eighties and early nineties concentrated on determining fire's historic role in the mountain parks and how this role may have changed in contemporary times.

2.2.4.1 Defining the Fire Regime

There are two conflicting views with regard to the type of fire regime or regimes at play in the Canadian Rockies. One point of view is that the fire regime is predominated by infrequent, high intensity, stand replacing fires (Johnson & Larsen, 1991; Masters, 1990). Major fire years are tied to synoptic weather patterns and in those years, fires burn large areas, regardless of elevation, aspect or fuel type. A commonly cited statistic is that 3% of lightning-caused fires account for 95% of the area burned in the Canadian Rockies (Johnson & Wowchuk, 1993). In years where burning conditions are marginal, differences in aspect, slope, elevation and fuel type can have a significant effect on fire behaviour, however these fires are not ecologically significant because they burn only small areas (Bessie & Johnson, 1995; Johnson & Larsen, 1991). Thus, the primary factor regulating the fire regime is climate (Johnson & Larsen, 1991; Johnson, Fryer, & Heathcott, 1990; Masters, 1990).

Other studies have found much greater variability in fire regimes, and in particular, spatial variability. In Yoho National Park, two fire regimes have been identified, one for high intensity fires, and one for low to moderate intensity fires. Fires also occur with more frequency in the western portion of the park, than in the area next to the Continental Divide (Tymstra, 1991). In an unpublished report for Parks Canada, Masters (1989) found that fires were more frequent in the Kootenay and Sinclair valleys, than in the Vermilion valley. Several studies in Banff National Park have also found that the fire regime varies spatially (White, 1985a; Rogeau, 1996; White, Pengelly, Rogeau, & Zell, 2003). White (1985a) found mean fire intervals to be less than 40 years in montane stands, but over 140 years in the upper subalpine. He attributed a reduction in the number of fires since the 1940's to the prevention of human-caused fires (White, 1985b).

2.2.4.2 Fire Suppression

The effect of active fire suppression on the fire regime in the Canadian Rockies is a subject of much debate. A decline in fire frequency in the twentieth century is commonly attributed to fire suppression efforts, but there are different views with respect

to the success of these efforts. Masters (1989) argues that although suppression efforts were successful in some cases and "many small fires under marginal burning conditions were suppressed" (p. 29), in others they had little effect on the final outcomes. Suppression has probably been most effective since the early 1980's, when helicopter-assisted initial attack became the norm in wildland fire fighting (Masters, 1989).

White (1985b) suggests that a reduction in the frequency of fires is not so much a result of fire suppression, as the prevention of fire occurrence. The decline in wildfires after the 1880's coupled with short fire intervals in montane stands indicates that cultural burning may have played a role in shaping some ecosystems in Banff National Park. This hypothesis is supported by historical accounts of native people setting fire for hunting purposes in Banff National Park and other areas in the Rocky Mountains (White, 1985b).

There is also evidence that although the number of fires and area burned by lightning are much greater in British Columbia than in Alberta, similar fire frequencies existed historically on both sides of the Continental Divide. Human ignitions may therefore have played an important role in augmenting the number of fires and area burned on the east side of the Divide (Weirzchowski, Heathcott, & Flannigan, 2002). More recent work supports the idea that historically whole valleys were burned by people outside the lightning season (White, Feller, & Vera, 2000).

It is unclear what role aboriginal burning may have played in shaping the fire regimes in the LLYK Field Unit. Tymstra (1988) found little evidence of regular aboriginal use of Yoho National Park. Preliminary results of ongoing research in the Kootenay Valley show that aboriginal burning may have occurred in patterns similar to those seen in Banff National Park (C. White, personal communication, March 8, 2004).

Other studies have not found evidence that the frequency of fires has decreased since active fire suppression began (Johnson et al., 1990). "Prescribed burning is not required to reintroduce fire" because there is "little evidence to support the belief that fire suppression has reduced fire frequency" (Weir, Chapman, & Johnson, 1995, p. 277). Management-ignited prescribed burning might, in fact, result in double the area burned. Anecdotal evidence suggests however, that some recent fires in the field unit would have

grown to considerable size had they not been suppressed (R. Walker, personal communication, December 18, 2003).

2.2.4.3 Fuel Build-up

Another point of debate is the contention that fire suppression policies are resulting in fuel loads (accumulations of combustible materials) that are outside of historic norms (White, 1985a). These accumulations can result in more intense fires than would normally be expected. Johnson, Miyanishi, and Bridge (2001) argue that ideas developed for ponderosa pine systems have been misapplied to closed canopy boreal systems. Development of fine fuels sufficient to carry high intensity crown fires occurs relatively early in stand development, and the risk of burning is constant after that. Weather is the most important variable governing fire behaviour, not fuel loads or structure (Johnson & Larsen, 1991).

Contradictory scientific evidence poses a major dilemma for managers. If the argument that fire suppression or fire prevention has not had a significant impact on the fire regime is accepted, then the best strategy might be to allow most wildfires to burn except where limited by public safety, adjacent lands and built structures (Weir et al., 1995).

If it turns out that lightning fires that occurred under marginal burning conditions (and were therefore easy for fire crews to extinguish), or aboriginal fires did play a significant ecological role, then managers should be acting to counteract the effects of fire suppression, or to emulate a regime that existed historically. Management-ignited fires would play an important role in this scenario. Other questions about the extent to which humans shaped park ecosystems (how widespread and long-lived were traditional practices) and the desirability of emulating these practices also need to be answered.

The approach adopted in the *LLYK Field Unit Fire Management Plan* lies somewhere in between these two scenarios. Fire suppression is a priority in areas where there are significant risks to public safety, property or neighboring lands. In other areas, less aggressive tactics will be employed to allow fire to play a role in shaping vegetation communities. Management-ignited prescribed burning may be conducted to meet

specific ecosystem restoration objectives or fuel management goals, and lightning caused fires may be permitted to burn in more remote areas under specific conditions (Walker & Irons, 1998a).

2.3 Ecosystem Management

In the 1990's, policy development for fire management did not match the pace of the 1980's. However, there were developments at a broader level that would give added direction to resource management programs, and provide a strengthened policy framework for fire management activities. The new paradigm for ecosystems presented resource management agencies with a challenge – how to manage very complex systems in the face of uncertainty? This led Parks Canada, like many North American resource management agencies, to adopt an ecosystem management approach. More of a philosophy (Wallace, Cortner, Moote, & Burke, 1996) than a distinct set of principles, ecosystem management had a profound influence on subsequent developments in policy and legislation. The most notable influences were:

- the 1979 *Parks Canada Policy* was updated and became the 1994 *Parks Canada Guiding Policy and Operational Guidelines*,
- the Banff-Bow Valley Study (1996) produced recommendations for the management of Banff National Park,
- new park management plans were written for Banff (1997a), Kootenay (2000a) and Yoho National Parks (2000b),
- the Panel on the Ecological Integrity of Canada's National Parks (2000) produced recommendations at the national level about the management of the national parks system,
- the *National Parks Act* was overhauled in 2000.

These documents provide a strengthened framework and justification for fire management. The main thrusts of this new policy direction are described in the following sections.

2.3.1 Ecological Integrity

Grumbine (1994) identifies ecological integrity as one of ten dominant themes in ecosystem management literature. Parks Canada's *Guiding Policy and Operational Guidelines* (1994) states that ensuring the long-term ecological integrity of the national parks is the ultimate goal of ecosystem management. Ecological integrity is defined in that document as "a condition where the structure and function of an ecosystem are unimpaired by stresses induced by human activity and are likely to persist". Although ecological integrity made an appearance in the 1988 *National Parks Act* as the "first priority when considering park zoning and visitor use in a management plan" (Parks Canada 1997a, p.11), its role was greatly strengthened in 2000 in the amended *Canada National Parks Act*.

> Maintenance or restoration of ecological integrity, through the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks (subsection 8.[2]; Parks Canada, 2001b).

Of particular significance is the emphasis on restoration and natural processes. Ecological integrity is now to be considered in all aspects of park management, not just zoning and visitor use. The *Act* provides a powerful legislative mandate for the maintenance or restoration of fire as a natural process in the national parks.

2.3.2 Measurable Goals

Ecosystem management is often hampered by a lack of clearly-defined goals (Grumbine, 1994, Christensen et al., 1996). The *Guiding Policy and Operational Guidelines* commits to the development of measurable ecological goals consistent with park management plans (1994). The first such goal appears in the *Banff National Park Management Plan* (1997a). The plan contains an objective to "achieve a target of 50% of the long-term fire cycle through prescribed burns or random ignitions" (p. 19). This is important direction, since it gives managers a tangible target to strive for. Identical targets were incorporated into the Yoho and Kootenay National Park Management Plans in 2000. These plans contain additional indicators related to specific habitat types and fire management initiatives.

2.3.3 Humans as Part of Park Ecosystems

Ecosystem management recognizes that humans are not separate from the environment, but that their actions have shaped ecosystems, in some cases for millennia (Grumbine, 1994; Christensen et al., 1996). In sharp contrast to earlier views that human influence should be excluded from ecosystems, ecosystem management concedes that human influence is ubiquitous and that active management of natural resources may be required to achieve a desired outcome. The Western Region's *Vegetation Management Plan* (Masters, 1988) states that "the influence of man (native and European origin) … as a valid, natural vegetation process … where the exclusion of such influences would result in loss of Natural Region representation" (p. 6).

The Banff-Bow Valley Study Task Force (1996) recommended that prescribed burning "be used … to simulate historic fire regimes" (p. 176), including both human-caused and natural ignitions. Current park management plans recognize that aboriginal people may have influenced park vegetation in some areas, and that this needs to be incorporated into fire management practices (Parks Canada, 1997a). The Panel on the Ecological Integrity of Canada's National Parks (2000) recommended that "Parks Canada work with Aboriginal peoples to understand the history of Aboriginal fire and its application to prescribed burning" (5-5).

2.3.4 Adaptive Management

Given the uncertainty surrounding historic fire regimes, managers require more flexible management strategies. Adaptive management is one of the tools that managers can use to create more responsive programs (Grumbine, 1994).

> Under this strategy, the goals of the management plan are articulated using an explicit model of the system that should encompass the components, interactions, and likely fluctuations. Then, appropriate techniques are applied to the system, the results are monitored, and the tactics or even the goals are modified according to what is learned from the response of the systems. In other words, management can be used to test hypotheses (Pickett & Ostfeld, 1995, p. 270)

Adaptive management is first recommended as a paradigm for fire management in the 1988 *National Fire Management Directive 2.4.4*. Monitoring is critical to the success

of this approach. A range of fire management alternatives should be identified, a course of action selected and implemented and the subsequent effects on park vegetation evaluated through monitoring.

Parks Canada's *Guiding Policy and Operational Guidelines* reminds managers that ecosystem management decisions should be based on solid science (hence research is required) and, that where the manipulation of naturally occurring processes is necessary, it should be followed with monitoring (1994). Monitoring then feeds back into the planning process and the strategy is adapted or refined as required. Despite the emphasis on monitoring and adaptation in policy, the reality is that "few [fire management] plans have been through the subsequent iterations that are required to be truly adaptive" (Parks Canada, 2003b, p. 5).

2.3.5 Building Social Consensus

If multiple pathways are available to ecosystems following disturbance (as described on p. 9), then the choice of which pathway or state to manage for becomes a question of values and judgments (Kay & Regier, 2000). Defining ecosystem management goals is as much a social and political process, as it is a process based on hard scientific evidence (Grumbine, 1994). Managers should therefore "make values explicit in and central to the planning process" (Lister, 1998, p. 148). The role of the scientist is to make society aware of the advantages and disadvantages of each state (Kay & Regier, 2000). In order to determine what the public values, ecosystem management emphasizes collaborative processes that build understanding and consensus (Wallace et al., 1996).

The most formal and regular mechanism by which the public can participate in fire management planning is through the park management plans. There have also been a number of stand-alone panels in recent years that have made recommendations about fire management (the most notable examples are the Banff-Bow Valley Study Task Force and the Panel on the Ecological Integrity of Canada's National Parks).

The Banff-Bow Valley Study (1996) made very strong and wide-ranging recommendations about fire management. They identified fire restoration as a key

requirement in the Bow Valley to reverse altered vegetation successional patterns and maintain biodiversity. But the task force also clearly recognized the need for public involvement, given the social and economic impacts of fire use. The task force recommended that Parks Canada provide opportunities for public involvement, ranging from notification (particularly with respect to tourism operators and residents) to consultation. Further, the task force provided detailed criteria for a public information program for prescribed burning and suggested that a major interpretative effort focusing on fire management be launched.

The need for public consultation before carrying out prescribed burns, as well as the need for communication with the public about the fire management program in general is reiterated in the *Banff National Park Management Plan*. It is likely that demands for public participation will increase in the future, as projects become larger in scope and complexity. Despite the opportunities for involvement through the park management plan and as specific projects are implemented, there is currently little public involvement when the fire management plan is updated.

2.3.6 Regional Planning

Issues of restoration or maintenance tend to occur on scales that exceed the borders of individual jurisdictions. Solving problems related to ecosystems requires a regional approach. Parks Canada's *Guiding Policy and Operational Guidelines* recognizes that cooperative work with other agencies and groups is required (1994). This cooperation would involve provincial land management agencies, fire management agencies, land owners and non-profit organizations. The Banff-Bow Valley Task Force recommended the development of an integrated fire management plan for the Central Rockies Ecosystem with the provinces of Alberta and British Columbia, and an integrated fire management plan for the Bow Valley. On the British Columbia side, the Yoho and Kootenay Management Plans aim to foster interagency relationships on a larger scale than currently exists.

2.4 Social and Economic Context

The last two topics, building social consensus and regional planning, lead into a new area for discussion: the social and economic context within which the fire management program operates. Fire can have significant social and economic impacts, which may constrain fire management activities or affect the public's perception and expectations of the program.

National parks are places where Canadians and their international guests are invited to learn about Canada's natural and cultural heritage. As the number of visitors to the mountain parks has grown over the years, so too has the number of facilities and the amount of infrastructure on the landscape. The majority of visitors to the field unit arrive in July and August, the peak wildfire season. The best figures available show that in 2001 there were:

- 4, 665,000 visitors to Banff National Park,
- 1, 805, 000 visitors to Kootenay National Park,
- 1, 085, 000 visitors to Yoho National Park (den Otter, 2003).

These figures are based on traffic counter data and traffic surveys and may not be completely accurate.

The 1979 *Parks Canada Policy* recognized several conditions under which natural processes like fire might be manipulated, including threats to public safety or health, major park facilities and adjacent lands. The most recent iteration of the National Fire Management Directive uses the term "values-at-risk" to describe all those values that could be "destroyed or otherwise altered by fire" (Parks Canada, 2003a). This definition is broad enough to capture very tangible values like built structures and less tangible value, like viewscapes. The *LLYK Field Unit Fire Management Plan* (Walker & Irons, 1998) does not identify the values-at-risk in the field unit, however the following list should provide an indication of those values that might require some level of protection from wildfire.

Public Safety: The primary consideration in fire management is typically public safety, both that of the park user and of crews engaged in fire operations. Although Parks

Canada policy is not as explicit in this regard as other policies are (for example, United States federal wildland fire policy states that "protection of human life" is "the first priority in wildland fire management" (U.S. Department of the Interior & U.S. Department of Agriculture, 1995), operational decisions do reflect the primacy of human safety.

Communities: The field unit contains two communities, the Village of Field (pop. 300) and the Hamlet of Lake Louise (pop. 1,500). A third community, the Village of Radium Hot Springs abuts the south-west end of Kootenay National Park.

Adjacent Lands: The objectives of adjacent land management agencies are often quite different from those of Parks Canada. Not only may there be pressure to keep wildfires from running onto provincial lands, but there may be pressure to suppress all park fires due to the perceived risk of a fire crossing park boundaries (Heathcott, Woodley, & Savoie, 1996). Commercial timber stands on the western boundary of the field unit are of significant economic value. There are also several backcountry lodges located on provincial lands adjacent to park boundaries.

Public and Private Facilities: Public facilities located outside of the communities range in size and value, from major facilities like the Radium Hot Springs, to much smaller facilities, like backcountry campgrounds or day use areas. The field unit also manages a number of operational facilities outside the townsites, such as warden stations and operational compounds. Private facilities found outside of the communities include outlying commercial accommodations, teahouses, alpine huts and backcountry lodges.

Cultural Resources: Most of the cultural resources in the field unit are located in communities, along transportation corridors, or near well-established backcountry trails. These resources range in size and significance, from old archaeological sites to national historic sites such as Skoki Lodge and Twin Falls Chalet.

Ecological Values: The presence of rare, threatened or endangered species, as identified under the Species at Risk Act, or rare habitat types may also limit where fire is allowed to burn.

Infrastructure: Infrastructure, such as transportation corridors and powerlines can be impacted by fire. The field unit has four major highways, the Bow Valley Parkway, the Kootenay Parkway, the Icefields Parkway, and the TransCanada Highway, a national transportation corridor. The Canadian Pacific Railway also runs through the park.

There are also less tangible values that may be affected by fire. Tourism is one of these values. Tourism generated $1.05 billion in the Canadian Rockies region in 2001, accounting for about a quarter of all tourism expenditures in the province of Alberta (Alberta Economic Development, 2003). Independent visitors (visitors traveling alone, and not with commercial tours) spent over $300 million in Banff National Park in the summer and fall of 2000 (Parks Canada, 2000c).

A large wildfire can have local and regional impacts on visitation, resulting in lost revenue for tourism operators and other service providers. Limits on access to trails or facilities while a fire is ongoing, and lost opportunities when facilities are damaged or destroyed, may contribute to decreased visitation. However, the biggest issue is probably smoke. It is difficult for fire managers to predict accurately how much smoke will be generated by a fire and how far it will travel, but smoke can travel long distances and affect air quality over large areas. This is highly dependent on burning and venting conditions.

Poor air quality is an issue that may raise concerns for park visitors and residents alike. Smoke can affect members of the public with respiratory ailments, aggravating conditions like asthma or emphysema (Weldon, 1996). It can also affect visibility, causing delays in traffic, or lead to road closures in extreme cases. Delays and closures of the Kootenay Parkway were part and parcel of both the Mount Shanks fire in 2001 (a 3000 ha wildfire in the Vermilion watershed) and the fires in Kootenay National Park in 2003.

In addition to indirect costs through lost business, there are also direct costs incurred during large fire events. Costs associated with the fire fighting operation itself are born by taxpayers. Costs associated with the loss of public or private facilities are born by either the taxpayer or the insurance industry (which eventually results in higher premiums for homeowners and businesses). Fire managers are increasingly interested in quantifying both the direct and indirect costs of fire fighting and comparing these costs to the costs of activities that might potentially lessen the impacts of large wildfires, such as fuel reduction or management-ignited prescribed burning.

Fire can also affect the scenic quality and acceptability of an area for recreation (Taylor & Daniel, 1984). Many people feel that burned landscapes are not attractive and not aesthetically desirable (Weldon, 1996), although some studies have suggested that burns may enhance scenic value. Whether fire results in a positive or a negative impact seems to depend to some extent on the type of recreation planned. Education and knowledge tend to increase support for fire management, particularly prescribed burning (Taylor & Daniel, 1984), and this may result in a change in expectations.

Other non-market benefits associated with various fire management practices are equally difficult to quantify (Hesseln, 2000). If a fire improves habitat for a species that the public would like to see more of, like the grizzly bear, there is a potential benefit. Unfortunately the linkages between fire effects on vegetation, and habitat use by a particular species, are not well understood.

2.4.1 Fire Control Capability

Given the potential for serious impacts arising from uncontrolled fire, Parks Canada concentrated heavily on improving its capability to control fire in the early days of the fire management program. As the policy to reintroduce fire to park landscapes took shape in the early eighties, it was quickly recognized that Parks Canada needed to become less dependent on provincial assistance, in order to advance its fire management objectives (Lopoukhine, 1985).

In 1986, Parks Canada approved an interim Fire Management Directive, containing important direction concerning the future of the fire management program.

The emphasis was on fire control; fire use was contingent upon a demonstrated capacity to control fire. When using fire, managers were urged to use the mode of ignition (lightning or management-ignited) "that best achieves objectives while minimizing costs and threats to other values" (p. 41). The directive also stipulated that an approved fire management plan was required before using prescribed burning.

Banff and Jasper had already produced interim fire management plans in 1984. The Banff plan acknowledged that there was not enough knowledge or capability to allow lightning fires to play out on the landscape, however the plan aimed to develop prescriptions for selected areas by 1986.

A 1987 evaluation by R/EMS Research found that fire control capabilities in most parks were hampered by ineffective initial attack and that improvements were needed in terms of preparedness (planning, acquiring and positioning resources before a fire). The creation of a support group to provide system-wide advice and coordination in fire management was recommended (R/EMS, 1988).

A year later *Keepers of the Flame* was written - a seminal document, which has guided fire management in the Canadian national parks for the last 15 years. *Keepers of the Flame* identified many of the same issues, and although western parks were advanced over eastern parks in terms of fire management capability, an overall a lack of resources in the system and poor coordination were hampering the ability of Parks Canada to create a professional fire control organization, let alone manage prescribed burns.

Keepers of the Flame laid out the steps by which individual parks could build their capacity to control fire, develop vegetation management plans containing broader vegetation objectives and finally enter into a fire use phase. The key was once again, good fire control and a phased approach to fire use through the implementation of a fire service system to share resources. An important recommendation was that the Canadian Parks Service should create a professional fire management service system, with a fire service centre to provide specialized advice and support. Other recommendations included the creation of a national fire management information system.

Yoho National Park produced its first fire management plan in 1989, followed by Kootenay National Park in 1994. Federal 'Green Plan' funding from 1988 to 1994

provided the means by which to implement much of the direction in *Keepers of the Flame*. Despite this support, the implementation of fire use has been much slower than expected. Static funding in recent years has led to fewer personnel and "the infrastructure for fire management has remained static or decreased particularly in recent years" (Parks Canada, 2003b, p. 7). The cuts experienced across the federal government have "slowed, and in some cases, reversed the progress made" (Hutchison, 1999, p. 10). "There are shortfalls noted in the areas of goal setting, the structure of the fire management organisation, training and experience, management support and awareness, and funding" (Hutchison, 1999, p. 5).

The prescribed burn program in Banff National Park was put on hold in 1994, pending completion of the Banff-Bow Valley Study (Parks Canada, 1997a, p. 19). In 1996, the national parks were reorganized into field units. Yoho, Kootenay and the north-east end of Banff National Park coalesced into one administrative unit, the LLYK Field Unit. A prescribed burning program was initiated in the field unit in 1997 with the first burn occurring in 1998.

A review of the program at the national level is currently underway. The fire management directive (now 15 years old) will be updated and *Keepers of the Flame* reworked. It is hoped that the funding of recommendations from the Panel on the Ecological Integrity of Canada's National Parks will result in a strengthened program, with more resources for research and ecological restoration work (Parks Canada, 2003b).

2.5 Conclusion

Fire management appears to be supported quite well by national and regional policies. Yet, implementation of some elements of the program has been slow. The next chapter describes the method that was developed to evaluate the program in more detail. Performance measures are used to quantify progress in program implementation in Chapter 4, and Chapter 5 reports on the results of a questionnaire that investigates the underlying reasons for program performance.

CHAPTER 3: METHODOLOGY FOR EVALUATING THE FIRE MANAGEMENT PROGRAM

3.1 Program Evaluation

Evaluation – "the systematic assessment of public policies, programs and projects" – is a critical step in any planning process (Politt, 2003, p. 121). It is difficult to provide a more precise definition than this, because evaluation can take many different forms to meet a range of objectives. In the rational planning process model (Figure 3.1), evaluation follows implementation. Issues to be resolved are identified and analyzed; goals and objectives are articulated; alternative solutions are proposed and assessed; and a plan is developed outlining a particular course of action. Following plan implementation, evaluation seeks to assess the outcomes of the planning effort. The results of evaluation may feed back into the planning process at a number of levels, resulting in a redefinition of the problem, formulation of new goals or objectives, or adoption of an alternative course of action. Thus planning is ideally an iterative process, where goals and actions are reappraised through periodic evaluations (Kraft, 1998).

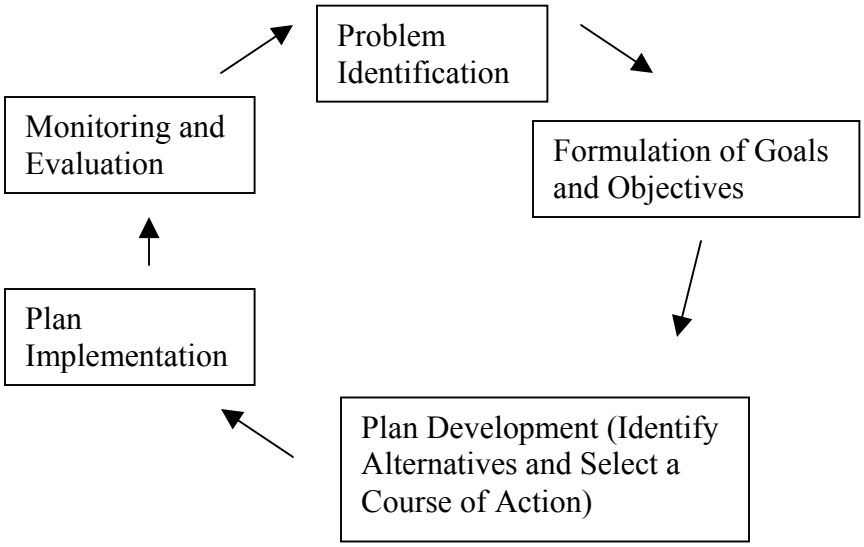

Figure 3.1 Rational planning process model

Two broad classes of evaluation are identified in the literature: summative and formative. Summative evaluation is used by organizations to determine whether or not a

policy or program should be continued, or where financial resources can be directed to best effect (Pollitt, 2003; Kraft, 1998). Formative evaluation seeks to improve the implementation of an existing program (Pollitt, 2003). This latter type of evaluation often concentrates on identifying shortcomings caused by factors other than insufficient resources (Kraft, 1998; Knaap & Kim, 1998). Given this dichotomy, it is important to clarify the intent of an evaluation at its outset. This purpose of the evaluation in the current research is formative; the aim is to improve the effectiveness of the fire management program for the LLYK field unit.

Bellamy, Walker, McDonald, and Syme (2001) describe a series of objectives for evaluation to improve natural resource program management:

- develop a common understanding of objectives and expected outcomes,
- provide a basis for informed decision-making on program/research direction, resource allocation and attainable levels of performance,
- identify gaps in performance and insights on how they might be addressed (p. 412).

These objectives provide a focal point for the evaluation of the fire management program.

The importance of evaluation cannot be underestimated. Without it, there is no objective way to determine whether or not a plan has been successful. Many natural resource management initiatives suffer from shortcomings in policy and implementation that might be remedied by regular program evaluation (Bellamy et al., 2001). However, although evaluation can lead to a rethinking of the goals, objectives and implementation of a plan, it should not be expected to substitute for less tangible forms of decision-making, such as managerial experience and judgment, stakeholder involvement in plan development, internal debate over policy goals, or broader political discourse (Kraft, 1998). It is unrealistic to expect evaluations to provide neat, readily packaged solutions to complex problems (Pollitt, 2003).

3.2 Evaluation Criteria

Once the objectives for the evaluation have been established, the criteria on which the assessment will be based must be determined. Several potential criteria for evaluation

are identified in the literature. Evaluations of **effectiveness** attempt to determine to what extent the original objectives of a plan or program were achieved. Where **economy** is the primary criteria for evaluation, the costs of inputs (e.g. human resources, facilities) to a program are examined, in order to determine if they were minimized to the greatest extent possible. Evaluations of **efficiency** assess whether program results were maximized given the available resources (Hockings, 1999; Pollitt, 2003). Evaluations of **responsiveness** seek to determine whether a program was developed and implemented in full consultation with other stakeholders (Pollitt, 2003).

The criteria for evaluation have a direct impact on the choice of analytical methods. For example, cost-benefit analysis is frequently used in evaluations of efficiency or economy. This type of rigorous approach would be less suitable for evaluations examining program effectiveness or responsiveness. While questions of efficiency and cost-effectiveness of fire-fighting techniques or prevention programs are of interest to fire management personnel, the absence of an integrated system to collect the data necessary for such an analysis at the field unit level would render it difficult to carry out. Since field unit fire management staff were most interested in determining why progress had been slow in some areas of the program (e.g. some objectives of the fire management plan had not been met in the five years since the plan was written), effectiveness was selected as the criterion for program evaluation. The analytical framework chosen for the first stage of this evaluation is a performance-based system of outcome measurement.

3.3 Outcome Evaluation

The measurement of outcomes is not a new approach to evaluation (Patton, 1990). However, it is an increasingly popular way to assess the impacts of social and environmental programs among government agencies and non-profit organizations, which often goes hand in hand with performance measurement. In the mid-eighties, an increasing emphasis on accountability led governments in North America and Europe to champion results-based systems of program management. Results-based approaches tend to emphasize the difference that a project makes, rather than looking only at its direct

results (e.g. number of people served, number of services delivered) (Zimmerman & Allen, 2001). Outcome evaluation is an appropriate framework for evaluations of effectiveness, because it links program objectives to program results, allowing managers to determine to what extent policies are resulting in desired changes.

Outcome measurement begins by defining the inputs, activities, outputs, and outcomes or impacts of a program (see Figure 3.2). **Inputs** are the resources (e.g. staff, funds, equipment and facilities) allocated to deliver the program. **Activities** are the concrete actions carried out to implement the program. **Outputs** are the immediate results of program activities, in other words, the products and services delivered. There is generally one output per activity. Outputs can be measured by looking at the extent to which targets have been achieved, activities implemented and time frames for implementation respected (Hockings, Stolton, & Dudley, 2000; Cox, Kozak, Griep, & Moffat, 2002; Newcomer, 1997). Although factors external to the organization may influence program outputs, in most cases, a strong correlation between activities and outputs can be established. For example, funding, human and material resources are made available to plan and implement one program activity, prescribed burning. One of the outputs, or direct results, of prescribed burning is an increase in the area burned in the field unit. This sequence of events leaves little room for alternative explanations for this output.

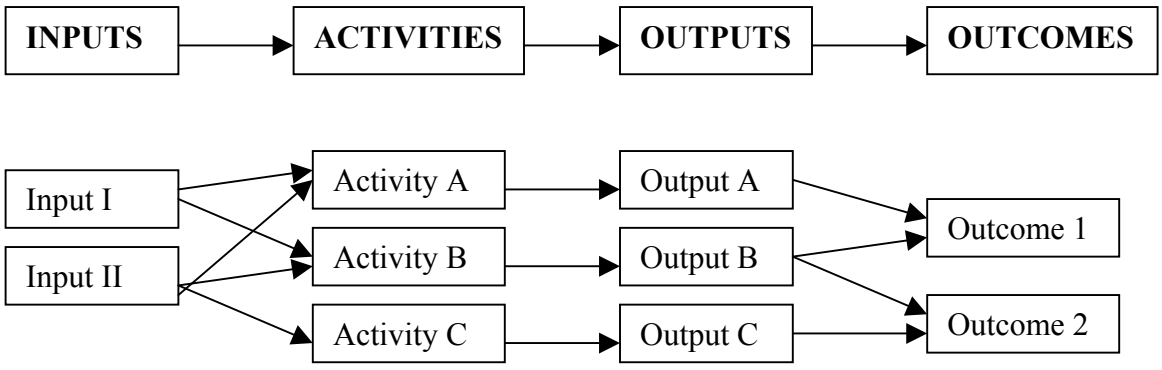

Figure 3.2 Outcome evaluation logic model

Outcomes or impacts are the longer-term results of program implementation. Several outputs generally contribute to a single outcome. It is more difficult to establish a direct relationship between program outputs and outcomes, because external factors over which the organization may have little control may also shape these outcomes (Hockings et al., 2000; Cox et al., 2002; Newcomer, 1997). For example, while prescribed burning may help to create a desired vegetation structure, other factors, such as wildfire, disease, and climate may be influencing vegetation structure at the same time. In a perfect world, the outcomes of a program would match its original objectives (Politt, 2003).

Outcomes are the critical ingredient to be measured in outcome evaluation, because they show whether or not policies are producing the desired changes. They are also the hardest factor to measure, and often require long-term monitoring (Hockings et al., 2000). Performance measures are tied to outputs and outcomes in order to determine the extent to which program implementation is producing the desired results.

Evaluations can concentrate more or less on any one of these categories, but evaluations that focus on the outputs or outcomes of a program provide more direct measures of achievement than those that target only inputs or activities. However, successful evaluation of outcomes depends on clear, consistent and realistic management goals and objectives, and the way in which proposed management actions will contribute to desired outcomes is often unclear in management plans for protected areas (Hockings, 1998). Goals may be poorly defined because they are controversial or because they are based on concepts that are difficult to clearly express or measure, like ecological integrity or ecological restoration (Knaap & Kim, 1998; Kleiman et al., 2000).

In the absence of clearly defined and measurable outcomes, while it may be possible to determine what actions have been carried out, it is quite difficult to say how successful these actions have been. In a case where clear objectives are lacking, "the focus of evaluation must be restricted to an assessment of inputs and processes of management" (Hockings, 1998, p. 338). The only other option is to come up with an independent set of norms against which the plan can be measured (Hockings, 1998).

Patton (1990) argues that given a choice between evaluating implementation and evaluating outcomes, an evaluation of implementation should be the first priority. Before the outcomes of a program can be assessed, the extent to which a program is actually being implemented must be determined. Understanding how a program is organized, the types of services it provides, and why it may have diverged from its original objectives are all important pieces of information gathered through the evaluation process.

Other problems, common to evaluation of environmental programs, may complicate the evaluation of outcomes. Uncertainty about how complex, dynamic ecosystems respond to human intervention and the consequences of environmental change may make it difficult to evaluate a program in more than very general terms (Knaap & Kim, 1998). Not only can it prove challenging to agree upon degrees of acceptable environmental change, but these changes may be difficult to quantify (Hockings, 1998). Given the length of time that it takes for environmental conditions to change (e.g. decades), some more recent programs may not be ready for assessment (Rich, 1998). This may prove true for the LLYK Field Unit fire management program, where some aspects of the program (e.g. prescribed burning) have been in place for only a short period of time.

In cases where the end results of a program are not immediately observable, intermediate-level criteria may be established so that progress towards the final goal can be assessed (Kleiman et al., 2000).

Another common problem, that may be particularly acute with new programs, is deficiencies in the amount and quality of available data to measure environmental quality (Kraft, 1998).

Environmental evaluations are often criticized for missing important social and economic impacts (Bellamy et al., 2001; Kleiman et al., 2000). Outcome evaluation is more flexible than more traditional methods in this regard. A broad range of measures that relate to social, technological, economic and institutional factors can be incorporated into program evaluation.

Perhaps the most important limitation of outcome evaluation is that it will not necessarily reveal to the evaluator why a program has not achieved the intended

objectives. The focus is on describing the extent to which the program has met expectations, but not the factors affecting its performance. Outcome evaluation reflects a rational approach to problem solving, and one that may not do justice to the less tangible elements of public policy development (Kraft, 1998). For those who are interested in the reasons *why* a program failed or succeeded, it is necessary to move into the realm of process evaluation. Process evaluations look at the underlying institutional, political or social factors that affect program implementation. The second stage of the MDP incorporates the elements of a process evaluation.

3.3.1 Performance Measurement

The success of an outcome evaluation depends heavily on the ability to judge performance in a meaningful and robust manner. The 1998 *LLYK Field Unit Fire Management Plan* contains a suite of performance measures linked to program activities described in the plan. Performance measurement "involves the selection, definition, and application of performance indicators, which quantify the efficiency and effectiveness of service-delivery methods" (Fine & Snyder, 1999, p. 24). These indicators can be analyzed as a snapshot in time, but more often, longitudinal information is collected to track changes in performance over time (Fine & Snyder, 1999; Rich, 1998).

The criteria for evaluation (e.g. effectiveness, efficiency) must be well defined in order to select appropriate indicators. Some performance indicators reveal information about the cost-effectiveness or efficiency of programs, while others target broader areas, such as interagency performance. Where common indicators are used across a sector, the performance of a particular program or agency can be compared to that of others, which is known as benchmarking. As with outcome evaluation, performance indicators do not attempt to establish causal linkages or explain changes in performance over time (Rich, 1998).

The selection of good indicators is a critical, but difficult step in the evaluation process. Hockings (1998) points out that even where there is direction to develop indicators as part of park planning processes, useful indicators have been difficult to find. The literature contains many discussions regarding indicator development and use, and

yet there is still plenty of debate over what variables should be measured, how they should be measured and how changes should be interpreted (Knaap & Kim, 1998). Two sets of indicator criteria were reviewed in order to develop criteria against which to assess the performance measures contained in the 1998 *LLYK Field Unit Fire Management Plan* and/or select new performance measures (see Table 3.1).

Maclaren (1996) reviewed sixteen papers that contained selection criteria for social, urban, environmental and healthy city indicators. Although urban sustainability was the focus of Maclaren's review, a comprehensive framework for indicator development and reporting is presented that has a strong basis in policy development and planning. Boyle, Kay and Pond (2001) also present a well-developed framework for indicator development in support of policy related to ecosystem management, which includes a detailed description of indicator selection criteria.

Table 3.1 Two sets of indicator selection criteria obtained from Maclaren's (1996) review of urban sustainability indicators and Boyle et al.'s (2001) description of a framework for ecosystem management

Maclaren (1996)	**Boyle et al. (2001)**
- scientifically valid - representative of a broad range of conditions - responsive to change - relevant to the needs of potential users - based on accurate and accessible data - based on data that are available over time - understandable by potential users - comparable with indicators developed in other jurisdictions - cost-effective to collect and use - attractive to the media - unambiguous	- clearly relevant to specific articulated goals and objectives for sustainability - scientifically valid - statistically and analytically sound - demonstrated by case studies to be practical - use data that are available and accessible - use data that are accurate - use data that are comparable over time - understandable to potential users - unambiguous - easy to use - at the appropriate scale for decision making

After reviewing the two sets of indicator selection criteria, the following four were chosen as the basis for the subsequent analysis:

- measurable - the data for the indicator is easy to collect and analyze,

- responsive - the measure can be compared in subsequent years, and demonstrates change over time,
- relevant - the measure is clearly related to policy objectives,
- simple - the measure is easy for policymakers and stakeholders to understand and unambiguous.

In order to apply the outcome evaluation methodology to the *LLYK Field Unit Fire Management Plan*, the following approach was adopted:

- divide fire management activities into clear categories,
- identify the desired outputs for each activity by examining the plan contents, and in particular, desired results and performance measures,
- select an appropriate performance measure for each output from the performance measures list,
- where no useful performance measure exists, propose an appropriate performance measure(s),
- analyze the data available for performance measures.

The results of this analysis are described in Chapter 4.

3.4 Process Evaluation

While an evaluation of outcomes should demonstrate how well a program has performed in delivering both immediate results and longer term impacts, it does not normally examine the factors underlying a program's performance. To gain insight into the reasons for a program's successes or failures, a different type of evaluation is required, commonly referred to as process evaluation.

Process evaluations focus on how something happens, rather than its outcomes or results. They are "aimed at elucidating and understanding the internal dynamics of how a program, organization, or relationship operates" (Patton, 1990, p. 95). Without an understanding of these dynamics, it can be difficult to make improvements to a program, or apply the lessons learned from one program to another. Thus, while outcome evaluation may be adequate for a summative evaluation to determine whether or not a

program should be continued, it does not provide enough information for a formative evaluation that aims to improve a program.

Process evaluations can examine many different elements of program development and implementation including:

- the processes through which policy is developed and the manner in which institutional factors shape these processes (Kraft, 1998),
- relationships created during program development and implementation,
- the strengths of the program and areas requiring improvement,
- the manner in which the program operates (Patton, 1990).

In order to collect information that could be used in a process evaluation, interviews were conducted with Parks Canada staff involved with the LLYK Field Unit fire management program. "Program participants often have in-depth understanding of a program, many important aspects of which are complex, difficult to express, poorly realized or understood, and/or highly sensitive" (Kleiman et al., 2000, p.358). It was hoped that these key informants would be able to describe the processes at work within the field unit and comment on less tangible elements of program development and implementation.

Many different factors have the potential to affect the implementation of fire management activities, however the ability to compare the factors that might be affecting the implementation of the LLYK Field Unit fire management program to other studies was limited because: 1) many studies describe factors specific to only one fire management activity (e.g. fuel management, prescribed burning) and not a whole program (e.g. Cleaves, Martinez and Haines, 2000); 2) few studies explain the mechanism by which the factors identified influence the implementation of specific activities; and 3) factors are not always identified using a rigorous methodology, but may be based on the author's professional opinion or experience (e.g. R/EMS Research, 1988; Hutchison, 1999).

In addition, most of the factors cited are external to the organization being studied (e.g. public perception, air quality regulations) and there is little information available about how factors internal to an organization (e.g. policy formulation, length of approval

processes) might affect implementation. For this reason, it was difficult to develop a hypothesis or identify a specific decision-making model that should be tested in advance of the interview process. Instead, an approach was adopted from qualitative inquiry, the constant comparative strategy, whereby "data from a number of cases are collected first and then categories, patterns, consistencies and inconsistencies in data analyzed to build a pattern of relationships that evolve into theory" (Stainback & Stainback, 1988, p. 41). In order to focus the data collection, general objectives were developed for the interviews.

The research objectives of the questionnaire were to:

- understand how fire management is perceived by Parks Canada staff involved to varying degrees in the field unit fire management program,
- characterize the state of fire management in the field unit,
- identify factors affecting program implementation in general and implementation of specific activities.

3.4.1 Sampling

Purposeful sampling was used to select individuals from within the Parks Canada Agency who could provide detailed information about the program and its implementation. The main drawback to this approach is that the results cannot be assumed to be representative of all field unit employees, or of employees in similar positions in other field units (Taylor-Powell, 1998b). However, given the case study approach adopted for this project, and the goal of the evaluation to improve a specific program, the utility of the data gathered seemed more important than the ability to generalize the findings.

A stratified sample was constructed to facilitate comparisons between subgroups. Respondents were selected based on their position with Parks Canada and involvement with fire management in a professional capacity. These respondents were identified in consultation with the Fire/Vegetation Specialist and Fire Operations Warden for the field unit. Respondents fell into four sub-groups:

Managers: Individuals that make up the management team for the field unit, including the Field Unit Superintendent.

Field Unit Specialists: A more diverse group of individuals who provide advice on resource management or human use issues related to fire management, review fire management initiatives or help to implement these initiatives, by developing communications or GIS products, for example.

Field Unit Fire Management Staff: All individuals working in the fire management program shop in the field unit at the time of the interviews, as well as off-season members of the initial attack crew.

Other Fire Management Staff: Other fire/vegetation specialists in Western Canada, incident commanders with experience managing wildfires in the field unit over the last five years and national and regional fire duty officers.

3.4.2 Questionnaire Design

A semi-structured interview, which consisted of a questionnaire administered face-to-face, was used to collect information for the process evaluation (see Appendix B). It closely resembled a structured interview, in that all the questions were pre-established and were asked in the same order and manner, however about half the questions were open-ended (i.e. no response categories were provided) (Fowler, 1998).

Open-ended questions allow respondents to express their opinions in their own words without being constrained by predetermined categories. This results in a richer data set, which may be particularly valuable when exploring complex opinions and attitudes. The other advantage of open-ended questions is that they do not limit the range of possible responses, hence they are well-suited to cases where there are a large number of possible answers, where not all the possible answers are known, or where suggestions for improvement are solicited (Henerson, Morris, & Fitz-Gibbon, 1987; Patton, 1990; Taylor-Powell, 1998a).

The large amount of data generated through open-ended questions, qualitative data can become difficult to manage as the sample size increases. Analysis of qualitative data can also be very time-consuming (Henerson et al., 1987). Both quantitative and qualitative approaches were combined in this survey in order to maximize the comprehensiveness of the instrument. Respondents were asked to rank statements on a

Likert scale to compare levels of support for certain concepts, or choose a category where the range of possible responses were well-defined. Open-ended questions were used where the possible response categories were not well-defined, or where descriptions of complex concepts, such as the role of fire in the field unit, were sought. These questions were made as specific as possible to obtain more targeted responses. Some questions were screened, so that respondents with less knowledge would not provide any information about that topic.

Since I was unsure how much each respondent knew about the program, all terms (e.g. fire control, fuel management) were carefully defined. Information was supplied to the respondents from the outcome evaluation (e.g. locations of prescribed burns conducted, total amount of area burned) to help them to better assess the program.

Although respondents could probably have completed the questionnaire on their own time and returned it by mail, face-to-face or phone interviews were solicited, because this would be less time-consuming for the respondents and would ensure that the return rate was higher (Feick, 2000; Henerson et al., 1987). This also provided the opportunity to clarify questions, ensure that the responses were understood and could be probed in certain cases.

Respondents were contacted by phone or e-mail and their interest in participating in the research project was gauged. An interview was then scheduled. The interviews generally ranged from an hour to an hour and a half in length. Respondents were asked to record the answers to quantitative questions directly on the questionnaire; their responses to the open-ended questions were recorded on a laptop. Each respondent received a copy of the notes taken during the interview, in order to verify that their comments were captured accurately. They could add comments if desired, and return the record of comments. Only two respondents edited their comments. Confidentiality was also guaranteed with the expectation that respondents would feel more comfortable answering questions openly and honestly (Henerson et al., 1987, Fowler, 1998). The method and instrument used to carry out the interviews received ethics approval from the University of Calgary.

Obtaining interviews was greatly facilitated by the researcher's position as a seasonal employee in the LLYK Field Unit and the endorsement of the research project by the Fire Management Program. Although some respondents might have expressed their opinions more openly to an interviewer with no ties to the field unit or the fire management program, most appeared to comment candidly on the program's performance. Subsequent data analysis was facilitated by knowledge of the terminology and concepts employed by Parks Canada staff. The potential for bias to be introduced because of the researcher's previous experience working for field unit or subsequent involvement in updating the field unit fire management plan was controlled for by validating the methods used for the qualitative analysis (Section 3.4.5).

3.4.3 Questionnaire Content

Basic demographic data were collected to see if there was any correlation between characteristics such as gender or length of time with Parks Canada and respondents' responses to other questions (Q-1 to Q-4). Information was gathered about respondents' duties related to the fire management program (Q-5) and the degree of familiarity with the fire management plan (Q-6).

Feick (2000) suggests that given the importance of organizational factors in determining the outcomes of programs, it is important to investigate the diverse views that may exist among sub-groups within an organization. Problem definition is identified by Kraft (2000) as one component of policy development that should be examined by process evaluations. Disagreement about the nature of a problem that an organization is seeking to address, or even whether the organization has identified the correct problem, can result in difficulty implementing a desired course of action. Thus the study sought to assess the level of agreement on some of the ecological principles underlying the fire management program (Q-7 to Q-11), convergence of ideas about the role fire should play in the field unit (Q-12), and agreement with the stated goals for fire management (Q-15). The study also examined what process respondents thought should be used to set objectives for fire management (Q-16) and how initiatives should be evaluated (Q-17).

The answers to these questions shed some light on the adequacy of processes used to set policies and factors likely to influence decision-making.

The second goal of the questionnaire was to develop a picture of the state of fire management in the field unit. As suggested by Patton (1990), information was collected about the strengths and weaknesses of the program, in order to identify features that can be capitalized on or places where improvements can be made (Q-18, Q-19). The study examined relationships that require strengthening, key challenges faced by the program and priorities for the next planning period (Q-18 to Q-21). Questions about individual fire management activities required respondents to rate specific aspects of these activities, such as the ability to manage unplanned fires (Q-25) or the amount of prescribed burning (Q-28). This information was compared to the results of the outcome evaluation, to see if the findings were similar, or if there were discrepancies. Respondents were asked to compare the fire management program in the LLYK Field Unit to that in other field units (Q-24), and to Parks Canada's program at a national level (Q-23).

The final goal of the questionnaire was to determine what factors are limiting or facilitating implementation of specific fire management activities. Several authors note that fire management activities in general may be constrained by political or social realities (Rideout & Botti, 2002; Landres et al., 1999; Loupoukhine, 1983), however different fire management activities may be influenced by different factors.

For example, R/EMS (1988) found that organizational structure, pre-suppression and pre-attack planning, initial attack response times and detection times were limiting factors on Parks Canada's ability to control fire. Weather, fuel type and terrain/topography are other factors that can impact the effectiveness of fire control (Martell, 2001). Policies may also limit the use of certain equipment, and public attitudes may constrain operationally feasible alternatives (Rideout & Botti, 2002).

Cleaves et al. (2000) found the following factors to be major barriers to increased prescribed burning in the United States: air quality and smoke management regulations, funding shortfalls, narrow burning windows, and a shortage of available personnel. Public opinion, the wildland-urban interface, potential liability and an agency's policies regarding risk-taking were viewed as less important barriers. Rideout & Botti (2002) also

note that smoke and legislation (e.g. the Endangered Species Act) are issues constraining prescribed burning in the United States. The *LLYK Fire Management Program Level* identifies the following constraints to implementing restoration programs: differing land use objectives among provincial agencies on the east slopes, ubiquitous values-at-risk, smoke, public perception of risk and an absence of developed ecological objectives (Parks Canada, 2001a).

For each fire management activity, the questionnaire attempted to identify barriers to and enablers of the activity by asking what factors were facilitating or hindering implementation of that activity (Q-26, Q-27, Q-29, Q-30, Q-32, Q-34, Q-35). It also tried to identify factors influencing implementation at a broader, program-wide level (Q-13, Q-20).

3.4.4 Data Analysis

Data from quantitative questions were entered into SPSS and analyzed using basic descriptive statistics of central tendency (e.g. mean, median, mode) and dispersion (e.g. variance, standard deviation), and non-parametric tests where possible (e.g. Kruskal-Wallis, Mann-Whitney U, Spearman's test of correlation). Although non-parametric tests are less powerful than parametric tests (i.e. less likely to identify a significant difference where one exists), they are more robust (fewer assumptions need to be met to perform these tests). Non-parametric tests should be used in situations where:

- data are not normally distributed,
- the data are categorical or ordinal (e.g. the scale used does not contain equally spaced intervals that can be compared in a meaningful manner),
- the sample size is small, making it difficult to test for normality (Motulsky, 1995; Fowler, 1998; Mosteller & Rourke, 1973).

The data from the questionnaires were not expected to be normally distributed, given the sampling technique used. The frequency distributions showed that in most of the questions containing a scale, the data were skewed towards one end of the scale. Even where distributions appeared more normal, the sample size was quite small, making it difficult to test for normality.

Analysis of the open-ended questions followed the methods outlined by Taylor-Powell and Renner (2003). The responses were cut and pasted from Word files created during the interviews into an Excel spreadsheet. Each worksheet contained all the responses for a particular question. Each worksheet was then analyzed to get a sense of the themes that were identified by the respondents. Some themes were anticipated in advance of the analysis based on findings in the literature, but many unexpected themes emerged during this exercise. Each theme was given a number and then sections of text were labeled with the corresponding number. Themes were subsequently expanded, collapsed or redefined. An example of the types of themes identified and the way in which they were organized is provided in Table 3.2 for Q-29, a question about the factors facilitating prescribed burning. The left justified lines are the main themes; indented lines are sub-themes that fall within the main theme.

Table 3.2 Themes and sub-themes for Q-29

Availability of Resources	Other
Human Resources	Backcountry use levels
Other Resources	Communication
Field Unit Fire Management Shop	Environmental assessment
Expertise	Geography
Knowledge	Same Factors as Fire Control
Internal Support	Weather
Interagency Collaboration	Planning
National Support	Policy
Vote 120	Park Management Plan
National Duty Officers	Precedents
National Review Process	Public Perception
Mountain Pine Beetle	Two Views: EI and Protection
	2003 Fire Season
	Science
	Knowledge

In most cases the approach was to determine how often each theme was mentioned by respondents and to summarize the information within a category. To do this all the responses for a particular theme were counted and entered into a new table. Then the responses within the theme were compared to ensure they all fit within that

theme. The results of this analysis are reported in Chapter 5, along with recommendations about how the questionnaire can be improved.

3.4.5 Validation

In order to validate the methodology used to analyze the qualitative data, an outside party, experienced in conducting qualitative research, independently classified the raw data from Q-29 using the themes (not the sub-themes) that had been identified. The outside party had worked for Parks Canada in the past, but was relatively unfamiliar with the fire management program. Ideally, the final counts for each theme would yield similar results, however this was unlikely, given the ambiguity of some of the responses and the fact that many subjective judgments are made when classifying responses. Nonetheless, with relatively few instructions to follow and only a basic description of each theme, similar results were obtained (see Table 3.3).

Table 3.3 Qualitative counts of the number of respondents who identified factors facilitating prescribed burning by original and validation processes

Theme (Factors Facilitating Prescribed Burning)	**Number of Respondents (Original count)**	**Number of Respondents (Validation count)**
Staff Initiative and Expertise	19	22
Public Perception	17	16
Policy and Planning	11	10
Availability of Resources	9	9
Science / Knowledge	8	18
Internal Support	8	5
National Support	7	9
Precedents	7	5
Mountain Pine Beetle	4	4
Interagency Collaboration	3	3
Other (same factors as fire control, geography, backcountry use levels, environmental assessment, weather, communication)	7	8

On the most important issue of recognizing the prevalent themes, the validation review showed felt that all the major themes had been correctly identified. However two additional themes were identified: previous fires in British Columbia/Alberta (6 respondents) and Parks Canada staff education/communication (3 respondents). The reason for this discrepancy was that the initial classification placed responses on the effect of wildfires on public awareness in a sub-theme under Public Perception. In the second round, the responses relating to public perception were grouped together for simplicity's sake. The responses that the outside partly classified as Parks Canada staff education/communication, had been initially classified under a variety of themes (staff initiative and expertise, internal support and other).

Although the counts were similar in magnitude, they were rarely identical. Small differences in interpretation accounted for divergent counts. For example, the validation process classified some responses (e.g. "we have the people in place" and "there is adequate personnel in terms of number") under "Staff Initiative and Expertise", which the original process classified under "Availability of Resources", since they related more to adequate staffing levels than the experience or knowledge of the individuals within the program.

The validation process also interpreted knowledge (under Science / Knowledge) more liberally than the original process, which included responses in that category only if they were directly related to knowledge of fire regimes or the ecological effects of fire. The validation process interpreted knowledge to include broader understanding of the need for prescribed burning (e.g. "public opinion - those that are agreeing with what we are doing from ecological perspective", "if you have the right managers in place who have an understanding of the ecological processes involved, then you will get that support"). Some of these differences might have been avoided by better communication at the outset of the content analysis, and better advance definition of the themes.

Overall, most of the counts are similar. The objective of the qualitative inquiry was not to generalize the results to a larger population. Potential misinterpretation of the meaning behind each theme is mitigated in Chapter 5 by thoroughly describing the data

classified under each theme and by directly quoting comments that characterize each theme.

CHAPTER 4: APPLYING OUTCOME EVALUATION TO THE *LLYK FIELD UNIT FIRE MANAGEMENT PLAN*

The approach to fire management adopted in the *LLYK Field Unit Fire Management Plan* is described as the "mixed fire restoration strategy". Fire suppression will continue to be a priority in areas where there are significant risks to public safety, property or neighboring lands. In non-priority areas, less aggressive tactics will be employed to allow fire to play a role in shaping vegetation communities. Planned prescribed burning may be conducted to meet specific ecosystem restoration objectives or fuel management goals. Random ignitions may also be permitted to burn under specific conditions (Walker & Irons, 1998a).

The body of the plan contains four main sections: goals, implementation strategy, desired results and performance measures. Two goals (statements that define program direction or long term results sought) for fire management are listed: 1) "to ensure protection of life, property, cultural and natural resources on park and adjacent lands by suppression of wildfire while minimizing the environmental effects of suppression actions", and 2) "to maintain or restore, as closely as possible, the role of fire within park ecosystems" (Walker and Irons, 1998a, p. 14).

However, there are no accompanying objectives (statements that operationalize the goals by describing how they will be achieved). Linkages between goals and program activities are made in the implementation strategy section. Other parts of the implementation strategy describe the scientific basis for decision-making (e.g. target fire regimes) and a fire management zoning system for the field unit. The desired results include both immediate results of fire management activities and longer term impacts of the program. For example, the desired result that "appropriate fire management alternatives be implemented in each Fire Management Unit" is an immediate result or output of fire control actions (p. 24). The desired result that "stakeholders understand the importance of fire within LLYK and support the restoration of fire dependent and fire adapted vegetation" is an outcome – the longer term result of the implementation of a number of effective communications activities (p. 24).

In the plan, performance measures are not tied directly to each desired result but cover the spectrum of program activities. Most measure outputs (e.g. "both high and low intensity planned ignition fires conducted within five years of plan approval"), while only one relates to outcomes (e.g. "vegetation community fire regimes are within target ranges within twenty years of the planning threshold having been reached"; p. 25). When the performance measures are rated against the criteria proposed for indicator selection in Section 3.3.1 (measurable, responsive, relevant and simple), they prove inadequate in a few key areas. Most of the performance measures are easy to understand, and relate to policy direction contained within the plan, however very few are capable of demonstrating longitudinal change. For example, performance measures such as, the "LLYK Fire Management Plan developed and approved by March 1998" and, "a fuels management program developed and approved by March 1998" (p. 24), do not involve any type of measurement or variation over time, and are therefore not very useful as indicators of the effectiveness of fire management activities. A red flag should be raised any time a performance measure can be qualified with a simple "yes" or "no" answer.

The following approach was used to evaluate the contents of the plan:

- divide fire management activities into clear categories,
- identify the desired outputs for each activity by examining the plan contents, and in particular, desired results and performance measures,
- select an appropriate performance measure for each output from the performance measures list,
- where no useful performance measure exists, propose an appropriate performance measure(s),
- analyze the data available for performance measures.

Table 4.1 contains a summary of fire management activities and associated outputs identified through this analysis. Most of the performance measures contained in the plan have been replaced by proposed performance measures that are more useful in evaluating plan implementation. In the next section, inputs to the fire management program are briefly described. The main focus of the analysis is on activities and

outputs. The performance measures associated with each output are analyzed before moving on to a discussion of program outcomes.

4.1 Inputs

Fire management has traditionally been, and continues to be, the responsibility of the Parks Canada warden service. Within the warden service, the fire management program occupies the same position as other resource management programs, such as the wildlife and aquatics programs. The specialist responsible for each program reports to the Chief Park Warden. However, the fire management program differs in an important way from other programs - it is also supported by a national program. Thus, funding for the fire management program comes from two sources: the field unit's annual budget and a national fire management fund. The field unit funds two permanent full-time positions dedicated to fire management: the Fire & Vegetation Specialist and the Fire Operations Warden (Parks Canada, 2001b). The Fire & Vegetation Specialist is responsible for the planning and implementation of vegetation and fire management in the field unit and research and monitoring related to both programs. The Fire Operations Warden is responsible for the operational aspects of fire suppression, fire use and fuel management.

The national fire management fund (Vote 120) is essentially an emergency preparedness and response fund. Vote 120 pays for:

- variable pre-suppression costs – "expenditures that fluctuate on the basis of forecast and actual fire danger levels and prescribed fires to meet ecological objectives" (e.g. contract helicopters on stand-by in the field unit as fire danger increases; Parks Canada, 2003b, p. 24);
- emergency wildfire suppression costs – "expenditures directly related to suppression and rehabilitation costs in response to wildfires" (e.g. contract firefighters hired to help fight large wildfires; Parks Canada, 2003b, p. 24).

Table 4.1 Fire management activities, outputs and proposed performance measures

Program Activity	**Output**	**Existing Performance Measures***	**Proposed Performance Measures**	**Data Available**
Fire Control	Initial attack crews manage unwanted fires in accordance with the direction contained in the fire management plan	None	**Final fire size** Final fire size ≤ 0.1 ha in the Full Suppression Zone Final fire size < 5 ha in the Indirect Attack Zone	Yes
			Number of fire analyses conducted	Yes
Fire Use: Prescribed random ignitions	Unplanned prescribed random ignitions permitted to burn when within prescription and supported by fire analysis	Random ignition fires allowed to burn, within prescription, when fire analysis supports the decision	Number of random ignitions permitted to burn when within prescription (in the Random/ Planned Ignition Zone)	Yes
Fire Use: Manage-ment-ignited prescribed burning	Prescribed burns identified in the fire management plan are planned and implemented within 5 years of plan approval	Both high and low intensity prescribed burns conducted within five years of plan approval	Total area burned through prescribed burning	Yes
			Number of prescribed burns implemented from 1998 to 2003	Yes
			Proportion of prescribed burns that were high intensity fires	Yes
			Extent to which objectives for prescribed burns have been achieved	Yes
			Extent to which crown fraction targets in prescribed burn plans were achieved	No
				Yes
Community and Facility Protection	Communities, outlying facilities and adjacent	A fuels management program developed and approved by March 1998	Number of facilities protected	Yes

Program Activity	Output	Existing Performance Measures*	Proposed Performance Measures	Data Available
	lands are better protected from unwanted fire	Fuels management program implementation begun by December 1998	Number of landscape level fuel breaks constructed	Yes
Communi-cations	The public and stakeholders receive key messages about fire management	National Fire Communications Project products made available at all appropriate local and regional venues	Number of visitors and residents reached with fire management messages	No
Interagency Coordina-tion	Work with other agencies and stakeholders results in the implementation of common fire management objectives	LLYK attendance at a second Upper North Saskatchewan Watershed Interagency Fire Management meeting	Number and description of ongoing interagency initiatives	Yes
Research and Monitoring	Research and monitoring are conducted to improve our understanding of the effects of fire on park ecosystems	Annual Montane Meadow monitoring program developed and implemented by March 1999	Number of research and monitoring programs implemented	Yes
		Daer-Pitts Planned Ignition fire effects research program implemented by November 1998		
		Continue LLYK support for shared Mountain Park fire research programs. Support will include responsibility for coordination of some projects.		

* Existing performance measures taken from Walker & Irons, 1998a

The field unit is responsible for fixed pre-suppression costs (annual expenditures to maintain pre-suppression readiness that are independent of fire danger levels or occurrences [e.g. equipment maintenance]), but in recent years, Vote 120 has paid for some fixed suppression costs (e.g. an initial attack crew). Vote 120 also defrays the majority of the costs associated with prescribed burning, in particular the costs incurred on burn days (the days when the prescribed fire is burning). However it does not cover other important costs, such as project planning, communications work, thinning to prepare fireguards or monitoring following a prescribed burn (Parks Canada, 2003b).

The fire management program receives significant support from other functions within the field unit. The trail crew receives fire training and backs up the initial attack crew. The warden service also provides key services in the form of specialized advice and assistance with fire operations. Communications personnel work closely with the fire program, developing communications strategies for specific projects or information to educate the public about the role of fire in park ecosystems. When the field unit experiences a large wildfire, personnel and resources are brought from other national park field units across the country to assist in fire control efforts.

In terms of equipment and facilities, the fire program has a large fire base in Kootenay National Park with helicopter landing pads and an equipment cache. Three other fire caches containing equipment for initial attack are located at Lake Louise, Yoho Ranch and Saskatchewan Crossing. Mobile equipment is moved around the field unit based on fire indices (Parks Canada, 2001b).

The fire management programs in the mountain parks have recently received additional funding through the Canadian Forestry Service to address the easterly spread of mountain pine beetle. This funding has allowed the Fire Management Program to staff additional positions (e.g. a prescribed burn planner) and put more resources into the prescribed burn program (Parks Canada, 2001b).

4.2 Activities and Outputs

The fire management activities described in the *LLYK Field Unit Fire Management Plan* can be divided into six categories: fire control, fire use (through management-ignited prescribed burning and monitoring of prescribed random ignitions), community and facility protection, communications, interagency cooperation and research and monitoring (see Table 4.1).

4.2.1 Fire Control

Fire control is an "absolute prerequisite to fire use, and is oriented towards developing the capability to exclude and suppress all fires that occur on the landscape" (R/EMS Research, 1988, p. 27). The organization and operation of fire suppression systems is a broad field of study. Specific direction regarding pre-suppression activities, initial and sustained attack is contained within a fire operations plan for the field unit (Irons, Kubian, & Walker, 2003). The fire management plan provides strategic direction and zoning, which form the basis for subsequent decision-making about the manner in which to implement fire control. While this section concentrates on the outputs related to this strategic level of direction, a brief account of the activities considered to be an integral part of fire control is provided first.

Fire control is commonly divided into four phases: fire prevention, pre-suppression, pre-attack planning and fire suppression. Fire prevention is oriented towards reducing fire occurrence through activities such as public education efforts, law enforcement and reduction of hazards and risks (Canadian Interagency Forest Fire Centre [CIFFC], 2003). These activities are examined in more detail under the Community and Facility Protection (4.2.4) and Communications (4.2.5) sections.

Pre-suppression planning is carried out prior to fire occurrence and generally involves "the organization, training and management of a fire fighting force and the procurement and maintenance of equipment and systems to ensure effective fire suppression" (CIFFC, 2003, p. 35). These are largely inputs into the fire management program and have been discussed in Section 4.1.

Pre-attack planning involves the ability to detect ignitions (e.g. siting and activation of fixed detection systems, timing, frequency and distribution of mobile detection patrols) and preparedness (the allocation, movement and distribution of fire control resources in response to predicted quantitative changes in fire danger, hazard, risk and behaviour) (R/EMS Research, 1988). The primary detection systems are aerial smoke patrols, public reports of smoke and a lightning location system based at the Kootenay Warden Office. Roadside patrols for lightning ignitions are commonly performed by on-duty wardens and supplemented by aerial patrols by the initial attack crew during periods of high hazard. The frequency of patrols by field unit staff increases with fire danger. Fire danger codes are generated using data from ten weather stations located throughout the field unit (Irons et al., 2003).

The initial attack response is essentially "the action taken to halt the spread or potential spread of the fire by the first fire fighting force to arrive at the fire" (CIFFC, 2003, p. 29). When a new ignition is detected it is reported to a central dispatch and the initial attack crew is dispatched to the fire. The crew travels to the location of the fire by ground or by air, sets up suppression equipment, and begins suppression actions (e.g. bucketing by helicopter) as soon as possible (Martell, 2001).

Successful initial attack depends on an effective communications system, rapid transportation and delivery systems and highly trained crews (R/EMS Research, 1988). Fuel type, topography, fire behaviour, and the number of fire starts can significantly impact the success of the initial attack effort. "Some fires…are so large and/or intense that they cannot be contained regardless of the size of the initial attack force, and they burn freely until there is a significant change in fuel, weather, topography and intensity decreases to levels where spread can be safely contained" (Martell, 2001, p. 547). Initial attack crews are not expected to successfully control all fires burning under fire weather conditions exceeding the 90th percentile of the Fire Weather Index (Irons et al., 2003). When a wildfire is beyond the capability of initial attack, a fire analysis is conducted.

The purpose of the fire analysis is to ensure that the agency responds appropriately to an escaped or 'out of control' fire. Several different factors are reviewed (e.g. values-at-risk, natural resource management objectives, predicted fire behaviour)

before selecting the appropriate action (Parks Canada, 1997b). The actions taken on an escaped fire are referred to as sustained suppression. A sustained suppression effort generally requires a more complex and highly trained fire line organization than that employed with an initial attack (R/EMS Research, 2003). A number of different fire management strategies are possible, such as confinement, containment or control, and the tactics chosen (e.g. direct attack, indirect attack) depend on the situation (Parks Canada, 1997b).

In order to facilitate the appropriate fire management response, the field unit is divided into Fire Management Units (FMUs) based roughly on watersheds (see Figure 4.1). Each Fire Management Unit falls into one of "three fire management zones based on values-at-risk, potential fire behaviour and defendable landscape features" (Parks Canada, 2003a, p. 40). The three zones - Full Suppression, Indirect Attack and Planned/Random Ignition – are described in more detail below.

Between 1998 and 2003, 92 unplanned fires were managed in the LLYK Field Unit (see Table 4.2). Over half of these fires occurred in FMUs zoned for Indirect Attack. Lightning was the most important source of unplanned ignitions in the field unit (63% of all fires), particularly in Indirect Attack and Planned/Random Ignition Zones. However, human-caused ignitions (i.e. wildfires ignited by careless smoking or campfires left unattended) were also a significant source of wildfire, accounting for 24% of all fires in the field unit. The railway was responsible for 7.6% of ignitions in the field unit, with the majority occurring in the Full Suppression Zone. The cause of a further 5.5% of fires could not be determined.

One of the desired results identified in the plan is for appropriate fire management alternatives to be implemented in each FMU (Walker & Irons, 1998a). A performance measure that quantifies the ability of initial attack crews to manage unwanted fires in accordance with the direction contained in the fire management plan would be a good indicator of fire control capability.

Table 4.2 Number of random ignitions started by zone between 1998 and 2003

Zone	Ignition Mode				
	Lightning	**Human**	**Unknown**	**Railway**	**Total Ignitions**
Full Suppression	10	9	4	6	**29**
Indirect Attack	38	11	0	1	**50**
Planned/ Random Ignition	10	2	1	0	**13**
Total	**58**	**22**	**5**	**7**	**92**

Source: Data for the table obtained from *Lake Louise, Yoho and Kootenay National Parks historical fire database* [computer data]. (2003, September). Radium Hot Springs, BC: Parks Canada, LLYK Fire/Vegetation Program [producer and distributor].

4.2.1.1 Full Suppression

To identify an appropriate measure for this output, the direction contained within the fire management plan for each zone was reviewed. Full suppression is employed in FMUs located in "high profile corridors with considerable business interests, public facilities, utilities and transportation routes…The objective will be to control all ignitions by 1000 [hrs] the following day" (Walker & Irons, 1998a, p. 20). The 10:00 am target is most likely based on an historic US Forest Service fire exclusion policy that all fires should be contained by 10:00 am the day after the fire is detected (Martell, 2001). One relatively straightforward way to measure the performance of initial attack crews would be to determine what proportion of fires were controlled by 10:00 am the next day in the Full Suppression Zone.

Unfortunately, fire personnel do not record the time at which a fire is controlled (or if the fire has been contained by 10:00 am) in the occurrence reports generated for each fire. One piece of information that is readily available is final fire size. A draft national fire management directive contains direction to manage wildfires in the Full Suppression Zone "intensively to minimize fire spread using a full range of tactics… Management actions will be focused on reducing fire risk and restricting fire growth to a

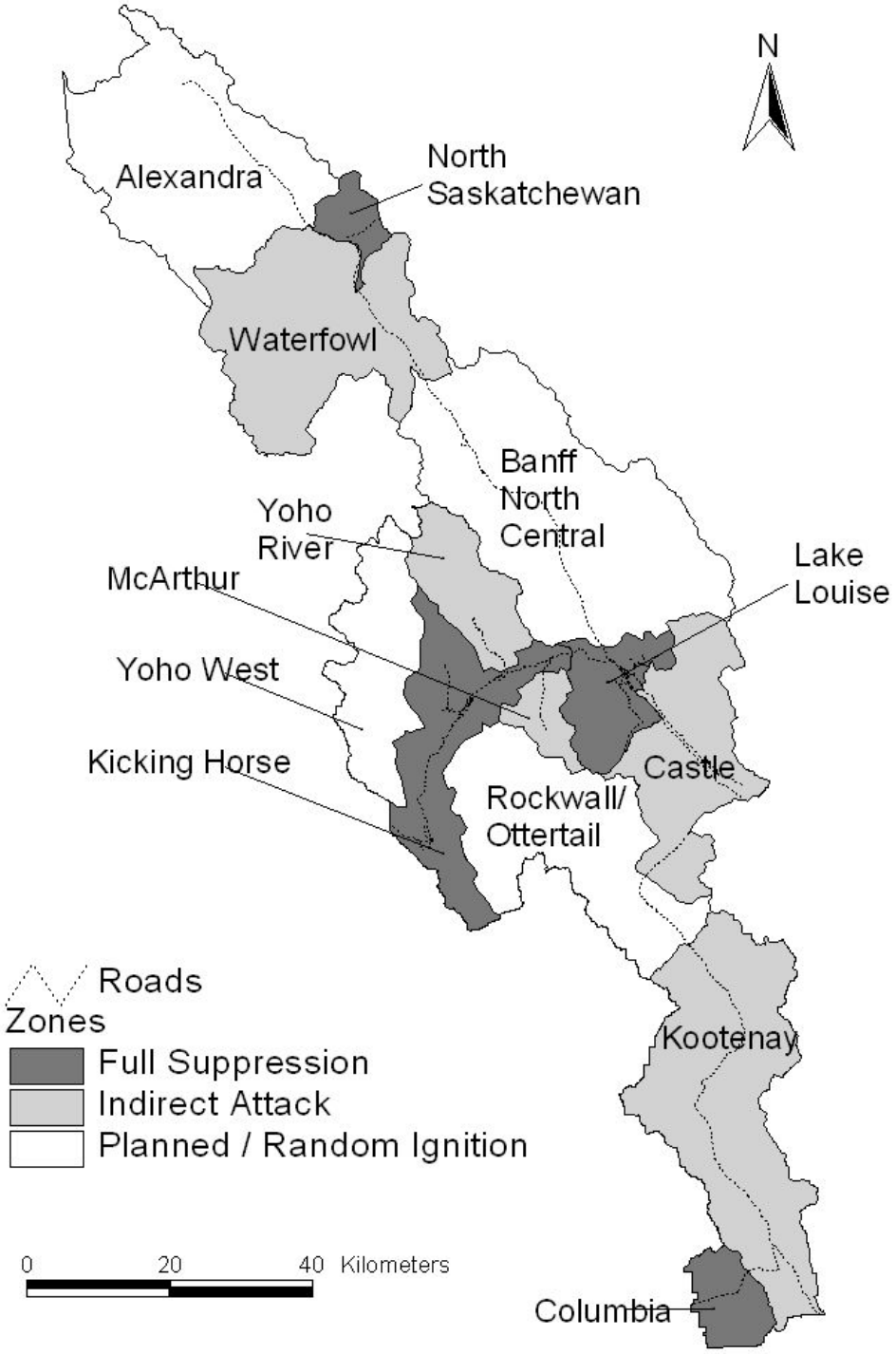

Figure 4.1 Zoning of fire management units in the 1998 *LLYK Field Unit Fire Management Plan*. Source: [Wildfire-related GIS files] [computer data]. (2003, October). Radium Hot Springs, BC: Parks Canada, GIS Specialist [producer and distributor], CD created Oct. 14, 2003.

very limited perimeter" (Parks Canada, 2003a, p. 40). The qualities of a "very limited perimeter" are left to the imagination. The smallest size class in the historic fire occurrence database was 0.1 ha, and the majority of fires in the field unit appeared to fall into this size class. It seemed reasonable to assume that if the final fire size was 0.1 ha or smaller, the goal to restrict the fire to a "very limited perimeter" had been met.

There are some problems with this assumption. A brief glance at a century's worth of fire occurrence data in the field unit shows that the majority of fires (83%) have remained 0.1 ha or smaller in size. Is effective initial attack the most important factor affecting final fire size, or do other factors, such as weather and fuel type play an equally important role? This is not a question that can be easily answered. This issue could be addressed by tallying the number of fires suppressed during Extreme fire danger. These fires have the potential to grow to a significant size without rapid initial attack. Unfortunately, the field unit has not kept records of fire weather indices or fire danger ratings for each of the fires suppressed. For the purposes of this analysis, an assumption is made that the effectiveness of initial attack is a significant determinant of final fire size.

Other problems with the data may have affected the accuracy of the results. For example, there were discrepancies between the GIS database used to determine in what zone fires occurred and the historic fire occurrence database. Discrepancies were corrected where possible. Occasionally, precise coordinates were not available for fires, although in most cases, the location of the fire could be determined from its name. If not, the record was removed from the data set.

From 1998 to 2003, 32% of ignitions (or 29 out of 92) occurred in FMUs zoned Full Suppression (see Table 4.3). The majority of these fires (93%) were 0.1 ha in size or smaller. The two exceptions had a final size of only 0.3 ha. The data suggest that the fire management program met its objective to aggressively control fires in the Full Suppression Zone.

Table 4.3 Final fire size by zone and Fire Management Unit from 1998 to 2003

Fire Management Unit	Zone	Count	Fire Size		
			≤ 0.1 ha	0.1 ha < x <5 ha	> 5 ha
Columbia	**Full Suppression**	3	3	0	0
Kicking Horse		15	14	1	0
Lake Louise		9	8	1	0
North Saskatchewan		2	2	0	0
		29	**27**	**2**	**0**
Castle	**Indirect Attack**	10	7	3	0
Kootenay		37	25	9	3
McArthur		0	0	0	0
Waterfowl		0	0	0	0
Yoho River		3	2	1	0
		50	**34**	**13**	**3**
Alexandra	**Planned/ Random Ignition**	3	2	0	1
Banff North Central		4	3	1	0
Rockwall		4	2	0	2
Yoho West		2	2	0	0
		13	**9**	**1**	**3**

Sources: *Lake Louise, Yoho and Kootenay National Parks historical fire database* [computer data]. (2003, September). Radium Hot Springs, BC: Parks Canada, LLYK Fire/Vegetation Program [producer and distributor].

[Wildfire-related GIS files] [computer data]. (2003, October). Radium Hot Springs, BC: Parks Canada, GIS Specialist [producer and distributor], CD created Oct. 14, 2003.

4.2.1.2 Indirect Attack

In the Indirect Attack Zone, the objectives for fire control are slightly different.

> Indirect attack is used in areas of moderate development or where historical fire analysis has indicated that fire risk … is relatively low. Less than full force suppression methods may be used… Current fire season conditions and time of year will influence suppression strategies. The objective will be to complete burnout operations and contain the fire by 2200 [hrs] the following day (Walker & Irons, 1998, p. 21).

Once again no data were available showing whether or not the 10:00 pm target had been met. It is also unclear from this description how the decision to employ less than full force suppression methods would be made or what tactics or strategies would be

appropriate. While the national fire management directive provides little additional direction, it does suggest that final fire size can be larger in the Indirect Attack Zone than in the Full Suppression Zone. "Wildfires will be managed to confine fire spread to a defined perimeter with the possibility of achieving ecological objectives… Acceptable fire perimeter will be defined based on natural and man-made barriers and operational considerations" (Parks Canada, 2003a, p. 21).

It is assumed that the objective to confine spread to a limited perimeter had been met if the final fire size was less than 5 ha. The 5 ha target was chosen, because most of the fires in this zone appeared to fall into this size class. Fifty out of 92 random ignitions occurred in the Indirect Attack Zone. The majority of these ignitions (68%) were 0.1 ha in size or smaller. Thirteen fires, or 26% of all ignitions, fell into the category between 0.1 ha and 5 ha. A small fraction of fires (6%) grew to over 5 ha in size.

One of these fires was 16 ha and was monitored for a period of time prior to suppression (R. Walker, personal communication, December 18, 2003). A second was 3000 ha in size; a mid-summer lightning fire that occurred in Kootenay National Park in 2001. In this case, a containment strategy was used instead of full suppression, in part because the fire was located in an area scheduled for eventual prescribed burning.

A third fire was part of the Kootenay complex of fires that resulted from multiple ignitions during an exceptional fire season in the summer of 2003. It grew to 9000 ha before a change in weather put it out.

These results do not explain why some fires ended up in the 0.1 ha to 5 ha size class. However, the fires that grew to a significant size were the result of fire management decisions or exceptional fire weather.

4.2.1.3 Planned/Random Ignition

The approach to fire management in the Planned/Random Ignition Zone is quite different from the approach in Full Suppression and Indirect Attack Zones. The Planned/Random Ignition Zone presents an opportunity to let fires grow to a significant size.

> These areas are located where values at risk are few ... allowing natural processes to fulfill their roles … will be the dominant fire management policy … random ignition fires may be allowed to spread freely under some conditions or may be burned out to defensible boundaries (Walker & Irons, 1998a, p. 21).

The draft national fire management directive also supports a policy of minimal intervention in such cases, stating that "management actions will be focused on containing fire growth to within the fire zone" (Parks Canada, 2003a, p. 40). There is no target time for fire control as there is in the Full Suppression and Indirect Attack Zones, nor is there a size class that would provide a suitable indication that the appropriate action has been implemented. A performance measure that addresses the desire to allow random ignition fires to spread under prescribed conditions is proposed in the next section.

Despite the potential for larger fires in this zone, the majority of fires (77%) remained 5 ha or smaller. This suggests that there are circumstances when it is desirable to implement more active suppression in these units. For example, while the fire management plan is silent on the actions that should be taken when fires are caused by humans, the railway or unknown factors, the Fire & Vegetation Specialist has indicated that full suppression would be favoured (R. Walker, personal communication, October 6, 2003). Three of the fires in this zone were human-caused and would probably have warranted full suppression.

Three fires were larger than 5 ha. Two of these were part of the Kootenay complex of fires in 2003. The third was the 200 ha JAKYLL fire, which grew rapidly in size while fire crews were preparing to burn out to containment lines (R. Walker, personal communication, December 18, 2003).

In general, it seems like the fire management program has a good ability to control fire, with 93% of unplanned fires remaining under 5 ha in size. However, the plan does not state very clearly what fire management techniques are appropriate and how decisions will be made in each zone. The 10:00 am and 10:00 pm targets seem to be of little consequence and may not be needed in future plans. Some of the terminology employed is also somewhat confusing. For example, Indirect Attack is normally used to

describe a fire fighting technique, and may not be the most appropriate name for a fire management zone.

4.2.1.4 Fire Analysis

The number of fire analyses conducted is another potential performance measure that might assist in evaluating the effectiveness of fire control. A fire analysis is required when a fire has not been controlled in the first period of burning (Parks Canada, 1997b). Fire analyses were completed for only two events in the last five years: Mt. Shanks and the Kootenay fires in 2003. An increase in the number of fire analyses conducted may indicate improved or declining performance, depending on fire management objectives.

In a Planned/Random Ignition Zone, an increase in the number of fire analyses might indicate that more ignitions are starting within prescription, giving fire managers the option of allowing these fires to continue to burn. An increase in the number of fire analyses in Indirect Attack and Full Suppression Zones might suggest that the number of fires that cannot be controlled through initial attack has increased; it might also signify that less than full force tactics are being chosen for fire suppression. In order for this performance measure to be useful, numbers should be coupled with the types of decisions made for individual fires. For example, an increase in the number of fire analyses resulting from decisions to monitor wildfires in the Planned/Random Ignition Zone would indicate improving performance. This is a measure worth pursuing in future fire management plans if the decision-making process for fire control can be more clearly articulated.

4.2.2 Fire Use: Prescribed Random Ignitions

The use of fire to achieve specific ecological objectives is a cornerstone of current Parks Canada policy. While some field units are more advanced than others in this area (e.g. the Banff Field Unit has twenty years of experience in planned prescribed burning), the LLYK Field Unit has been steadily building its capacity to use prescribed fire over the past five years. A prescribed fire is “any fire allowed to burn under a predetermined burning prescription designed to accomplish a particular management objective” (R/EMS

Research, 1988, p. 33). The prescription is essentially the set of conditions under which the fire will be allowed to burn (e.g. weather, relative humidity, wind speed). In the case of management-ignited prescribed burning, fire crews actually light the fire. Prescribed random ignitions are the result of unplanned lightning strikes.

The management of prescribed random ignitions can be viewed as simply one more option for fire control, where monitoring is the tactic chosen, instead of direct or indirect attack. However, the management of random ignitions requires the development of additional decision-making tools (see Figure 4.2). A random ignition decision support system and prescription must be part of the approved fire plan (Parks Canada, 1988). Although it is not stated explicitly in the plan, a fire analysis would normally be conducted and approved by the Field Unit Superintendent before allowing a random ignition to burn. The *LLYK Field Unit Fire Management Plan* contains random ignition prescriptions for all four FMUs zoned Planned/Random Ignition. Since the plan also contains desired results and a performance measure specific to unplanned prescribed fires or random ignitions, this activity can be considered distinct from other fire control or fire use activities.

A straightforward measure of performance is the number of unplanned prescribed fires permitted to burn within prescription between 1998 and 2003. Only one fire fell within the prescription contained in the fire management plan during the period in question. This was a fire in the Yoho West FMU, late in August 2003. The decision was made to suppress this fire immediately, given the number and size of fires ongoing in the Kootenay portion of the field unit (R. Walker, personal communication, December 18, 2003).

At first glance, it seems disappointing that no random ignitions were permitted to burn within prescription in the Planned/Random Ignition Zone. However, there were only 13 ignitions in this zone between 1998 and 2003. If the fire management program

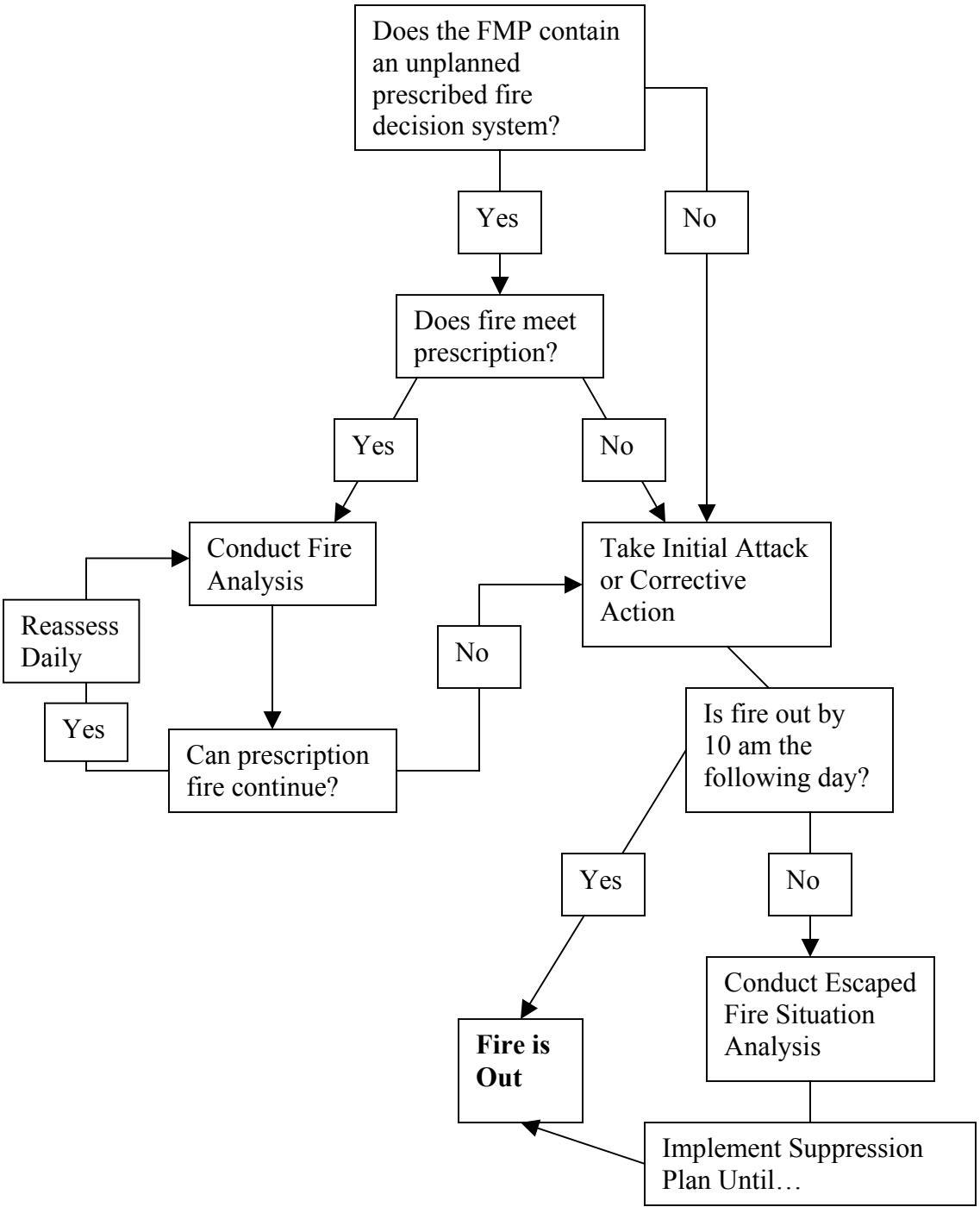

Figure 4.2 Unplanned prescribed fire decision support process

Source: This figure taken from Parks Canada. 1988. *National Fire Management Directive 2.4.4*. Calgary, AB: Environment Canada, Western Region, Natural Resource Conservation.

hopes to see more unplanned prescribed ignitions play out on the landscape, there are two options: to increase the size of the Planned/Random Ignition Zone to encompass areas where there is a higher frequency of lightning strikes or to develop less conservative prescriptions.

4.2.3 Fire Use: Planned Prescribed Fire

A program of planned prescribed burning was initiated in the field unit in 1997. Three priorities for planned prescribed burning are described in the fire management plan: to increase the extent of montane meadows in the field unit; to improve our understanding of the relationship between fire behaviour and fire effects through research burns; and to implement the landscape level burns mandated by the 1997 *Banff National Park Management Plan* (Walker & Irons, 1998a).

Although the approval process for prescribed burns is not well-defined, there are generally two parts (see Figure 4.3). A prescribed burn plan is submitted to the National Fire Duty Officer who circulates the plan to other fire management specialists for review.

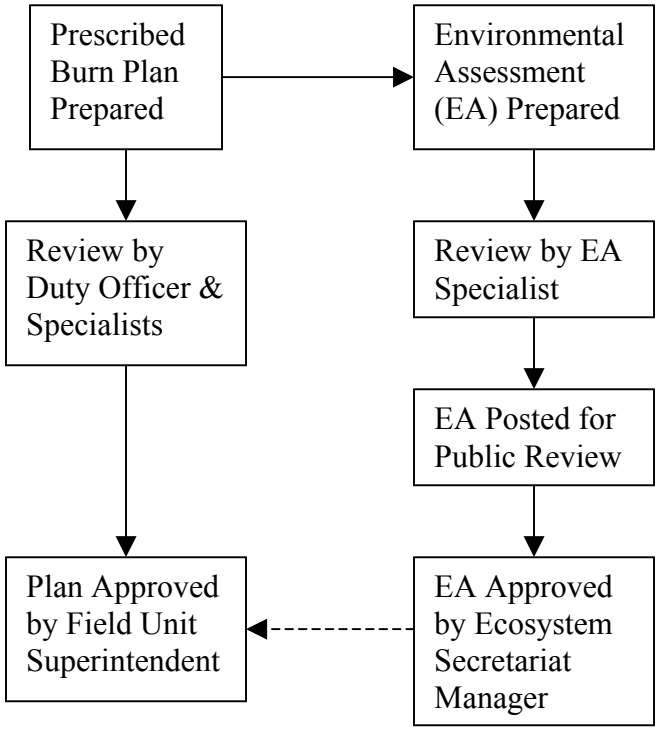

Figure 4.3 Prescribed burn approval process

The prescribed burn plan describes the objectives of the project, details the burning prescription, schedule, ignition and containment units and allocates the operational resources required to carry out the burn. Burn plans vary in length and complexity depending on the scale of the proposed project. If no revisions to the plan are required, the National Duty Officer recommends funding the burn days through Vote 120 (Parks Canada, 2003b). Final approval for the prescribed burn comes from the Field Unit Superintendent. Changes to the system have been proposed recently, which would add additional steps to the approval process at the national level. Prescribed burns would also receive approval from a national fire management committee (Parks Canada, 2003b).

Each prescribed burn plan also requires an environmental assessment under the Canadian Environmental Assessment Act (CEAA). The environmental assessment is reviewed by the Environmental Assessment Specialist for the field unit and other specialists. It must then be approved by the manager of the Ecosystem Secretariat. A public notification component is built-in to the environmental assessment process. However, additional consultation is often required, particularly for larger projects.

The performance measure contained in the fire management plan for prescribed burns is that both low and high intensity burns will have been conducted by the end of the planning period. This measure is simple and easy to assess, however it does not comment on whether the objectives for the program have been achieved, or how prescribed burns have changed over time. In order to determine what other information is available to form the basis for an appropriate performance measure, a review was conducted of the prescribed burn plans written between 1998 and 2003 and of associated environmental assessments and operational supplements. The following potential performance measures were identified:

- total area burned through prescribed burning,
- number of prescribed burn plans implemented from 1998 to 2003,
- proportion of prescribed burns that were high intensity fires,
- extent to which objectives for prescribed burns identified in the fire management plan were achieved,

- extent to which crown fraction targets in prescribed burn plans were achieved.

4.2.3.1 Area Burned

Fourteen planned prescribed burns were implemented from 1998 to 2003 (see Table 4.4). In some cases (e.g. Montane Meadows, Crooks Meadows), repeated burning in the same location was required. A total of 532 ha was burned from 1998 to 2003.

The extent of the area burned is significant, because park management plans set targets for annual area burned (see Section 4.3), to be achieved either through prescribed burning or random ignitions (Parks Canada, 1997a; Parks Canada, 2000a; 2000c). Prescribed burning over the last five years has made only a small contribution to the field unit's overall annual burn target of 1125 ha (or 6750 ha from 1998 to 2003).

Table 4.4 Prescribed burns implemented from 1998 to 2003

Prescribed Burn Title	Number of Burns	Date Implemented	Total Area Burned (ha)
Crooks Meadow	5	Various	108
Montane Meadows	6	Various	70
Dolomite Pass	1	9/16/98	12
Simpson River	1	5/26/01	311
Point Camp Meadow	1	6/5/03	30
Total	14	-	531

Source: *Lake Louise, Yoho and Kootenay National Parks historical fire database* [computer data]. (2003, September). Radium Hot Springs, BC: Parks Canada, LLYK Fire/Vegetation Program [producer and distributor].

However, given that the program of prescribed burning began in 1997, 531 ha or 8% of the total area burned target (6750 ha) may not be an unreasonable result. It is certainly a starting point against which future progress can be measured.

4.2.3.2 Number of Prescribed Burn Plans Implemented

Prescribed burn plans were written for five out of eight prescribed burns identified in the fire management plan (see Table 4.5). Two of these prescribed burns have been completed (Dolomite Pass, Simpson River). Implementation of two plans is still ongoing (Montane Meadows, Redstreak Restoration). Ignition of the Daer Pitts prescribed burn was attempted once, but failed. The Crooks Meadows burn plan was written before the fire management plan, but implementation did not begin until 1998.

Four plans were also written during this time period for projects that were never identified in the fire management plan. Of these prescribed burn plans, only one has been implemented so far (Point Camp Meadow).

In summary, out of ten possible projects, only three have been completed (Dolomite Pass, Simpson River and Point Camp Meadow). Implementation is ongoing in three other cases (Crooks Meadows, Montane Meadows, Redstreak Restoration).

4.2.3.3 High Intensity Prescribed Burns

The implementation of high intensity prescribed burns is of interest for two reasons. Fire regimes in the Canadian Rockies are characterized by high intensity fires, and these fires are much more difficult to manage than low intensity fires. Out of the fourteen prescribed burns conducted during the planning period, only two were high intensity burns (Simpson River, Dolomite Pass). The fire management program lacks significant experience in this area, although several high intensity wildfires have been successfully managed over the past three years (e.g. Mt. Shanks, Kootenay fires of 2003).

4.2.3.4 Objectives for Prescribed Burns

Outside of three priorities for prescribed burning, the fire management plan contains no criteria for selecting candidate areas and no information about the approval process for prescribed burning. To assess this process objectives contained within individual prescribed burn plans were examined to see how they matched the priorities

Table 4.5 Summary of prescribed burn plans for the LLYK Field Unit

Prescribed Burn Name	**Fire Management Unit**	**Notes**
Prescribed burns identified in 1998 fire management plan		
Crooks Meadows	Kootenay	- Low intensity meadow burns implemented since 1998 (ongoing)
Dolomite Pass	North Banff Central	- Implementation complete
Simpson River	Kootenay	- Implementation complete
Daer Pitts	Kootenay	- Three burn plans written since 1998 (each one for a larger area than the next) - Ignition attempted once in 1998, but failed
Redstreak Restoration	Columbia	- Project ongoing - Mechanical thinning of Douglas Fir stands complete - Low-intensity burn required over multi-year period to complete restoration
Montane Meadows	Kicking Horse/Kootenay	- Variety of low intensity meadow burns implemented since 1998 (ongoing)
Mosquito	Banff North Central	- Burn plan never written
Baker/Skoki	Castle	- Burn plan never written
Amiskwi	Yoho West	- Burn plan never written
Prescribed burns written 1998-2003, but not identified in 1998 fire management plan		
Sodalite	Kicking Horse	- Burn plan written; not implemented
Mitchell Ridge	Kootenay	- Burn plan written; not implemented
Point Camp Meadow	Banff North Central	- Burn plan written in 2002 - 30 ha burn conducted in spring 2003
Little Pipestone	Banff North Central	- Burn plan written; not implemented

Sources: Walker, R. & Irons, B. (1998a). *LLYK Field Unit fire management plan*. Radium Hot Springs, BC: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

Lake Louise, Yoho and Kootenay National Parks historical fire database [computer data]. (2003, September). Radium Hot Springs, BC: Parks Canada, LLYK Fire/Vegetation Program [producer and distributor].

Walker, R. (1999a). *Mitchell Ridge anchor unit prescribed burn plan*. Internal report, February 1999. Radium Hot Springs, BC: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

Walker, R. (1999c). *Sodalite Creek whitebark pine research prescribed burn: Environmental screening*. July 1999. Radium Hot Springs, BC: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

for prescribed burning described in the fire management plan. Table 4.6 shows that the plans contain many objectives for prescribed burning different from those identified in the fire management plan. Most prescribed burns have multiple objectives.

The first priority for prescribed burning mentioned in the plan is to increase the extent of montane meadows in the field unit. The absence of fire from these communities has allowed trees to encroach, reducing the total area of meadows. Two prescribed burn plans have as an objective to reintroduce fire to these ecosystems (Walker, 1997; Walker & Irons, 1998a; Walker & Irons, 1998c). Both plans have been implemented and although implementation is still ongoing, the program has made some progress in meeting this objective.

Another priority for prescribed burning identified in the plan is research. Two research burns have been planned to evaluate the potential for use of prescribed fire as a management approach to preserve whitebark pine (Walker, 1998a; Walker, 1999c). A third research burn, the Daer Pitts prescribed burn, has much broader research objectives to investigate the link between fire behaviour and fire effects on park ecosystems (e.g. vegetation communities and succession, avian communities, terrestrial invertebrates, bark beetles; Walker, 1998a). Control data have been collected, but prescribed burning is required in order to complete the research. Only one out of three research burns has been carried out (Dolomite Pass). Two remaining burns (Sodalite Creek, Daer Pitts) remain to be implemented. The fire management program has not made as much progress as anticipated in meeting this objective.

Some prescribed burns have as an objective to assist in the restoration of the long term fire cycle (Walker, 1998a; Walker, 1999). While it can be argued that all prescribed burns contribute to the area burned within the field unit, some burns make more of a contribution than others. Five planned burns might be considered large enough to make a significant contribution to restoring the long term fire cycle: Mitchell Ridge, Simpson River, Daer Pitts, Sodalite Creek, and Little Pipestone. With only one out of the five implemented, there has been limited progress in achieving the objective to implement landscape level burns mandated by the Banff National Park Management Plan.

Table 4.6 Objectives for prescribed burns planned and/or implemented from 1998 to 2003

Prescribed Burn	**Reintro-duction of fire into specific communities**	**Research**	**Habitat Restor-ation**	**Protect Adjace nt Lands**	**Create Fuel-break**	**Learning by Doing**	**Crown Fraction Target**
Crooks Meadow	✓ (montane meadows)						
Montane Meadows	✓ (montane meadows)						The majority of the surface area will be burned, removing up to 50% of standing trees.
Dolomite Pass		✓ (white-bark pine)					
Sodalite Creek		✓ (white-bark pine)					
Mitchell Ridge				✓	✓		
Simpson River				✓	✓		50-95% reduction in conifer cover within the ignition unit, with no remaining patches larger than 10 ha.
Daer Pitts		✓			✓	✓	50 – 90% crown removal. Fire effects will range from areas with largely unburned fuels to areas where the majority of surface vegetation has been burned and most of the standing trees have been killed.
Redstreak Restoration			✓	✓	✓		

Prescribed Burn	Reintro-duction of fire into specific communities	Research	Habitat Restor-ation	Protect Adjace nt Lands	Create Fuel-break	Learning by Doing	Crown Fraction Target
Point Camp Meadow	✓ (subalpine meadows)		✓				The majority of the surface area will be burned, removing up to 50% of the standing trees within the meadow and slide paths and killing trees around the perimeter of the meadow.
Little Pipestone	✓ (subalpine forest)	✓			✓		50%- 90% crown removal, ranging from areas of unburned fuels to areas where the majority of surface vegetation has been burned and standing trees have been killed.

Sources: Walker, 1997; Walker, 1998a; Walker, 1998b; Walker, 1999a; Walker, 1999b; Walker, 1999c; Walker, 2002; Walker & Irons, 1998b; Walker & Irons, 1998c; Parks Canada, 2003c.

Individual prescribed burn plans contain four objectives that are absent from the fire management plan. Habitat restoration involves the creation or improvement of habitat that is likely to benefit a particular species. For example, the Redstreak restoration project is intended to improve winter range for bighorn sheep in the Radium area, and one of the reasons given for the Point Camp Meadows burn was to improve habitat for ungulates and bears in a backcountry area near Lake Louise (Parks Canada, 2003c; Walker, 2002).

Prescribed burns can also be used to create landscape level fuelbreaks. A fuelbreak is a wide strip of modified vegetation that acts as a buffer to fire spread and enhances fire control (CIFFC, 2003). Fuelbreaks are desirable, because they create options for future fire management efforts. For example, fuelbreaks may help to protect townsites or outlying facilities, and may also reduce the concern that planned prescribed fires or unplanned prescribed fires will spread outside of the containment area.

An objective that often goes hand in hand with the creation of fuelbreaks adjacent to provincial lands is the desire to protect neighbouring values-at-risk, such as commercial timber stands. Prescribed burning may be used to reduce forest fuels in these areas, particularly in locations that have been heavily affected by mountain pine beetle infestations, such as the southern part of Kootenay National Park (Walker, 1999a; Walker, 1999b). Both field unit and provincial objectives can be met through these boundary burns.

Prescribed burns can also help fire crews to gain experience in managing fires (Walker, 1998a). This is particularly true with larger prescribed burns, where crews gain valuable insights into fire behaviour.

That there are four objectives commonly cited in prescribed burning plans in addition to the three objectives mentioned in the fire management plan suggests that, either the priorities of the prescribed burning program have changed over the last five years, or it is not clear what those priorities should be. Although a prescribed burn that achieves many different objectives at once is likely preferable to a burn that achieves only one objective, a lack of focus in the program may make the approval process and

communications about prescribed burning more challenging. It may not be clear to staff or the public what the intentions of the program are.

4.2.3.5 Crown Fraction Targets

Previous measures have examined the extent to which prescribed burns were actually implemented, but did not consider whether individual burns were successful. Many prescribed burn plans contain crown fraction targets, which if evaluated following a fire, would indicate whether or not the desired fire effects were achieved. The crown fraction target is a measure of the percentage of crown fuels (those fuels not in direct contact with the ground) burned, and therefore the intensity of the fire (CIFFC, 2003). The more intense the fire, the greater the fraction of crowns burned. The crown fraction burned can be determined following the fire using air photos of the area (Walker, 1999b). Although this type of work has not been done to date due to limited monitoring budgets, it offers excellent potential as a performance measure in future plans.

4.2.3.6 Conclusion

For a program that is only five years old, significant progress has been made in implementing prescribed burns. Some burning has been carried out each year since the program started. The quality of prescribed burn plans has improved over the last five years. Some early burn plans did not identify the locations of prescribed burns or anticipated size (e.g. Montane Meadows). Recent plans are much more detailed and contain well-delineated burn areas and objectives. However, there are some areas where the program has made less progress.

- High intensity landscape level burns have been planned but implementation has been limited to date. The Simpson River prescribed burn is the only example of this type of burn. It may be that this objective was too ambitious for the first five years of the program. Intermediate objectives, which would have set the stage for landscape level burning, would have been more appropriate.

- The prescribed burn program seems to lack focus. Many of the objectives contained in individual plans are absent from the strategic plan. Although it is desirable to meet as many objectives as possible with a single burn, this may engender confusion about the purpose of the program and make it difficult to communicate its goals to internal and external audiences. Stronger program direction is required in the fire management plan.

As noted for fire control, some of the terminology used (particularly in individual burn plans) is not well defined. For example, the terminology for area burned differs from plan to plan. Some plans refer to area burned, but plans for larger, more complex burns generally divide the prescribed burn unit into ignition and containment areas. The difference between an ignition and a containment area is unclear and needs to be better defined.

4.2.4 Community and Facility Protection

Given the potential for high intensity crown fires to develop in the field unit, preventative measures that make fires less likely to start or spread near facilities or communities are critical. Two key activities are involved: managing the amount of fuel available to a fire and planning, building and maintaining fire-resistant structures (Parks Canada n.d.).

Fuel management involves the construction and maintenance of fuelbreaks, extensive understory thinning or the use of other techniques to reduce fuel loading, and prescribed burning to modify fuels in order to reduce their flammability. The final objective is "to reduce the likelihood that fires will occur and to stop or slow the spread of fires" (Martell 2001, p. 553). A fuels assessment was carried out in 1995 to identify priorities for fuel reduction in the field unit (R. Walker, personal communication, October 6, 2003). A fuel management plan was written in 1998. Values-at-risk on provincial lands (e.g. commercial timber, backcountry lodges) are also considered when making decisions about fuel management.

Constructing and maintaining facilities to make them more fire resistant requires the active participation of local businesses, residents and other Parks Canada departments

(e.g. the townsite development review office). Leaseholders are ultimately responsible for fire proofing within their lease, such as the installation of fire protection systems (e.g. sprinkler systems), landscaping with fire resistant vegetation and using fire resistant building materials in construction or redevelopment (Parks Canada, n.d.).

The fire management plan gives priority to fuel reduction in FMUs zoned for Full Suppression, where active mechanical thinning may be complemented by limited, low intensity prescribed burning to reduce fuels. In FMUs zoned for Indirect Attack, fuel management will be conducted at isolated facilities, near field unit boundaries or upwind of Full Suppression FMUs, through mechanical thinning or prescribed burning (Walker & Irons, 1998a). The plan contains no explicit objectives for fuel management in FMUs zoned Planned/Random Ignition and given the nature of this zone, there may not be any need for fuel management.

The performance measures detailed in the fire management plan for this activity (a fuels management program developed and approved by March 1998 and implementation begun by December 1998) are inadequate to assess the amount of progress made in this area. Two alternative performance measures that provide a better indication of progress over time are: the number of facilities where fuel reduction was carried out and the number of landscape level fuelbreaks created.

Fuel reduction was implemented at Mosquito Creek Hostel in 2000 and at Kootenay Park Lodge in 2001 (see Table 4.8). Mechanical thinning was also carried out around Redstreak Campground in 2002, as part of a habitat restoration project. Despite the fact that FMUs zoned for Full Suppression are the priority, only one out of the three projects was carried out in a Full Suppression FMU. There was no fuel reduction carried out around either the Lake Louise or Field townsites during that time.

Two landscape level firebreaks have been created in Kootenay National Park. Both are boundary guards, designed to keep wildfires within the park from spreading into the province (or vice versa). One was created through mechanical thinning, the other through prescribed burning. The Simpson guard is located in an Indirect Attack Zone, and the Redstreak guard is located in a Full Suppression Zone.

Table 4.8 Fuel management activities from 1998 to 2003

Location	Zone	Type of Fuel Management	Date
Mosquito Creek Hostel	Indirect Attack	Fuel Reduction around facility	2000
Kootenay Park Lodge	Indirect Attack	Fuel Reduction around facility	2001
Redstreak Campground & Area	Full Suppres-sion	Fuel reduction around campground as part of bighorn sheep habitat restoration Creation of firebreak on park boundary	2002
Simpson River	Indirect Attack	Fuel reduction on boundary to create anchor unit and protect commercial timber on provincial lands	2001

Sources: R. Walker, personal communication, October 6, 2003.

Walker, R. 1999b. *Simpson River Anchor Unit Prescribed Burn Plan*. Radium Hot Springs, BC: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

Parks Canada. 2003c. *Environmental Screening for the Redstreak Ecological Restoration in Kootenay National Park*. Radium Hot Springs, BC: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

Overall, facility protection does not seem to have been as important a priority as other activities like prescribed burning. Relatively few projects have been carried out and most of these were at small outlying facilities. With upwards of thirty outlying facilities (including two national historic sites) and two communities that require some form of protection, the emphasis on fuel management and facility protection has changed following the 2003 fire season.

4.2.5 Communications

Communications is a difficult activity to assess, due to the number of different Parks Canada staff involved in communications efforts (e.g. media relations, interpreters, visitor centre attendants, gates staff, client services staff) and the variety of resulting products. The fire management plan has as an objective to deliver consistent and effective communications about the fire management program. These communications emphasize the ecological benefits of fire, so that stakeholders understand the role that fire

plays in park ecosystems and support the use of fire in the field unit (Walker & Irons, 1998).

The fire management plan does not specifically address public education as a vehicle to reduce the incidence of unwanted ignitions. However, there is clear direction at the national level that park users should be made aware of the current level of fire danger in the field unit, fire reporting practices and fire prevention (Parks Canada, 2003a). The fire operations plan proposes to support efforts to reduce human-caused fire risk in Full Suppression and Indirect Attack Zones through public awareness campaigns (Irons et al., 2003).

Martell (2001) points out that it is difficult to evaluate the effectiveness of fire prevention messages, since the public receives many such messages from many different sources (e.g. provincial media campaigns) throughout their lives. Isolating the impact of one public awareness campaign from another is not impossible.

Risk abatement is also supported by communications activities. For example, the fire operations specialist meets periodically with facility managers or owners to ensure, for example, that fireplaces where open fires are permitted are being well managed (Irons et al., 2003).

This section focuses on communications with the public, recognizing that the effectiveness of these communications is predicated on good internal communications. The information that Parks Canada employees provide to the public is only as good as the information that they receive from fire management staff.

The existing performance measure for communications is based on the provision of national fire management information at all communications venues within the field unit. However this does not reflect the range of communications activities in the field unit, nor does it say anything about the effectiveness of communications. A more appropriate performance measure might be the number of people the field unit is reaching with messages about fire.

Although Parks Canada has good statistics for visitors attending interpretive programs and visitors receiving personal communications at visitor centres and park gates, there is no easy way to determine how many of these people are receiving

messages about fire. This would require the establishment of data collection system to answer this specific question. For this reason, this section concentrates on describing communications products or activities ongoing in the field unit (see Table 4.9). The following summary cannot be related directly to outputs. However, it does provide a baseline against which future communications efforts can be compared. Field unit staff communications and suggest areas for improvement in Chapter Five.

Table 4.9 List of communications products or activities related to fire management

Product or Activity	**Description**
Web-site	Web-pages about specific fire events or topics are posted on the field unit web-site.
Fire Management Factsheets	National factsheets are distributed at visitor centres or fire information booths to interested visitors.
Field Unit Infosheets	Specialized factsheets about specific topics (e.g. use of retardant in fire fighting) are distributed at visitor centres or fire information booths to interested visitors.
Interpretation Programs	Campground theatre programs contain fire management messages.
Publications	Ten articles/conference proceedings have been published over the last five years.
Media Releases/ Information Bulletins	Press releases are faxed to media when fire bans are imposed, prior to prescribed burning and during sustained suppression of wildfires.
Interviews	Media interviews about specific events or initiatives (68 recorded contacts, not including the summer of 2003).
Field Trips/ Fire Operations Tours	Tours are often organized for park staff, media and stakeholders during prescribed burns or wildfires. Field trips covering broader fire management issues have been organized with academic institutions and other groups.
Open Houses	Open houses are held in affected communities prior to large prescribed burns.
Presentations	Fire/vegetation staff have spoken at a variety of venues including: community council meetings; chamber of commerce meetings; colleges; elementary schools; conferences; and staff orientations.
Communications Strategy	A communications strategy is prepared for each prescribed burn and large fuel management projects.
Information Booths	At large prescribed burns an information booth is staffed to provide information to the public.
Site Visits	Fire management staff visit park and commercial facilities to discuss

Product or Activity	Description
	facility protection with stakeholders.
Fire Danger Bulletins	Bulletins are circulated to staff at visitor centres, campgrounds, etc. when fire danger reaches "High".
Signage	Highway signs throughout field unit display current fire danger.

Sources: Irons, B., Kubian, R. & Walker, R. (2003). *Lake Louise, Yoho and Kootenay fire operations plan* (Rev.). Radium, BC: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

Parks Canada. (2002a). *Kootenay National Park of Canada: Implementation report*. Lake Louise, AB: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

Parks Canada. (2002b). *Yoho National Park of Canada: Implementation report*. Lake Louise, AB: Parks Canada, Lake Louise, Yoho and Kootenay National Parks Field Unit.

Walker, R. (2003). *LLYK Fire & Vegetation Specialist communications activities 1998-2002*. Internal Memo. Radium Hot Springs, BC: Lake Louise, Yoho and Kootenay National Parks Field Unit, Parks Canada.

4.2.6 Interagency Coordination

Discussion of interagency coordination in the fire management plan is limited to "work with other agencies and stakeholders to achieve common fire management objectives in boundary areas" (Walker & Irons, 2003b, p. 22). These interagency initiatives include mutual aid agreements and information exchange with other wildland fire agencies and volunteer fire departments (Irons et al., 2003). In times of need the field unit can draw on interagency resources through four mutual aid agreements:

- the 1983 Mutual Aid Resources Sharing Agreement (MARS) through which provincial and federal fire management agencies may share resources;
- the 1996 Canada/Alberta Agreement, a memorandum of understanding between Parks Canada and various Province of Alberta departments covering various fire management topics;
- the 1976 Canada/British Columbia Agreement, which addresses coordinated fire suppression along the boundary of national parks and adjacent lands; and

- the Canada/U.S. Agreement, which allows fire management agencies in Canada and the United States to share resources (Irons et al., 2003).

The above are all long standing agreements, which are negotiated at a regional or national level. In terms of interagency initiatives advanced by the field unit, two significant projects stand out. The field unit worked for several years in the late nineties with the Province of Alberta to develop a common fire management plan for the Upper North Saskatchewan watershed, hence the performance measure that the field unit would attend a second meeting in November 1998 (Walker & Irons, 1998). Work with the Province of British Columbia (BC) on a cooperative prescribed burn plan for the Redstreak / Stoddart Creek area is ongoing (R. Walker, personal communication, October 6, 2003). Fire management personnel have also participated in joint training with local fire departments (R. Walker, personal communication, December 18, 2003). Although none of these initiatives have produced tangible results, they can be viewed as intermediate measures of progress in this area.

Since interagency initiatives typically take some time to produce results, it was difficult to develop an appropriate performance measure for this activity. For example, the groundwork for the Mount Shanks wildfire in 2001 (a wildfire which was allowed to burn in an area identified for eventual prescribed burning) was laid in the early nineties, through discussions with the Province of BC to implement a prescribed burn on the boundary of Kootenay National Park that would meet fire management goals of both jurisdictions (Parks Canada, 2002). A more qualitative approach, evaluating participants' opinions of the usefulness of interagency activities and the quality of these relationships would also provide a relevant measure of success. This is explored further in the next chapter through interviews with field unit staff.

4.2.7 Research and Monitoring

The fire management program has an active research component involving partners such as universities, regional colleges and other government agencies. Funding for these projects comes from the field unit and/or partners, such as the Canadian Forestry Service. The research program aims to improve our understanding of fire

ecology and the effects of management interventions on the landscape. More specifically, research over the past five years has focused on: characterizing fire regimes in the field unit; studying the effects of fire on vegetation; determining whether vegetation within the field unit is outside of the natural range of variability; and whether activities, such as prescribed burning, are having the desired effect on ecosystem components. Some of these projects were identified in the fire management plan. The performance measures contained in the plan can be rolled into a more general measure of achievement, that is, the number of research and monitoring projects implemented over the last five years.

Table 4.10 Fire-related research and monitoring conducted from 1998 to 2003

Research and Monitoring Projects Identified in FMP	**Project Conducted**
Season of burn	Partially complete
Alpine larch regeneration	Yes
Whitebark pine/blister rust	Yes
Douglas fir population dynamics	Yes
Fire effects on mountain pine beetle	Yes
Fire effects on aspen poplar regeneration	No
Prehistoric pine beetle population reconstruction	Partially complete
Effects of montane meadows prescribed burns on succession	Limited implementation
Daer Pitts research burn	Control data collected; no treatment carried out
Research and Monitoring Projects not Identified in FMP	**Project Conducted**
Fire history in Radium/Stoddart Creek area	Yes
Paleoecological study of fire, drought and lake levels	Yes
Review of stand origin data, Vermilion Valley	Yes
Prescribed burn avian monitoring program	Yes
Fire history mapping	Yes
Lichen biodiversity index at Mt. Shanks fire	Yes
Mt. Shanks fire vegetation monitoring project	Yes (ongoing)
Forest health inventory	Yes (ongoing)

Source: Petersen, D. (2003). *The state of science, research and monitoring in Lake Louise, Yoho National Park and Kootenay National Park*. Unpublished Report, April 2003. Radium Hot Springs, BC: Lake Louise, Yoho and Kootenay National Parks Field Unit, Parks Canada.

Sixteen research and monitoring projects have been initiated over the past five years. Ten are now complete. Some of these projects involved more than one research question (for example, several people have worked on various questions related to whitebark pine). Only one of the research projects proposed in the fire management plan has not yet been implemented. In a couple of cases, data has been collected, but not yet analyzed.

Implementation of monitoring programs investigating the results of human interventions on the landscape does not appear to have been as successful as implementation of projects focusing on basic research. Limited monitoring has been carried out for the montane meadows prescribed burns. This included pre-burn and post-burn avian monitoring conducted at some sites in Kootenay National Park (R. Walker, personal communication, December 18, 2003). Prescribed burning is required at the Daer-Pitts site, in order to collect post-treatment data.

Overall, this aspect of the fire management program appears to be quite strong, although a more substantive monitoring effort is required. Another potential measure of performance might be the value of research results. This is a qualitative measure that is explored through interviews with field unit staff in the next chapter.

4.3 Outcomes

While the long-term impacts of program activities are arguably the most important part of outcome evaluation, they are the most difficult to measure for many of the reasons described in Section 3.3. For example, increased biodiversity might be a desired outcome of fire management. It would be the long-term result of several different outputs, such as the implementation of the direction for prescribed random ignitions and management-ignited prescribed burning. However other factors external to these outputs (e.g. climate change, the spread of non-native species) may be concurrently influencing biodiversity, making it difficult to determine the relative importance of the actions of the organization in maintaining biodiversity. Performance measure selection is also more challenging. Broader indicators of ecosystem health or integrity may be appropriate

measures of program performance, but the data collection requirements associated with these measures are more intensive.

Two goals and a desired result that resembled outcomes were identified, but only one applicable performance measure in the field unit fire management plan was identified (Walker & Irons, 1998a). According to Martell (2001), the "fire manager's role is to develop and implement fire management plans that are compatible with and contribute to the achievement of the objectives of the higher level… land management plans" (p. 533). Targets, such as average annual burned area, should be set in these higher order plans.

Following this logic, several higher order park plans were reviewed for statements of outcomes and potential performance indicators: the Banff , Yoho and Kootenay National Park Management Plans and the LLYK Field Unit Vegetation Plan. The LLYK Field Unit Vegetation Plan contained the same outcomes and performance measure as the field unit fire management plan. Table 4.11 contains a summary of statements from these plans that are outcomes or performance measures. Similar outcomes from different plans are grouped together in the left hand column of the table. The plan from which each outcome was drawn is identified in the middle column. Performance measures that relate to each group of outcomes are described in the right hand column. New performance measures were not proposed.

Out of the three performance measures contained in the park and vegetation management plans, only the annual area burned measure was readily quantifiable. The other two measures would involve relatively complex GIS analysis, assuming that available data sets are suitable for this type of analysis.

Table 4.11 Outcomes and performance measures identified in the fire management plan and higher order plans

Outcome	**Plan Title**	**Performance Measures**
Ensure protection of life, property and cultural and natural resources on park and adjacent lands.	LLYK VMP	None
Maintain or restore, as closely as possible, the role of fire within park ecosystems ***OR*** Maintain, and where feasible, restore native vegetation communities to reflect the long-term ecosystem states and processes ***OR*** Natural processes maintain the long-term composition and structure of vegetation communities.	LLYK VMP BNPMP YNPMP, KNPMP	Through prescribed burns and not suppressing fires caused by lightning, achieve a target of 50% of the long-term fire cycle: - approximately 1400 ha annually in BNP - approximately 350 ha annually in YNP - approximately 175 ha annually in KNP
Stakeholders understand the importance of fire within LLYK and support the restoration of fire dependent and fire adapted vegetation ***OR*** Promote a greater understanding of the ecological role of fire.	LLYK VMP YNPMP, KNPMP	None
Achieve target ranges for desired fire regimes for vegetation groups ***OR*** Determine suitable vegetation patterns, including age-class structures and distributions that will ensure viable populations and natural biodiversity ***OR*** Provide adequate habitat for native species by maintaining the natural structure and composition of vegetation.	LLYK VMP BNPMP YNPMP, KNPMP	Mean stand ages are within target ranges within twenty years of reaching a planning threshold for each group
Maintain and restore key structural components of the park's vegetation including aspen, willow and grassland communities.	BNPMP	Area occupied by open forest, montane meadows and young forest stands

Note: LLYK Field Unit Vegetation Management Plan = LLYK VMP, Banff National Park Management Plan = BNPMP, Yoho National Park Management Plan=YNPMP, Kootenay National Park Management Plan = KNPMP

Several authors suggest that outcomes should relate to ecological, social and economic impacts (Bellamy et al., 2001; Kleimann et al., 2000). This is a major gap in all of the plans reviewed. Only the field unit fire management plan contains an outcome relating to public safety and the protection of values-at-risk. No performance measures are proposed. It would be challenging to find a suitable measure for social and economic impacts, since the magnitude of these impacts can fluctuate greatly from year to year, due to factors that may be largely outside of the control of fire management personnel, such as weather, number of ignitions and fire behaviour (Martell, 2001). Irregardless, some sort of baseline would be valuable, even if only to compare the impacts during "regular" fire seasons to the impacts in "exceptional" seasons.

Although the annual area burned target for Banff National Park is 1400 ha, the LLYK Field Unit is only responsible for managing the north-western portion of the park. A new target of 600 ha for the Banff portion of the field unit was calculated based on the proportion of the land base of Banff National Park that falls within the field unit. This is a rather crude measure, since it does not take into account the fire cycles that exist in this portion of the field unit. If the fire cycles in the northwest corner of the park are generally longer than fire cycles found elsewhere, then this target might be artificially high. However, for the purposes of general comparison it was deemed acceptable to make the assumption that this target was generally correct.

The park management plans do not suggest how to go about calculating the annual area burned, and as Tables 4.12, 4.13 and 4.14 show, the method used to calculate area burned has some bearing on the final results.

Should average annual area burned be calculated from when the parks were first established? Kootenay National Park has been managed under a fire suppression policy since its beginnings in 1919. However, Masters (1990) suggests that only since the early eighties have helicopter-assisted initial attack crews been truly successful in suppressing wildfire. Perhaps it is more appropriate to calculate annual area burned starting from the date the new park management plans came into effect. In Kootenay's case, the result would be an annual area burned well above the historic average, due to two important fire

seasons in 2001 and 2003. No matter how it is calculated, the average annual area burned in Kootenay National Park exceeds the management plan target of 350 ha.

Table 4.12 Average annual area burned in Kootenay National Park for various time periods

Time Period	Total Area Burned (ha)	Average Annual Area Burned (ha)
1919-2003	37,722	444
1980-2003	21,829	910
2000-2003	20,854	5,213

Table 4.13 Average annual area burned in Yoho National Park for various time periods

Time Period	Total Area Burned (ha)	Average Annual Area Burned (ha)
1886-2003	9,001	76
1980-2003	221	9
2000-2003	118	30

Table 4.14 Average annual area burned in Banff National Park for various time periods

Time Period	Total Area Burned (ha)	Average Annual Area Burned (ha)
1886-2003	24,213	205
1980-2003	254	11
1997-2003	248	62

Source: *Lake Louise, Yoho and Kootenay National Parks historical fire database* [computer data]. (2003, September). Radium Hot Springs, BC: Parks Canada, LLYK Fire/Vegetation Program [producer and distributor].

The situation in Yoho and Banff National Parks is far different. The average annual area burned is far below the management plan targets (175 ha and 600 ha respectively), no matter how it is calculated. In recent years, the average annual area burned has increased slightly. In Yoho, this is due mainly to 100 ha burned on the Yoho/ Kootenay boundary by the Tokumm Creek fire in 2003. In Banff, the increase is due primarily to the 200 ha burned by the JAKYLL fire. This analysis suggests that fire

management efforts should be concentrated in the Yoho and Banff portions of the field unit in the next round of planning. However, the average annual area burned does not tell managers anything about the types of vegetation communities that burned or their relative importance to wildlife species or other values.

4.4 Conclusion

Politt (2003) points out that it is far easier to carry out evaluations of outcomes in organizations that are already oriented towards performance measurement. Although the *LLYK Field Unit Fire Management Plan* contains performance measures, the lack of useful measures, reliable data and identifiable outcomes suggests that the program is leaning towards results-based management in only a cursory way. This is probably reflective of the state of performance-based management in the rest of the field unit – the fact that performance measures were included in the *LLYK Field Unit Fire Management Plan* back in 1998 is unusual and innovative. If there is interest in pursuing this approach, more work is needed to identify meaningful performance measures and data collection methods. Certainly there are many advantages associated with the ability to quantify performance, and particularly so in a fiscal environment where resources are limited. The next logical step would be to evaluate efficiency, or in other words, how much has been accomplished with the inputs into the program.

Adequate information about the inputs to the program and program activities was available, although it was not necessarily contained in the fire management plan. It was possible to come up with outputs based on the contents of the plan, and reasonable performance measures for these outputs. This analysis showed strong performance in fire control, mixed performance in prescribed burning and research and monitoring, and limited performance in facility and community protection and management of prescribed random ignitions (see Table 4.14). Unfortunately, these are somewhat subjective judgments, since the plan contained no firm targets for any of these outputs. Additionally outputs related to ecological restoration (e.g. fire control, prescribed burning) were easier to develop and assess than were outputs related to social relationships (e.g. communications, interagency coordination). Communications and interagency

coordination are investigated in more detail through the process evaluation in the next chapter.

Table 4.15 Summary of performance by output and outcome

Output or Outcome	Performance Rating	Summary of Evaluation Results
Fire Control	Strong	- 93% of unplanned fires remained under 5 ha in Full Suppression and Indirect Attack Zones - Only two fire analyses conducted over last five years
Fire Use: Prescribed Random Ignitions	Limited	- No unplanned ignitions allowed to burn within prescription
Fire Use: Management-Ignited Prescribed Burning	Mixed	- 532 ha burned through planned ignitions over the last five years - Only two high intensity fires implemented - 30% of prescribed burns planned have been completed; implementation ongoing in 30% of cases - FMP objectives related to prescribed burning only partially met - Project approval takes on average four months; implementation takes on average five and a half months
Community and Facility Protection	Limited	- Fuel reduction at three outlying facilities - No fuel reduction around townsites - Two landscape level fuelbreaks established
Communications	Not able to assess	- 15 distinct activities or products identified; may form basis of future evaluation efforts
Interagency Coordination	Not able to assess	- two major interagency initiatives ongoing, but no tangible outputs (e.g. interagency plans) yet
Research and Monitoring	Mixed	- 16 out of 17 projects ongoing or complete - limited monitoring
Average Annual Area Burned	Mixed	- target exceeded in Kootenay National Park - far below target in Yoho and Banff National Parks

Given the ambiguity of many decision-making processes (e.g. response to wildfire in Indirect Attack or Planned/Random Ignition Zones) and the inability to determine how objectives were prioritized, it is possible that some of the performance measures developed do not fairly assess the effectiveness of program implementation. For

example, if prescribed burning was a more important priority than community and facility protection over the past five years, the amount of fuel reduction that took place in the field unit might be judged to be acceptable. Clear, consistent and realistic objectives were lacking in many areas, either because the concepts on which they are based are difficult to express or because the intent of the program would not be readily accepted by others if it were clearly stated.

While the evaluation of outputs was problematic, evaluating outcomes was much more difficult. The field unit does not yet have the ability to determine the long-term impacts of the fire management program for many of the reasons covered in Chapter Three. Some program activities are relatively new and a longer period of implementation is needed before long-term impacts can be properly evaluated. The extent to which management activities are achieving the desired ecological effects is also difficult to quantify (e.g. it is difficult to quantify in a meaningful way the contribution of outputs, like prescribed random ignitions and management-ignited prescribed fires to outcomes like the restoration of desired fire regimes). Although the limitations of outcome evaluation must be recognized in the context described above, this type of analysis has certain advantages. When combined with the process evaluation in the next chapter, outcome evaluation becomes a more effective tool. The process used to develop the performance measures aids in understanding the main activities of the program, formulating a picture of where the program is headed and identifying potential issues that require more investigation. Some of the measures can be used as benchmarks against which future implementation efforts can be measured. The analysis of the program for the outcome evaluation also enabled development of a better process evaluation questionnaire, which helped determine what issues should be explored further and provided some background information that would help staff to frame their comments. The next chapter discusses the results of these interviews.

CHAPTER 5: RESULTS OF THE PROCESS EVALUATION

The analysis of the results from the questionnaire is divided into five parts. The first section, *5.1 The Respondents*, paints a picture of how respondents were involved with the fire management program and their overall familiarity with the fire management plan. Section 5.2, *State of Fire Management in the Field Unit*, examines how respondents characterized the state of fire management in the field unit. Respondents discussed the challenges facing the program, its strengths and weaknesses and progress being made in specific areas, such as fire control, prescribed burning, communications and research. In Section 5.3, *Support for Fire Management*, the level of agreement on the goals of the program and some of the underlying concepts that guide the program are assessed. Opinions are voiced on the role that fire, and in particular random ignitions, should play in the field unit. Section 5.4, *Factors Influencing Program Implementation*, examines specific factors facilitating and hindering implementation the program. The last part of the analysis, *5.5 Looking Forward*, covers priorities for the future, and respondents' opinions about how planning should be carried out.

5.1 The Respondents

The researcher interviewed 40 Parks Canada employees. Ten were members of the field unit management team; fourteen were specialists; eight work for the field unit fire management program; and eight work in fire management outside the field unit (Table 5.1).

Table 5.1 Positions of respondents interviewed

Field Unit Fire Management	Managers
Resource Management Technician Park Warden Fire Operations Specialist Prescribed Burn Planner Initial Attack Crew Member Weather Station Specialist Initial Attack Crew Leader Fire & Vegetation Specialist	Aboriginal Liaison Communication Ecosystem Secretariat Finance & Administration Highways, Mech. Shops & Solid Waste Ops. Human Resources Resource Conservation Superintendent Townsite Visitor Services
Other Fire Management	Specialists
Fire Management Coordinator, Western Fire Centre Chief Park Warden, Elk Island National Park Vegetation Specialist, Prince Albert National Park Acting Fire & Vegetation Specialist, Jasper National Park Western Canada Fire Mgmt. Officer Fire Management Officer, Riding Mountain National Park Conservation Biologist, Banff National Park National Fire Duty Officer	Aquatics Specialist British Columbia Integrated Land Use Specialist Client Research Specialist Communication Specialist Communication Specialist Conservation Biologist Ecosystem Database Specialist Environmental Assessment Specialist Environmental Management Specialist Executive Services & Media Relations Mgr. Grizzly Bear Specialist Protection Operations Manager Wildlife Specialist Wildlife/Human Conflict Specialist

For questions where respondents were asked to rate a concept or an aspect of the fire management program (Q-6 to Q-11, Q-15, Q-23, Q-25, Q-28, Q-33, Q-36, Q-39a, Q40a, Q-42), the following variables of interest were used to stratify the numerical data:

- position,
- gender,
- the number of years employed by Parks Canada (Q-1),
- the number of years in current position (Q-2),
- age (Q-3),
- tasks or responsibilities (Q-5).

Kruskal-Wallis tests were conducted to determine whether any significant differences existed by variable. If a significant difference ($p \leq 0.05$) was found, Mann-Whitney U tests were used to pinpoint where significant differences were located within the stratified sample. None of the analyses revealed significant differences by gender, age, or the number of years with Parks Canada. Spearman's test of correlation was conducted on the same data (Q-6 to Q-11, Q-15, Q-23, Q-25, Q-28, Q-33, Q-36, Q-39a, Q40a, Q-42) to determine if any relationships between the responses existed. Only significant differences are reported below.

5.1.1 Involvement with the Fire Management Program

Respondents are involved in many different ways with the field unit fire management program. Table 5.2 summarizes the number of respondents responsible for duties related to fire management by position. In general, all respondents participated in some way in the program, from providing advice about the potential impacts of fire management activities, to helping to plan and implement specific initiatives.

Fire management staff reported involvement with more aspects of the program than managers and specialists. Several respondents identified other responsibilities that were not listed on the questionnaire, including directing fire management personnel, developing fire management infrastructure and more general responsibility for vegetation management, including communications with the public on vegetation-related issues.

Field unit managers were most often involved in providing advice about resource management or human use implications of fire management activities and reviewing proposed fire management projects. Very few were involved with planning or implementing fire management initiatives or developing fire management policy. Three managers were responsible for approving fire management proposals. Other duties that were not captured in the list of responsibilities included: providing financial services for fire management, responsibility for the health and safety of employees; managing facilities at risk from wildfire; and providing input to assist in planning fire management initiatives.

Table 5.2 Respondent tasks or responsibilities related to the fire management program

Tasks or Responsibilities	Field Unit Fire Mgmt. (n=8)	Other Fire Mgmt. (n=8)	Mana-gers (n=10)	Special-ists (n=14)
Participate in fire suppression operations	7	8	0	4
Plan fire management initiatives	8	8	1	4
Implement fire management initiatives	8	8	1	4
Provide advice about resource management or human use implications of fire management activities	6	8	6	10
Develop fire management policy	2	7	2	0
Review proposed fire management initiatives or policy	5	8	7	6
Approve proposed fire management initiatives or policy	2	7	3	0

Specialists reported more diverse involvement with the program. Several participate directly in fire suppression operations and roughly a quarter help to plan and implement fire management initiatives. Specialists were most often involved in providing advice about resource management or human use implications of fire management activities. Slightly less than half also review proposed fire management initiatives. None of the specialists are involved in developing policy or approving proposed fire management initiatives. Other tasks include managing area closures related

to fire and providing information needed in the development of initiatives, plans and fire operations.

Although only four people outside the fire management program are involved in planning and implementing fire management initiatives, two thirds of managers and specialists provide advice to the program, and just over half are responsible for reviewing fire management proposals. Given this level of involvement, staff outside the fire management program should be in a good position to comment on the state of fire management in the field unit and judge what factors might be affecting program implementation. Furthermore, the level of internal support for the program could have a significant impact on the speed with which various initiatives move forward.

Very few respondents outside the program saw themselves as responsible for developing fire management policy or approving fire management initiatives or policy. Within the field unit fire management program, only two respondents reported that they are tasked with developing fire management policy. This suggests that policy development is not a process that actively involves others in the organization, despite the fact that the general direction chosen for the fire management program may have important consequences for other programs in the field unit.

5.1.2 Familiarity with the Fire Management Plan

Respondents were asked to rank their familiarity with the existing fire management plan on a scale of 1 to 5, where 1 ("not at all familiar") meant they had never read the plan, and 5 ("very familiar") meant they had read the plan thoroughly. Respondents were most often "somewhat familiar" with the fire management plan; sixteen respondents were less than "somewhat familiar". Only seven were "familiar" or "very familiar" with the plan.

The Kruskal-Wallis test was used to determine if there was a significant difference in how respondents rated familiarity with the plan (by position, gender, age, length of time in position and length of time with Parks Canada). The only significant difference was by position. The Mann-Whitney U test was then used to test for significant differences among positions (see Appendix D for p-values). Field unit fire

management staff were most familiar with the plan, followed by fire management staff outside the field unit. However, there was no significant difference between these two groups. Field unit specialists and managers were more likely to report that they were unfamiliar with the plan. The scores for these two groups were significantly different from the scores for the fire management groups. There was no significant difference between managers and specialists.

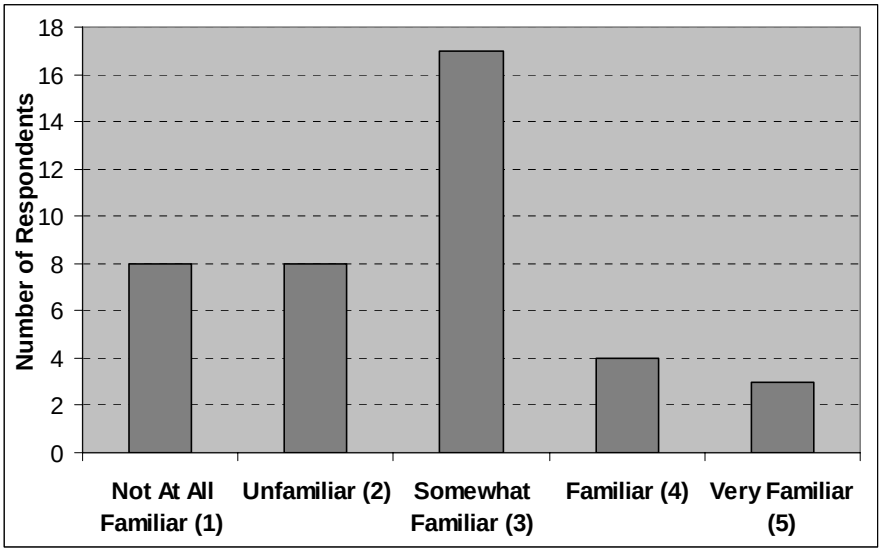

Figure 5.1 Respondent rating of familiarity with the 1998 *LLYK Field Unit Fire Management Plan*

Even among field unit fire management staff, there was not a strong familiarity with the fire management plan. Half of field unit managers reported they were "not at all familiar" with a plan that might have significant impacts on their operations. This is an area where there is room for improvement. These scores might be improved by distributing the plan more widely or communicating its contents more effectively.

Table 5.3 Median familiarity with fire management plan by position

Position	**Median**
Field Unit Fire Management Staff	3.5
Other Fire Management Staff	3.0
Field Unit Specialists	2.5
Field Unit Managers	1.5

Mann-Whitney U tests also showed that respondents who participate in fire operations, plan and implement fire management initiatives, develop policy and approve fire management initiatives or policy were more familiar with the fire management plan than those who reported no involvement with these tasks (see Appendix D for p-values). Respondents who provide advice about the implications of fire management activities were also more familiar with the plan at the 0.10 confidence level.

5.2 State of Fire Management in the Field Unit

Despite the fact that many respondents rated themselves as less than "somewhat familiar" with the fire management plan, most had well-defined opinions about the program. Respondents were asked to comment on challenges facing the program and its strengths and weaknesses. The following section provides a good overview of the program and the issues program staff are currently facing.

Table 5.4 Main challenges facing the fire management program identified by respondents

Theme	Number of Respondents*
Managing Public Perception and Building Public Support for the Program	16
Building Internal Support for the Program	15
Maintaining a Sustainable Program with Adequate Resourcing to Meet Program Objectives	9
Restoration of Fire on the Landscape	4
Other	8

* Refers to the number of respondents who talked about the theme

Managing Public Perception

Managing public perception and building public support was most often mentioned as the main challenge facing the fire management program. "The biggest challenge is going to be balancing the need for doing the work with managing …the public perception of the role of fire." Low tolerance for smoke and a traditional fear of fire were cited as two reasons for limited public support. Competing environmental and economic objectives and a range of values among the public ("the public perceptions vary a lot") make this a very complex issue, so that "getting social, political consensus to manage these things is a challenge". One respondent remarked that fire management staff must "shape or define common objectives with all concerned – stakeholders, residents".

Building Internal Support

Improving the level of internal support was identified as a significant challenge by fifteen respondents. Eleven of these respondents pointed to a lack of support at the management level. Several reasons for this lack of support were suggested:

- heavy workloads mean that managers "are trying to think about everything under the sun and fire management only becomes important at certain times".
- there is a lack of understanding of what is required to maintain or restore ecological integrity; "the on the ground actions required are not always clear to senior bureaucrats".
- different people perceive the risk related to fire management activities differently and may be unwilling or hesitant to accept this risk.
- "we seem to be in a culture where political considerations are so important that it is difficult to make a decision, and a lot of decisions have to be made quickly because windows are short."
- there are conflicting philosophies (e.g. about how parks should be managed) or personal views.

One respondent remarked that individuals can have a large impact on the ability to carry out certain projects, because Parks Canada is "not a line organization…there is a lot of autonomy… not just at the operations level...but right through the organization." Several respondents suggested that field unit fire management staff need to spend more time selling the program and engaging Parks Canada management in their activities, in order to build support.

Maintaining a Sustainable Program

Nine respondents saw a lack of financial and/or human resources as a key challenge for the fire management program. They suggested that Parks Canada needs to build a more solid base so that the program is sustainable in the long run and the program needs more appropriate resourcing for the suite of initiatives that should be implemented. This is challenging given the current financial context within Parks Canada. Field unit budgets are shrinking, as is the number of positions in the organization. Limited

resources in functions outside of the fire shop (e.g. resource conservation) make it difficult to run large operations or projects. Currently, the program is only effective because it is funded outside the field unit. Without sufficient people to plan projects and sufficient field unit staff to provide support in other areas, it is impossible to implement a landscape level program.

Restoration of Fire

Simply getting more fire on the landscape was seen by four people as the main challenge facing the program. Larger fires, more stand replacing fires and fires closer to developed areas are seen as a need. This was related back to public acceptance - these large events are challenging to implement because they compete with other park objectives (e.g. objectives for visitor experience) or uses (e.g. transportation on through highways). Respondents questioned whether Parks Canada is prepared to inconvenience the public.

Other significant challenges mentioned by respondents include:

- developing a long term plan that defines the role of the program;
- changing the approach to projects and planning so that others are consulted and engaged early on;
- proactively integrating science and stakeholder support to create a progressive program;
- preventing catastrophic fires;
- addressing issues around mechanical harvesting and disposal of surplus timber; and
- mitigating the risk to neighboring lands.

5.2.1 Strengths and Weaknesses of the Fire Management Program

Public perception, internal support and the availability of resources are themes that recurred throughout the interviews. They were often among the top three factors affecting implementation of specific activities, such as prescribed burning or the

management of random ignitions. They were also labeled as strengths and weaknesses of the fire management program. Table 5.5 lists those strengths and weaknesses.

Table 5.5 Strengths and weaknesses of the fire management program identified by respondents

Theme	**Number of Respondents**
Strengths	
Fire Management Personnel	35
Support for the Fire Management Program (Public and Internal)	8
National Network	7
Track Record / Good Fire Suppression Capability	6
Communications	5
Program Based on Science	5
Frequent Natural Fires	3
Availability of Resources	3
Good Planning	5
Other (e.g. operational strengths, field unit experience, vision, common sense objectives, organized, diverse environment)	8
Weaknesses	
Support for the Fire Management Program (Public and Internal)	18
Planning / Process	12
Availability of Resources	11
Cooperation Between Field Units	8
Monitoring / Evaluation	6
Communications	5
Program Depth	3
Other (e.g. interagency coordination, organizational structure, skill set, scale of work to be done, interpretation of scientific information)	8

Fire Management Personnel

Thirty-five respondents portrayed the people in the fire management program as one of its main strengths. They described experienced, knowledgeable staff, who are personally committed to the program and want to move it forward. "It is an ambitious group, not afraid to take risks in a reasonable measured way." "We have many individuals working in that program that are dedicated to getting fire back on the landscape and have the credentials to be able to do that safely." Words like energy,

enthusiasm, leadership, expertise and professionalism were associated with field unit fire management staff, and to a lesser extent, fire management staff at the regional level. Two respondents also noted that the "field unit collectively has acquired quite a bit of experience dealing with fire on a variety of scales" and that field unit staff work in a cohesive manner.

Public and Internal Support

Although park staff expressed confidence in the ability of fire management staff to carry out their work effectively, eighteen respondents identified a lack of public and internal support for the fire management program as a weakness. In contrast, eight respondents felt that increasing support for the program from key stakeholders, such as neighboring communities or provincial agencies and Parks Canada management, was a strength. "There have been a lot of years of dialogue with our partners and we have developed a sense of trust with key partners".

National Network / Program Depth / Availability of Resources

Seven people saw that the fact that the fire management program was part of a larger national program as a strength. "Nationally the program is very well respected" and "it is one of the few things we try to conduct on a national level". The national network allows local fire management staff to draw on broader resources and expertise, while maintaining some autonomy and the ability to innovate.

Despite the ability to draw on the national network for assistance, several respondents were concerned that the program does not have enough depth at the field unit level and that "it relies on key individuals". Furthermore, these individuals may not have the skill set required to manage very large and complex projects that have the potential to impact many stakeholders.

A lack of program depth is probably related to limited resources, described as a weakness by fourteen respondents. "We have lots of ideas about what we should be doing, but don't have the resources to do all these things." However, three respondents felt that there were strengths in this area, with good equipment and training available.

Track Record

A proven capability in fire suppression and a good track record in other areas of the program were seen as strengths by seven respondents. The field unit experiences relatively frequent lightning fires, particularly in Kootenay. Therefore, field unit fire crews have significant experience managing wildfires. The occurrence of several large fires over the past few years has also helped the fire management program to achieve some of its ecological goals. The "success of previous initiatives in the suppression and management end" of fire management has contributed to the credibility of the program, so that the program is "increasingly trusted to deliver".

Planning

Twelve respondents identified issues related to the planning and implementation of fire management initiatives as weaknesses. Without a current fire management plan, "people don't see the association of individual actions with broader objectives for fire management" and opportunities are lost to make proactive decisions about facility protection or establish a larger context for prescribed burning.

More interaction with stakeholders and within Parks Canada is required. Fire management staff "should engage people early on in order to build support for what they want to do and come back at key points and report" to the management team. Right now, "the process gets really far down the line before they engage management". The approval process for fire management projects was described as "difficult and laborious" by one respondent; another remarked that "in terms of laying out a clear process for these people to work within, we spend a lot of time going in circles because there is no clear process".

The fire management program needs to be better integrated with other functions and programs. "Sometimes considerations are not integrated into planning early enough" and it is difficult for park staff to provide input into this process because the time frame is too short or there is not enough organizational capacity.

Contrasting opinions were expressed by three people who cited a good planning capability as a strength of the program and by an additional two who stated that there

appears to be "a much stronger desire now to engage others in the process" and to "integrate the various goals of each land use manager".

Communication

Several respondents commented on communication. Five viewed good communication as a program strength, whereas five respondents felt this was an area where improvement is needed. While communications during large events, such as the Kootenay fires in 2003, tended to be viewed favourably, strategic communications need some work (see Section 5.4.2 for more information).

Science

Five respondents viewed the availability of scientific information and its incorporation into the program, so that decisions are based on good science, as a strength. However, two respondents cautioned that this information needs to be interpreted carefully. One respondent remarked that there has been a "failure to understand that you can "shrink" the regime; that there is another fire regime underneath the lightning regime that allows humans to get a toe-hold in managing the regime like we have for hundreds of years." Another respondent pointed out that because more information is available from the last century than previous centuries "our perspective is biased - sometimes the fire management program focuses too much on trying to recreate what was there 100 or 120 years ago." A robust monitoring program is also lacking, as is the documentation and evaluation of past successes.

Cooperation Between Field Units

Eight respondents felt that cooperation between field units could be improved. "We need to coordinate better with what is happening in Banff and Jasper…I think there may not be good communications between the three sections and they may not be thinking on a landscape level". For example, the three field units do not have consistent zoning for random ignitions.

Other strengths identified by respondents include:

- the ability to implement the program with a minimum of resources and people as a strength – the fact that the fire management people are "doers";
- a "fairly common sense approach to what our objectives should be";
- the ability to learn from the mistakes of others and the program's own mistakes;
- the most diverse environment for fire management in the mountain block;
- a vision for the program;
- a fairly well-organized program.

Other weaknesses include:

- the organizational structure of Parks Canada is not conducive to rapid change. Because there is very little accountability it is "difficult to get people doing things the same way".
- there is a lot of work to carry out, because a policy of suppression has been in effect for so long.
- the current scale of burning is too small.
- there may be areas where Parks Canada should be coordinating with the provinces more.

The majority of respondents was able to rate or comment on how the program in six key areas: fire control, prescribed burning, fuel management, research and monitoring, communications and interagency coordination. Respondents rated the field unit's ability to manage wildfire very positively. However, there was general agreement that more prescribed burning and facility protection are required. Interagency work was also viewed very positively, whereas comments about communications, and research and monitoring were mixed.

5.2.2 Fire Control

Thirty-six respondents rated the field unit's ability to manage unplanned fires as good or excellent (Figure 5.2). One respondent pointed out that since large fires are

handed over to a national fire management team, credit is due to more than just the field unit. Another respondent felt that, given the resources available, the field unit is doing a good to excellent job, but if it were compared to other better resourced organizations, it might slip to fair or good.

A Kruskal-Wallis test showed that there was a difference in the rating given to fire control by position only at the 0.10 confidence level. A Mann-Whitney U test showed that managers rated the ability to manage wildfire significantly higher (Median = 4) than fire management staff from outside the unit (Median = 3) at the 0.05 confidence level, and higher than field unit fire management staff (Median = 3) at the 0.10 confidence level. Respondents who participate in fire operations and in planning fire management initiatives also rated the ability to manage fires slightly lower (Median = 3) than respondents who do not participate in those activities (Median = 4) at the 0.10 confidence level (see Appendix D for p-values).

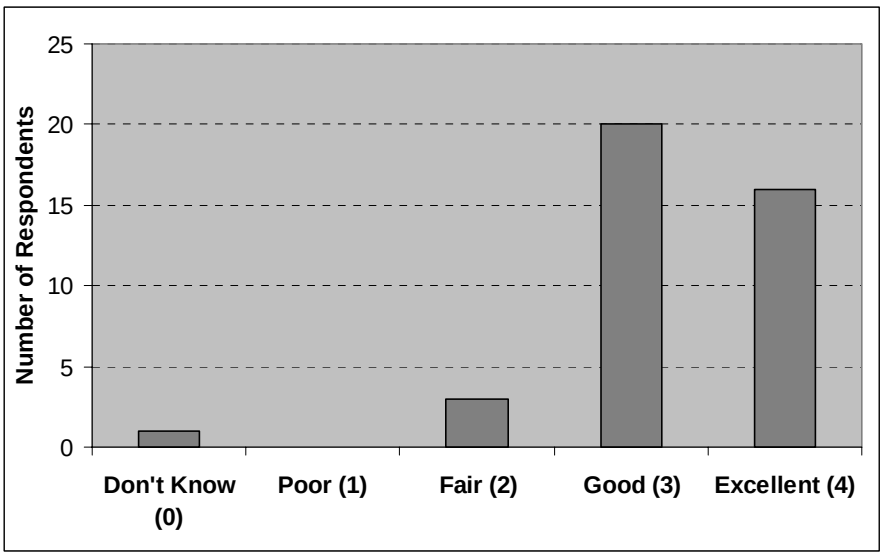

Figure 5.2 Respondent rating of the field unit's ability to manage unplanned fires

Despite these differences, this activity was rated very favourably, indicating that there are good competencies in this area. This confirms the assertion that the field unit's track record in terms of fire suppression and management is one of the program's strengths. This is also a change from evaluations in the late eighties and nineties (e.g.

R/EMS, 1990) that described major shortcomings in Parks Canada's ability to carry out fire suppression.

5.2.3 Management-Ignited Prescribed Burning

Thirty-two respondents reported that more or much more management-ignited prescribed burning was required in the field unit (see Figure 5.3). Several respondents had difficulty answering this question – they pointed out that given the fires in Kootenay in 2003 and the Mount Shanks fire in 2001, the need for prescribed burning may not be as great as it was previously. Prescribed burning plans should be reassessed based on the targets in the park management plan. "I suspect that the fires that happened in Kootenay have changed things, so I'm not sure if that is good for now, or what they need to do in terms of acting proactively for other fires".

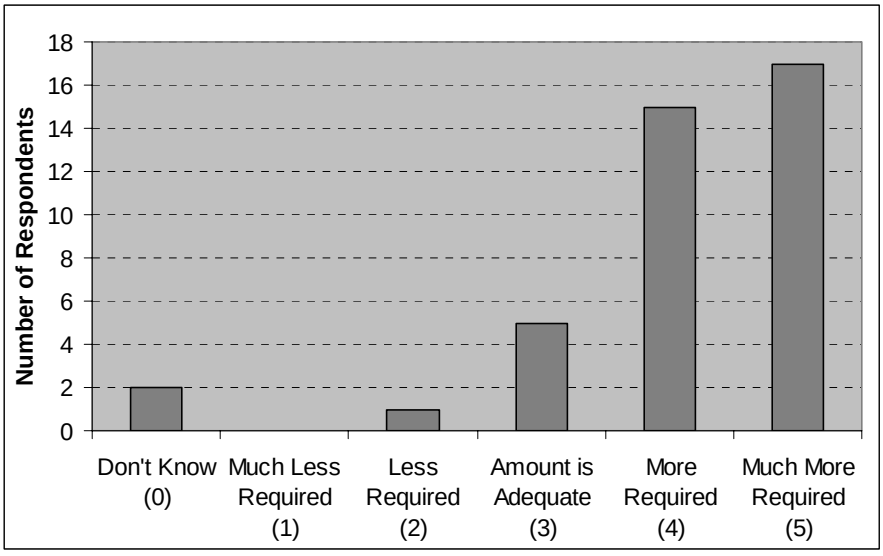

Figure 5.3 Respondent rating of the adequacy of the amount of prescribed burning carried out in the field unit

Other respondents countered that despite the gains in Kootenay, there have been no significant fires in Yoho and the Lake Louise area. Another point of view was that the scale of burning in the first few years of the prescribed burning program was adequate since the program was just getting started, "but the last couple of years there should have been more". Still others suggested that there is a need to move the prescribed burn

program from small scale burning in the montane ecoregion to take on more strategic burns in the subalpine ecoregion.

A Kruskal-Wallis test revealed that there was a statistically significant difference ($p \leq 0.05$) in the perceived adequacy of prescribed burning by position (see Appendix D for p-values). Mann-Whitney U tests showed that this was due to a significant difference between managers and field unit fire management staff. At the $p \leq 0.10$ level, there was also a significant difference between managers and other fire management staff and specialists. Managers reported more often than these other groups that the amount of prescribed burning was "adequate" and, less often, that "much more" was required. This suggests that there is slightly less support for prescribed burning among managers or that the need for prescribed burning is not perceived to be as important.

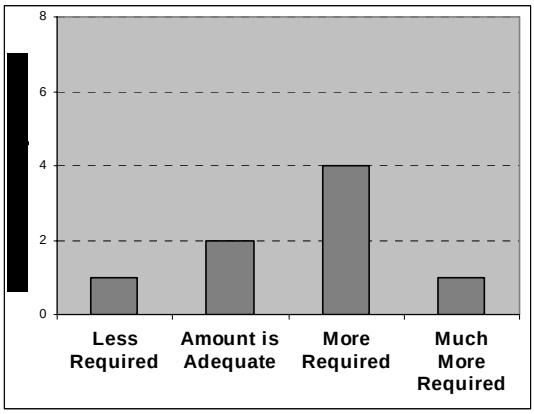

Figure 5.4 Manager rating of adequacy of amount of prescribed burning

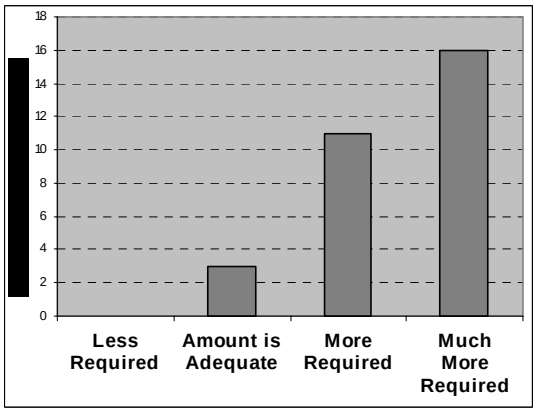

Figure 5.5 Fire management staff and specialist rating of adequacy of amount of prescribed burning

Spearman's test of correlation showed that there was a strong negative correlation between the respondents' rating of fire control and the amount of prescribed burning required. Respondents ranking the ability to manage wildfires very highly tended to perceive less of a need for prescribed burning. There was also a positive correlation between plan familiarity and the amount of prescribed burning needed. Those respondents who were more familiar with the fire management plan tended to report that more prescribed burning was required (see Appendix D for r_s values).

5.2.4 Fuel Management

Thirty-five respondents believed that "more" or "much more" fuel management (e.g. fuel reduction programs around specific facilities or townsites, construction of landscape level fuelbreaks) was required (see Figure 5.6). The median rating for fuel treatment (4.5) was slightly higher than the median rating for prescribed burning (4.0), which suggests that respondents feel that slightly more effort is required in terms of fuel treatment. Again, respondents offered a variety of comments on this topic. Some noted that "some of this fuel management might be or should be in the form of prescribed burning" and that, because fuel treatment projects can involve the creation of landscape level fire guards through prescribed burning, it is difficult to separate the two. Others emphasized that Parks Canada should proceed cautiously with these projects, because "from an ecological perspective, there is no real need for fuel management activities".

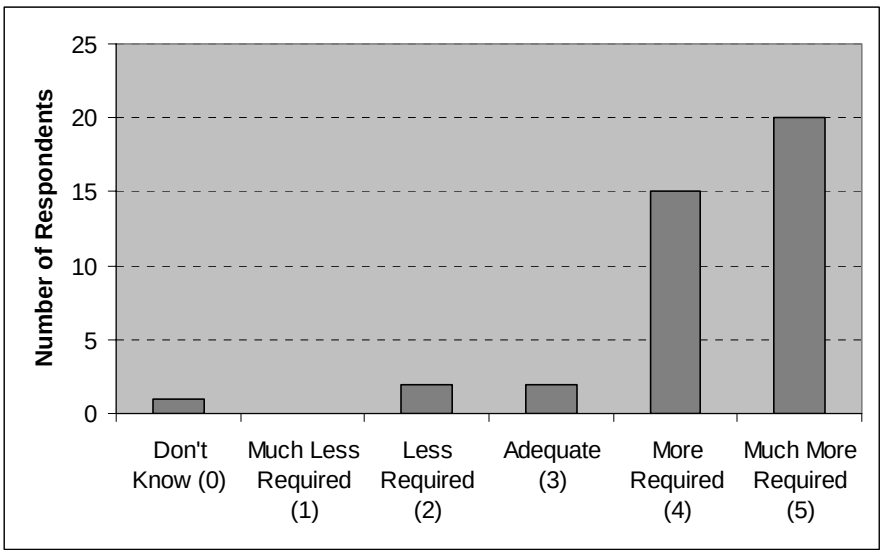

Figure 5.6 Respondent rating of the adequacy of the amount of fuel management in the field unit

Kruskal-Wallis tests showed no significant difference by position in rating the need for fuel management. However, there was a significant difference at the $p \leq 0.10$ level by length of time in current position. Mann-Whitney U tests demonstrated a significant difference between those who had been in their positions for less than three

years and those who had been in their positions for more than eight years (see Appendix D for p-values). Support for "much more" fuel management was significantly higher among respondents who had worked in their current position for less than three years. There was also a significant difference at the $p \leq 0.10$ level between respondents who had worked less than three years in their positions and respondents who had worked between three and eight years. It is unclear why this relationship exists.

5.2.5 Communications

Respondents were asked to rate the consistency of fire management communications, where consistency means that under similar circumstances, the same messages are communicated in the same way. Communications most often ranked between "somewhat consistent" and "very consistent" (see Figure 5.7). Where respondents thought that messages were being communicated less than "somewhat consistently", they were asked to explain their reasoning. Although only three people rated the communications as "inconsistent", eight people commented on this topic.

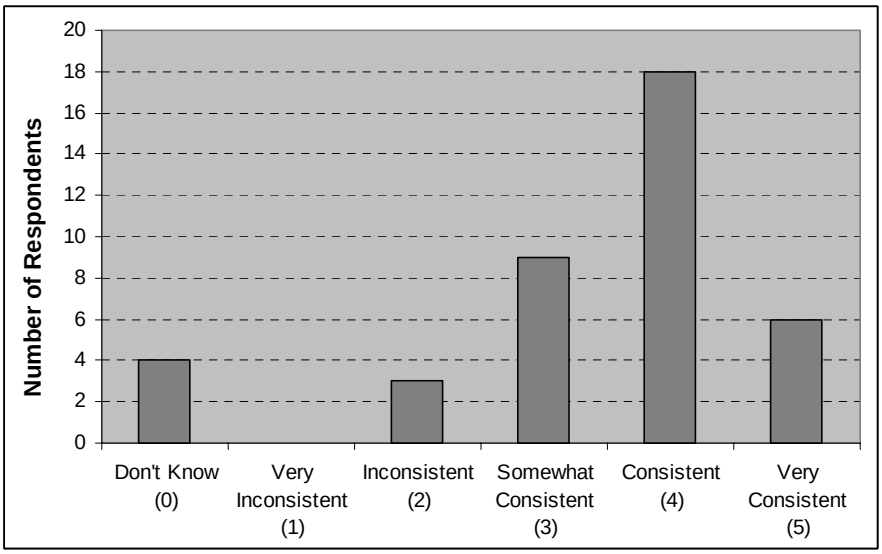

Figure 5.7 Respondent rating of the consistency of communications

The following reasons were given for lack of consistency in communications:

- communications tend to be very reactive and generally occur in response to a major event or crisis. There needs to be more of an effort to communicate about fire at other times and to lay the groundwork for more consistent communications when there is a major event.
- there are relatively few major fires. Therefore, staff are not able to regularly practice the skills or procedures required to communicate effectively.
- communication processes for newer initiatives, like prescribed burning and fuel treatment projects, are not well defined. Staff are uncertain if they should be consulting or informing the public about these projects. As staff become more experienced with these initiatives, the process may be smoother.
- communications efforts are not well-organized. This may be due to field unit reorganization. A communications function has only recently been established and is just beginning to work more closely with the fire management program.
- staff turnover within the fire management program and among communicators has had a negative effect.
- fire management personnel in different field units do not approach fire management in the same way, communicate the same messages to the public or communicate with one another. Inconsistencies at a broader level make it difficult to implement regional initiatives like fire bans.
- the terminology that Parks Canada uses to describe fire management needs to be standardized.

Just over half of all respondents thought that the right people were being reached by the fire management program (see Table 5.6). However, seven of these people qualified their response (e.g. “but that is during a fire, I am less confident before and after a fire, or not necessarily enough people and with all the right messages”). Thirteen respondents did not know if the right people were being reached.

Table 5.6 Respondent views on whether the field unit reaching the right people with its communications

Responses	**Number of Respondents**
Yes	22
No	5
I don't know	13

There was no real consensus among the fourteen respondents who attempted to identify the audiences that Parks Canada is not reaching. For example, several respondents felt that Parks Canada was doing a good job of reaching park visitors but needed to concentrate more on reaching park residents and local stakeholders. However, others felt Parks Canada was doing a good job of reaching local audiences and that park visitors were not "getting the message".

Audiences most often mentioned include (in descending order): local stakeholders (e.g. businesses and residents), regional or national audiences (e.g. transportation industry, logging industry, broader tourism industry), the field unit management team, park visitors, other field unit staff and the Canadian public. The diversity of responses to this question might be explained by one respondent's comment that "I'm not really sure we understand who all the stakeholders are…or if we understand their needs". More work is needed to define Parks Canada's audiences and the information they require. This would help Parks Canada determine how best to reach each group, and with what messages.

5.2.5.1 Improving Communications

Respondents were asked how they thought communications could be improved. Numerous comments mirrored remarks about the consistency of communications. However, there were many new ideas as well. Table 5.7 presents these ideas.

Table 5.7 Respondent opinions about the manner in which communications can be improved

Themes	**Number of Respondents**
Reach the Right Audiences / Engage Stakeholders and Staff	12
Specific Techniques or Recommended Initiatives	12
Improve Strategic Communications / Timing of Communications	11
Commit more Resources to Communications	10
More Communications Planning	9
Integrate Communications	5
Improve Training	3
Other (consistency, unplanned mid-sized events, radio communications)	6

Reaching the Right Audiences

Twelve respondents came back to the issue of properly identifying target audiences and how best to engage them. Parks Canada needs to spend more time matching messages to audiences because some audiences require more detailed information than others. More work is needed to connect with some groups (e.g. park businesses, residents). "Many would be surprised about our thoughts on random ignitions and what targets in the management plan really mean on the landscape". One respondent suggested that focus groups with stakeholders, such as residents, businesses and park user groups, might help Parks Canada to understand how communications can be improved. In another field unit, stakeholders are involved on an annual basis in selecting areas for prescribed burning.

Five respondents emphasized the need to include internal staff in communications efforts. "In my own experience with fire and vegetation management, the most important group to reach is our staff…they are a good cross-section of the public, so we will get many questions answered by talking to them". General information sessions for staff at regular intervals throughout the year might improve awareness about the program and future projects. Staff should also be invited out to prescribed burns "so that they have a better understanding of what is going on…".

Improve Strategic Communications

Eleven respondents touched on the need for more proactive communications. As mentioned above, "communications seem to be really focused on informing staff and stakeholders when there is a big fire" and a greater effort is needed to communicate with the public in advance of planned activities and on a year round basis. "We need to put in place communications plans that recognize not only the needs for crisis communications, but pre- and post-fire communications with an emphasis on community building and collaboration". A different view was that the best time to deliver messages about fire is during a large wildfire, when the public is most interested. In short, communications need to be well-organized and positioned to take advantage of any opportunity to communicate about fire.

Commit More Resources

Ten respondents reported that committing more resources to communications (e.g. dedicating a person to fire communications) would help to improve communications. More consistency would be provided if a single person carried out the communications planning for all the different fire management projects. Support from communications officers is required on large fires, because fire management personnel are often too busy to carry out any communications work. Communicators need more training to fill these kinds of roles, and more time to plan for the next big event together, experiment with "mock scenarios", and create tools and templates. The national network is currently supporting the development of specialists in fire communications.

Communications Planning

Nine respondents touched generally on the need for more communications planning. Some respondents thought communications planning should be incorporated directly into the fire management plan, which should outline communications objectives or develop a "tactical approach to communications". A strategic communications plan could also be an appendix to the plan. Communications planning should work towards integrating all the staff supporting an operation, so that there is a common understanding

of the key messages and audiences. A standard communications plan would ensure consistency in communicating about different projects. Projects could be categorized, from routine to more complex, and the approach or steps to be taken with each type of project outlined. There also needs to be some commitment to evaluating communications efforts so that they can be adapted over time.

Integrate Communications

Communications about fire also need to be integrated with other resource management programs, so that they are part of a bigger message about the manner in which parks are being managed to protect ecological integrity or biodiversity. There are many different initiatives ongoing at a national (e.g. national fire management communications), regional (e.g. the mountain pine beetle program) and local level (e.g. individual prescribed burns). At present, these are "packaged as distinct identities" and "for communications to be effective these things need to be linked" with two or three common messages.

Recommended Techniques or Initiatives

Many respondents talked specifically about communication products that could be developed or methods that could be employed to improve communications, such as:

- more interpretive signage or other non-personal media, particularly in Kootenay National Park, where there are excellent examples of fire and mountain pine beetle on the landscape;
- permanent displays at information centres;
- a brochure for park residents about how Parks Canada manages fire;
- educational products that can be incorporated into school curricula and outreach to community groups (e.g. naturalists);
- use of non-traditional media, such as video or radio, to reach a larger audience in a mode they are more likely to notice (since most people are now getting their information from electronic sources);

- greater availability of fire information on Parks Canada web-sites and an ability to update this information quickly;
- more newspaper articles about prescribed burns;
- during fire operations open houses in affected communities to dispel rumours quickly;
- use of uniformed communicators to deliver messages during wildfires increases credibility (e.g. in Kelowna communicators wore the same uniforms as fire line staff).

Other points raised include:

- communications need to be of the same standard and quality across the country.
- greater consistency among field units is required.
- a conscious effort to continue to improve communications on the fire line is required.
- radio communications in the field unit need to be improved.
- communications around mid-sized events need to improve (a committee of fire people and communicators might work on this together and communicators from other field units should be involved).

5.2.6 Research and Monitoring

Respondents were asked to rate their familiarity with this aspect of the fire management program. Only respondents who felt they were at least "somewhat familiar" with research and monitoring were asked to provide more detailed information. Although this question was intended primarily to filter out less knowledgeable respondents, it gives a good indication of how much profile research and monitoring has within and outside the field unit.

While the median response was "somewhat familiar", eleven respondents were less than somewhat familiar with research and monitoring ongoing in the field unit (see Figure 5.8). Eleven respondents were more than "somewhat familiar", but only two

described themselves as "very familiar". Although it was expected that field unit fire management staff would be more familiar with this aspect of the program than any other group, a Kruskal-Wallis test showed that managers, specialists and fire management staff were all equally familiar (or unfamiliar) with research and monitoring related to fire.

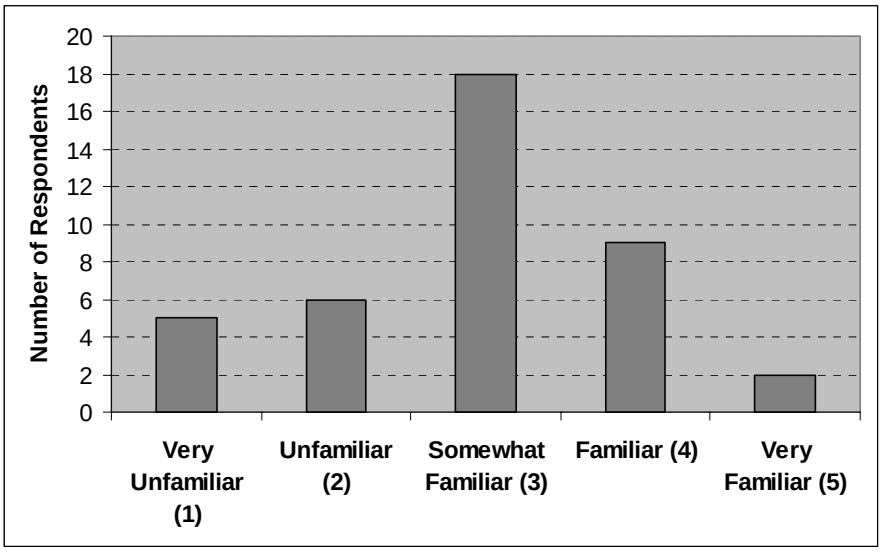

Figure 5.8 Respondents rate their familiarity with research and monitoring related to fire

There was a strong positive correlation between familiarity with the fire management plan and familiarity with research and monitoring in the field unit (based on Spearman's test of correlation). Respondents who were more familiar with the plan were also more familiar with the science behind the program (see Appendix D for r_s values).

Communication of the Results of Research and Monitoring

Even among respondents who said they were at least somewhat familiar with research and monitoring, there seemed to be a fair amount of uncertainty about what was happening in the field unit and how that was contributing to program development or direction. Eleven respondents commented that there was a lack of awareness about research and monitoring related to fire or that information was not easily accessible.

Comments like "I never really see anything and I am in the program" and "the information being generated doesn't really get out" are fairly representative.

Five respondents felt that communication of the results of research and monitoring needed to be improved. "We need to communicate the results and relate them to objectives in a clear way for multiple audiences". This would help to build more support for the fire management program both internally and externally. One respondent suggested that the program should be profiled more, because it is probably a good example of a science-based program. The Panel on Ecological Integrity in Canada's National Parks recently recommended that Parks Canada become more science-oriented.

One respondent noted that this lack of awareness is not unique to the field unit. There are many different fire-related projects ongoing in different field units, but they are not coordinated. The benefits of individual projects to the broader national program are not clear. "We may be tackling things that are unimportant…" The results of research and monitoring conducted in different field units need "to be collected into a single database" where they can be accessed by others and projects can be assessed.

More Research and Monitoring Required

Sixteen respondents felt that more fire research and monitoring are needed. "There is a lot of good information, but not anywhere near as much as there should be in general or from the stuff we started." Several respondents noted that there were missed opportunities for post-fire research and monitoring with the Mount Shanks fire in 2001 and the fires in Kootenay National Park in 2003. Post-fire monitoring of prescribed burns is also lacking. This was perceived to be an issue because without adequate research and monitoring it is difficult to set clear ecological objectives and determine whether those objectives have been achieved. "It gets back to support, if we can't see the results or consequences of our previous actions, have they achieved our objectives?"

Lack of Resources

Seven respondents attributed limited research and monitoring to a lack of resources and funding. Areas where respondents would like to see more work include:

monitoring, recording and reporting of fire behaviour and fire effects; basic research into the effects of fire on aquatic ecosystems; social science (e.g. public attitudes towards fire, traditional knowledge); and monitoring of interventions (e.g. use of fire retardant). Several respondents noted that research needs to be integrated with other science programs, such as aquatics and wildlife programs, so that it answers broader questions like habitat requirements.

Monitoring

Limited monitoring was also perceived to be a program-wide issue. Monitoring needs to be better integrated into fire programs everywhere. Consistent methodologies and cost-effective techniques to evaluate prescribed burns need to be developed and a more rigorous approach adopted for following these projects over a long period of time. One respondent suggested that not every project need be monitored. If, for example, there are 10 prescribed burns with the same objective, then Parks Canada should "do a good job of monitoring one or two for long enough so that after 10 years we can modify our approach if necessary".

Other Viewpoints

Five respondents noted that there is now a fair amount of information on fire and much more research may not be required. "My perception is that generally speaking we have an excellent knowledge of fire behaviour and the effects of fire on the landscape." Quite a bit of work has already been done "…to develop a scientific basis for restoring fire. I don't think we need to do lots more, but it needs to be focused, applied science". Another comment was that research in the field unit was likely to show that the response of vegetation to fire is similar to that observed in other locations in the Rockies, and that existing models used elsewhere could probably be applied to the field unit.

Some respondents felt that the results of research were not being incorporated into fire management plans or prescribed burn plans. Others questioned to what extent research was contributing to policy development and active management, or whether it is in some cases "purely an academic exercise". Research topics should be chosen based on

whether they can help to set goals for fire management. "People need to understand how it fits in with the park management plan and helps with management because there is the perception that projects happen ad hoc, it gets back to support."

Quality of Research

In terms of the research and monitoring that is taking place, only seven respondents were able to comment on the quality of the information being generated. However, their overall impression was good. "I am confident it is good science…I think it is generally of very high quality". One respondent expressed concern that scientific rigour may sometimes be lacking.

Other issues identified include:

- The length of time required to determine whether management interventions are having an impact or to understand ecosystem patterns.
- Parks Canada employees may not be the best people to carry out scientific research. They should engage specialists from universities or other government organizations to do this work and concentrate instead on identifying research needs, managing the projects and applying "the results of research and monitoring to the land base".

5.2.7 Interagency Coordination

Compared to research and monitoring, fewer respondents were "somewhat familiar" with interagency coordination. More respondents fell into categories at either end of the spectrum (see Figure 5.9). Only two respondents rated themselves as "very familiar" with interagency initiatives related to fire in the field unit. Ten fell into the category between "somewhat familiar" and "very familiar". Fifteen respondents rated themselves as less than "somewhat familiar" with interagency coordination.

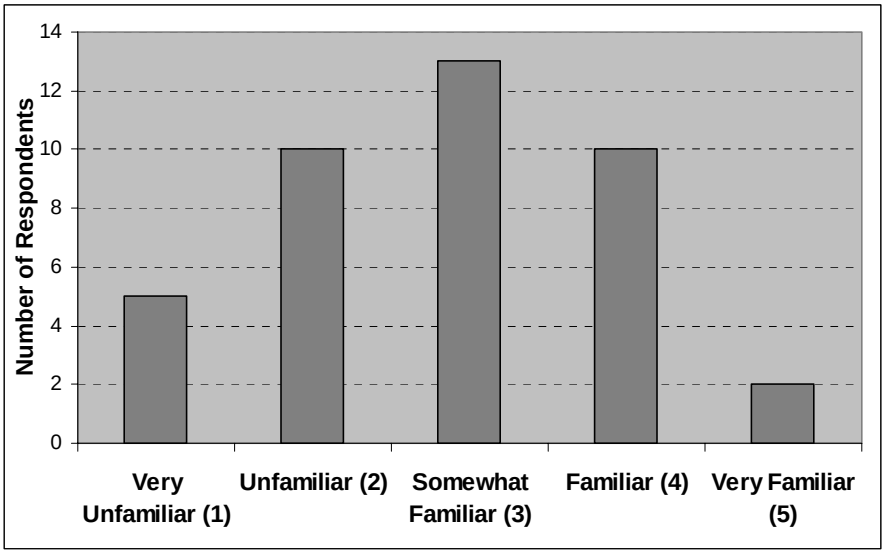

Figure 5.9 Respondent rating of familiarity with interagency initiatives

A Kruskal-Wallis test showed that there was a significant difference in familiarity by position. Field unit fire management staff were most familiar with interagency work, followed by fire management staff outside the field unit, and then specialists and managers (see Table 5.8). According to the results of Mann-Whitney U tests, there was no significant difference between field unit and other fire management staff. However specialists and managers scored significantly lower than field unit fire management staff, and specialists scored significantly lower than other fire management staff (see Appendix D for p-values). Managers also scored significantly lower than other fire management staff at the 0.10 confidence level. Managers were more often less than "somewhat familiar" with interagency initiatives; specialists were more likely to report that they were "somewhat familiar".

Other fire management staff probably scored relatively high in this category because interagency work is a significant part of positions at the regional and national levels. As well, fire management staff in neighbouring field units stay abreast of interprovincial developments elsewhere that might be of interest. There appears to be room to improve the profile of interagency work among specialists and the management team.

Table 5.8 Median familiarity with interagency coordination by position

Position	Median
Field unit fire management staff	4.00
Other fire management staff	3.50
Specialists	3.00
Managers	1.75

Some differences were also found by task, which mimicked the pattern observed with fire management plan familiarity. Mann-Whitney U tests revealed that respondents who participate in fire operations, plan and implement fire management initiatives, develop policy and approve fire management initiatives or policy were significantly more familiar with interagency work than those who reported no involvement with these tasks (see Appendix D for p-values).

There was a strong positive correlation between familiarity with interagency coordination, familiarity with the fire management plan and the science program (as demonstrated by Spearman's test of correlation). Respondents who were more familiar with the plan and with research and monitoring, were also more familiar with interagency activities.

Value of Interagency Coordination

Eighteen respondents expressed generally positive opinions about the interagency work that has been carried out over the last 5 years. It is "very good, they are off on the right foot – it is just a matter of building those relationships." "We have done good work here and we have a whole bunch more going on." This is an area where there has been improvement over the past ten to twenty years and, at least in crisis situations, interagency cooperation is becoming the norm. "It is increasingly worthwhile… I am increasingly optimistic that we have had diminishing hostility to our actions and much more collaboration". As with research and monitoring, some people commented that the results of interagency initiatives were probably not being sufficiently communicated internally.

Currently, interagency work tends to be sporadic and although connections are being made at lower levels, senior managers in the field unit may not be as familiar with

their provincial counterparts. More regular coordination is needed, although respondents recognized that interagency coordination can be time-consuming for both parties and a bigger commitment to resourcing might be required.

Relationship with British Columbia

The relationship with the province of British Columbia (BC) was generally perceived to be better than the relationship with Alberta. "BC is much more proactive than Alberta, so it is easier to integrate into the program." Fire management personnel tend to work more closely with their counterparts in BC because there are more natural ignitions on that side of the field unit, which has helped to build working relationships. There have however been challenges in BC, due to recent cutbacks at the provincial level, differing land use objectives and the lack of an "integrated fire management system on provincial lands". A few respondents were hopeful that this would change with the Filmon report, which recommends practices supported by Parks Canada, such as prescribed burning. Some respondents saw this as a real opportunity to share Parks Canada's expertise with the BC Forest Service.

Five respondents held up the Redstreak project as an excellent example of interagency work – a "model…we should be celebrating". With the involvement of the local community and provincial agencies, this project integrated different field unit programs like wildlife and fire and vegetation to restore an open Douglas Fir habitat type that is limited in the Columbia Valley and improve winter range for Bighorn Sheep. There is potential for Parks Canada to build on the success of this project, for example by soliciting provincial expertise and capacity to help with ecological monitoring.

The Simpson River prescribed burn was another success story. The prescribed burn plan was approved by both the province and Parks Canada and there were joint communications. However, two respondents wanted to see more interagency agreements for boundary areas, such as for the Beaverfoot and Blaeberry valleys. These agreements should focus on how wildfires will be managed in those areas and where strategic prescribed burns might be implemented to limit the risk to provincial lands. Making

these areas a priority for prescribed burning "will give us more flexibility to do burns within the park".

Relationship with Alberta

Only five respondents talked about the relationship with Alberta, compared to eleven who talked about BC. Little concrete work on a joint fire management plan for the North Saskatchewan drainage has been carried out because it was not a high priority for either agency. Nonetheless, "it is all a good investment, because if we have another meeting we know one another". On a more positive note, "a tremendous amount of work has been done since mountain pine beetle popped up – it has been good, the province has been totally engaged". Another perspective was that "mountain pine beetle concerns are driving much of our fire program" on the Alberta side of the field unit. Alberta's move to hire a prescribed burn coordinator this year was seen as a positive step by two respondents.

Canadian Interagency Forest Fire Centre

The benefits of interagency work at the national level were mentioned by four people. It was felt that the Parks Canada's reputation within the Canadian Interagency Forest Fire Centre (CIFFC) was good, particularly in terms of the "ability to reintroduce fire onto the landscape in a managed fashion", although Parks Canada may "get little-brothered [treated like a less important agency] a little bit because they know we don't have resources". The use of similar training and fire management protocols by CIFFC members was also believed to foster understanding among different agencies.

Several respondents talked more generally about the benefits of interagency coordination. For example, they pointed out that Parks Canada cannot work in isolation on landscape scale issues and that the provinces have a much larger land base and consequently audience. Cooperation on fire management issues was seen as a potential way to open the door to cooperation on other ecological issues, such as carnivore management.

5.2.8 National Performance

When asked how Parks Canada was performing in fire management at the national level, the majority of respondents gave the agency a "good" rating. Once again, many respondents provided insight into their rating. Several respondents compared Parks Canada to other fire management agencies. Some felt Parks Canada rates well compared to other agencies. Others felt that the agency lacks "a unified direction at the national level" compared to other agencies, and therefore "consistency at the field unit level." "Stronger standard operating procedures are needed."

Two respondents rated Parks Canada as only "fair" in achieving its mandate and goals, but compared to other agencies it rates "good" to "excellent". Other respondents framed their rating in terms of overall resourcing and the size of the program - the program is "fair to good, but given what's available for resources, it rates good to excellent". Two respondents felt that Parks Canada is a leader in prescribed burning, and has an important role to play in demonstrating how fire can be reintegrated into landscape management.

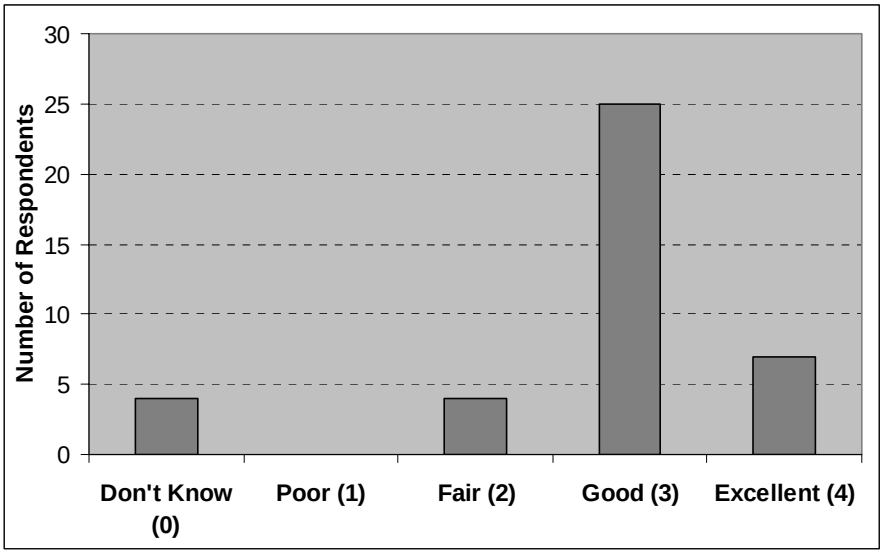

Figure 5.10 Respondent rating of Parks Canada's performance in fire management

Mann-Whitney U tests showed that there was a statistically significant difference between the rating given by field unit fire management staff and by managers (see

Appendix D for p-values). Managers gave good or excellent scores to the national fire management program more readily than field unit fire management staff. There was no significant difference between any of the other groups, although at the 0.10 significance level, managers also gave significantly higher scores than other fire management staff. Since fire management staff are likely more familiar with the state of fire management across the country, perhaps they are more realistic or critical in rating the program than managers.

Figure 5.11 Manager rating of national performance in fire management

Figure 5.12 Field unit fire management staff rating of national performance in fire management

Mann-Whitney U tests showed that respondents who were involved in planning fire management initiatives rated the national performance slightly lower than other respondents, although the median values were the same (4.0). Those who participated in fire operations also rated national performance lower than other staff, although this was only significant at the 0.10 confidence level. This is similar to the finding for fire control, which indicates that respondents that are most directly involved in these activities have a slightly more pessimistic view of performance than those who are at arm's length.

Negative correlations between familiarity with the fire management plan and the amount of prescribed burning required, and with the rating given to national fire management performance were found using Spearman's test of correlation. Respondents

who were less familiar with the contents of the fire management plan or who thought less prescribed burning was required, tended to rate national performance more highly. In contrast, there was a strong positive correlation between these respondents' rating of fire control and national performance.

Comparing the LLYK Field Unit to other Field Units

Three quarters of respondents commented on how the LLYK Field Unit's fire management program compares to fire management programs in other field units. Comparisons were most often made to the Banff and Jasper fire management programs, which are located in adjacent field units of similar size, environment and issues.

Nine respondents felt that either the LLYK Field Unit compared favourably to other field units or that all field units were more or less equal when it came to fire management. Three respondents felt that the field unit, along with Banff and Jasper, was among the top three field units in terms of fire management.

Eight respondents felt that the field unit was a little behind other field units in terms of implementation. The reorganization of national parks into field units in the mid-nineties resulted in a relatively new program compared to other parks. Past personnel in the fire management program may have been more interested in fire suppression than fire use. The situation in the field unit is quite complex (with two townsites and many outlying facilities).

Other points raised by respondents:

- LLYK Field Unit fire management personnel have been more cautious in implementing prescribed burning than other field units, particularly Banff and Jasper (this was viewed positively).
- Even within the field unit, there are differences in implementation, with the Kootenay part of the field unit ahead of Yoho and Lake Louise.
- It can be difficult to compare field units because they often have different fire regimes, approaches to fire management and physical constraints (i.e. some parks have a lot of facilities and others do not).

- From a communications perspective, communications have improved over the past few years, and the mountain parks are all doing a good job. The field unit could learn from Jasper and Banff experience, but is well-positioned in terms of resourcing to deal with large fire events.

The mix of opinions suggests that the field unit has some distance to go in bringing its program up to the level that exists in other field units, particularly Banff and Jasper, which are field units with comparable budgets.

5.3 Support for Fire Management

The purpose of the following set of questions was to assess the level of agreement on ceratin fundamental principles on which the fire management program is based. Significant differences between respondents with respect to certain statements might indicate a lack of support for some elements of the fire management plan or program. For example, if respondents disagreed that "fire suppression has resulted in a reduction in area burned by wildfires", they might not see any merit in reintroducing fire through management-ignited prescribed burning.

Kruskal-Wallis tests were used to test for differences in the degree of agreement by statement among respondents and for differences in overall agreement with the five statements. Surprisingly there was only one significant difference among respondents in the degree of agreement with these statements (see Aboriginal Burning), however there were significant differences in overall agreement with different statements. Mann-Whitney U tests were used to determine how the level of agreement differed from statement to statement (see Appendix D for p-values).

Fire Creates a Mosaic of Vegetation Types

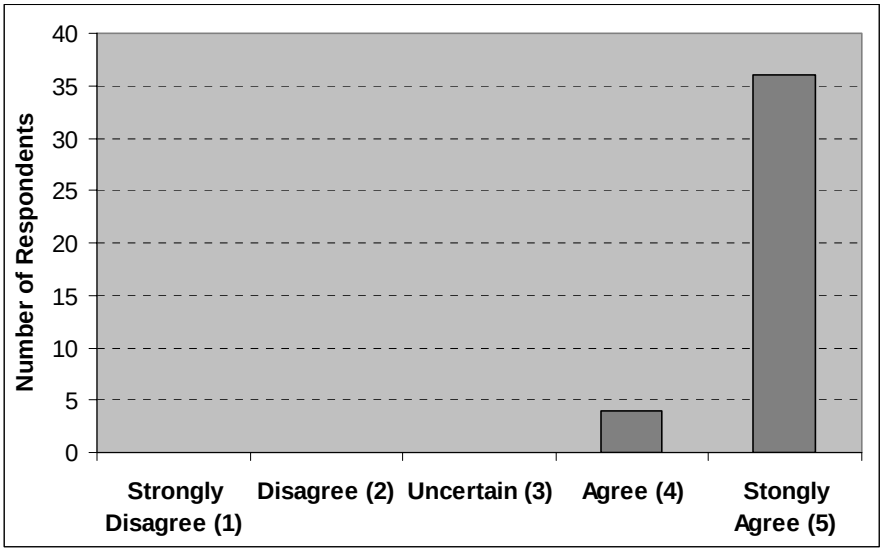

Figure 5.13 Respondent rating of agreement with the statement: Fire creates a mosaic of vegetation types that provides habitat for a variety of animals

Respondents agreed very strongly that fire creates a mosaic of vegetation types that provides habitat for a variety of animals. Agreement with this statement was significantly stronger than agreement with the next four statements.

Fire Suppression

The statement with the next highest level of agreement was that fire suppression has resulted in a reduction in area burned by wildfires. There was no significant difference between the level of agreement with this statement and the statement that frequent low to moderate intensity fires have played an important role in shaping park ecosystem. However there was significantly more support for this concept, than for the idea that infrequent high intensity fires have shaped the subalpine and that aboriginal burning played an important role in some areas of the field unit.

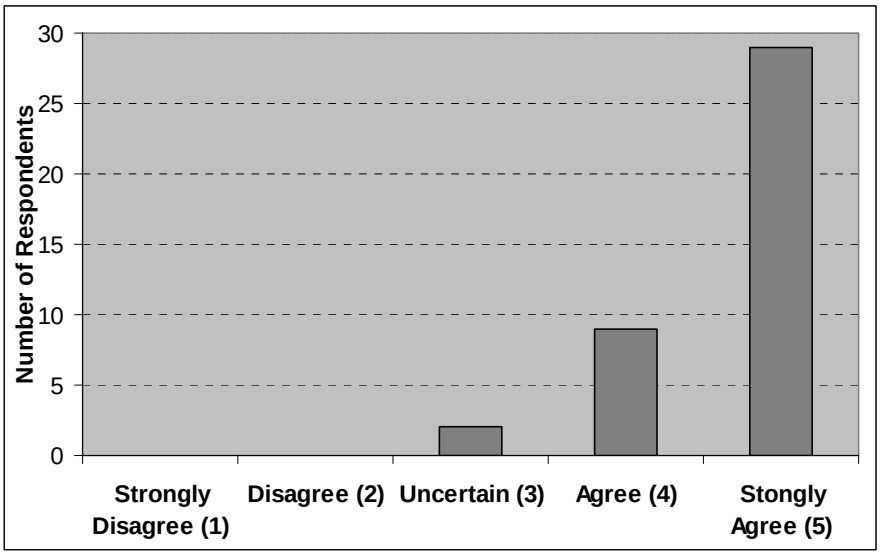

Figure 5.14 Respondent rating of agreement with the statement: Fire suppression has resulted in a reduction in area burned by wildfires

Fire in Montane Ecosystems

Thirty-seven people agreed or strongly agreed with the statement that frequent low to moderate intensity fires played an important role in shaping montane ecosystems. A few disagreed or strongly disagreed with this statement - some may have viewed it as

too simplistic, since high intensity stand replacing fires play a role in montane areas as well. One respondent remarked "the montane explanation is too simplified – I think there are other factors other than fire that have played a role, such as drought…"

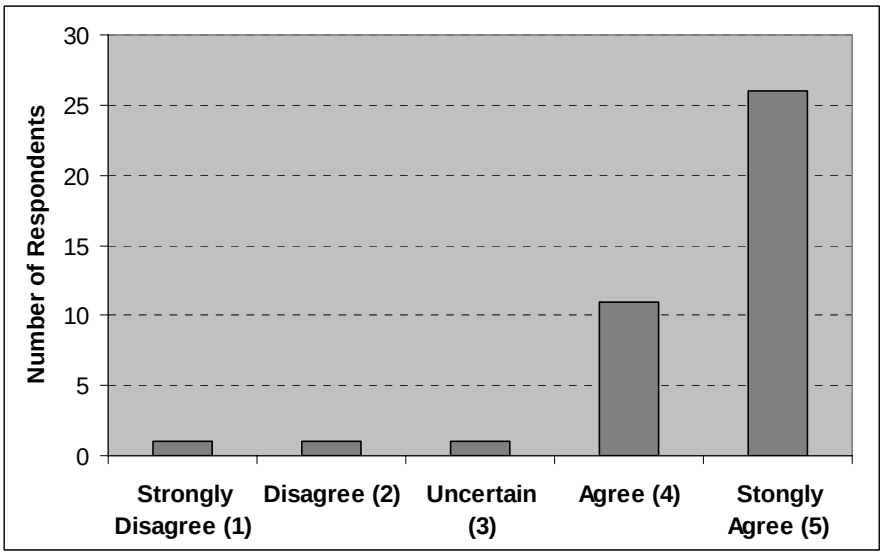

Figure 5.15 Respondents rate their agreement with the statement: Frequent low to moderate intensity fires played an important role in shaping montane ecosystems

Respondents who agreed strongly with this statement were likely to agree strongly with the statement that fire creates a mosaic of habitat types and less strongly with the statement about fire suppression, according to Spearman's test of correlation (see Appendix D for r_s values).

Fire in Subalpine Ecosystems

Thirty-three people agreed or strongly agreed with the statement that infrequent stand replacing fires played an important role in shaping subalpine ecosystems, with another four uncertain and three disagreeing. However, agreement on this topic was not significantly different from agreement about the role of fire in shaping montane ecosystems. Again, some respondents may have disagreed with this statement because they do not believe that stand replacing fires are all that infrequent, or they believe that moderate to low intensity fires also play a role in the subalpine.

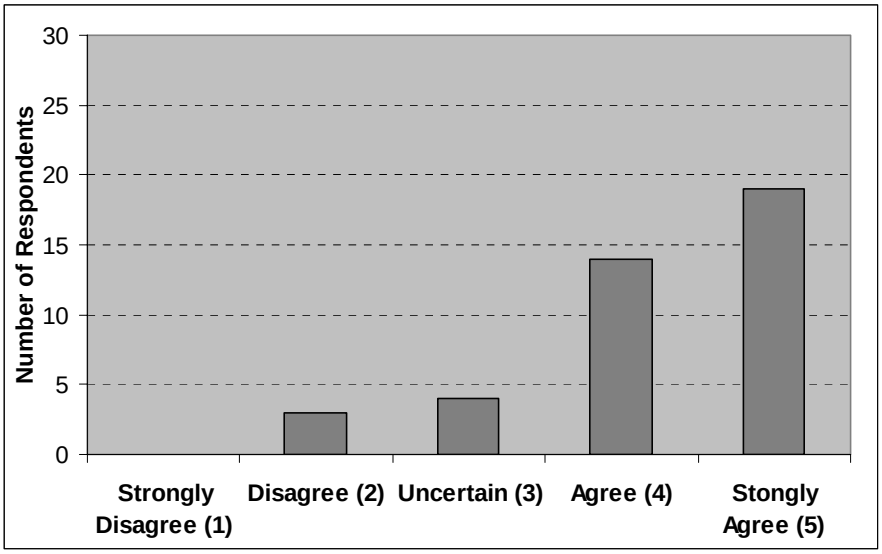

Figure 5.16 Respondents rate their agreement with the statement: Infrequent stand replacing fires played an important role in shaping subalpine ecosystems

Spearman's test of correlation demonstrated a very strong positive correlation between agreement with this statement and agreement with the previous (frequent fire in the montane ecoregion) statement.

Aboriginal Burning

The statement for which there was the least amount of agreement was the effect of aboriginal burning on the landscape. Eleven respondents were uncertain about the role of aboriginal fire in the field unit. There was significantly less agreement with this statement, than with all other statements, except "infrequent stand replacing fires played an important role in shaping subalpine ecosystems". Some respondents felt that aboriginal burning may have been important in some areas of the field unit but not in others. Twenty-seven respondents still agreed or strongly agreed that aboriginal fire played an important role in the field unit prior to park establishment.

There was a very strong positive correlation between agreement with this statement and agreement with the montane statement and, to a lesser degree, the suppression statement (using Spearman's test of correlation).

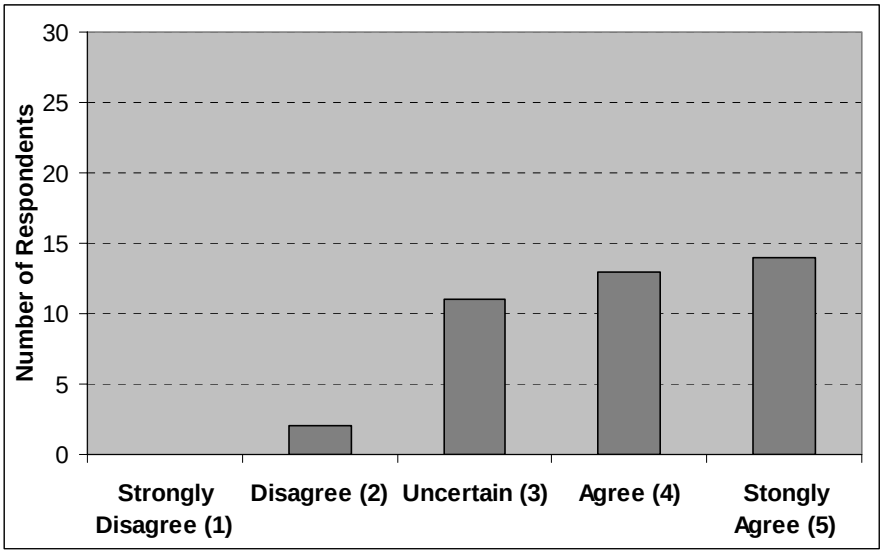

Figure 5.17 Respondents rate their agreement with the statement: Aboriginal fire played an important role in shaping the landscape prior to park establishment

A Mann-Whitney U test demonstrated a significant difference in how respondents responsible for fire management policy development rated this question. They agreed more strongly with this concept (Median = 4) than respondents who were not responsible for policy development (Median = 5).

In conclusion, there was a great deal of consistency among field unit staff and other fire management staff in terms of agreement with these five concepts. There was no disagreement about the ecological role of fire or the influence of modern day fire fighting techniques on fire occurrence, but there was slightly less agreement about what kind of fire regime is at work in the field unit and the historic role of aboriginal people. These findings indicate that there is a good foundation from which to advance the objectives of the fire management program.

5.3.1 Fire Management Goals

The next set of questions assesses the level of agreement with two main goals of the 1998 fire management plan. In general, there was strong agreement with the goals. However, a Mann-Whitney U test showed significantly greater agreement with the goal

that relates to ecological integrity, than the goal that relates to the protection of life and other values (see Appendix D for p-values).

Some respondents commented that the goals appear to conflict because the need to protect values may preclude that ability to allow fire to play an ecological role. Others pointed out that the goals do not conflict because public safety and the protection of values-at-risk need to be guaranteed before the ecological integrity goal can be pursued. Other comments were that aspects of the goals are vague ("as closely as possible to what?") and that there should be more goals related to other parts of the Parks Canada mandate, such as appropriate visitor opportunities, heritage presentation and cultural resources.

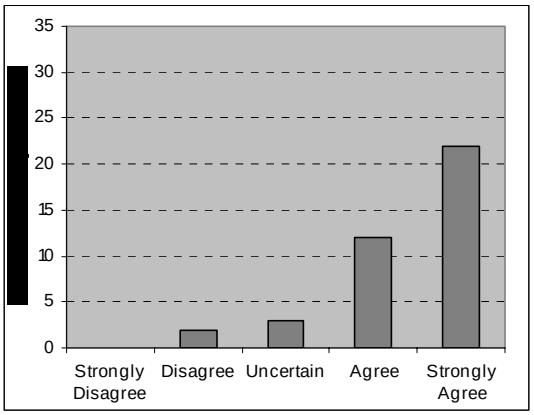

Figure 5.18 Respondent rating of agreement with Goal A (protection of life, property and natural resources on park and adjacent lands by suppression of wildfire, while minimizing the environmental effects of suppression activities)

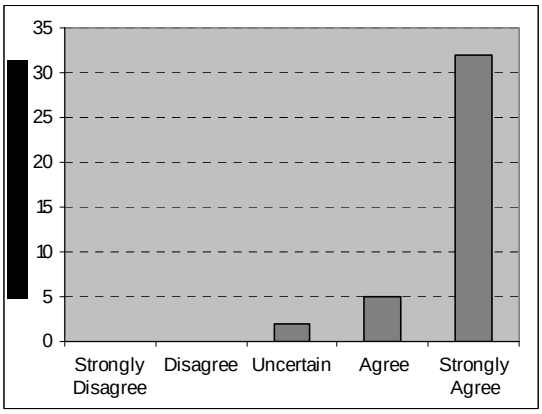

Figure 5.19 Respondent rating of agreement agreement with Goal B (to maintain or restore, as closely as possible, the role of fire within park ecosystems)

There was a positive correlation between agreement with the Goal A (the protection goal), the rating given to fire control ability and the need for more fuel management (see Appendix D for r_s values). There was also a very strong positive correlation between agreement with the statement that fire suppression has limited the area burned in recent times and agreement with the protection goal. It is not surprising that respondents who agree strongly with the goal to protect life and property would also perceive a greater need for fuel management. However, the relationship between the

protection goal and agreement with the fire suppression statement and the rating of the ability to manage wildfire is not as clear.

5.3.2 Role of Fire in the Field Unit

Respondents were asked to comment on the role they thought fire should play in the field unit. Responses ranged from relatively simple or short comments on the ecological importance of fire to much more detailed and complex descriptions of fire's role in a national park setting. Given the potential complexity and wide-ranging nature of comments in response to this question, it should probably have been worded differently or split into several different questions, in order to be of value in comparing attitudes towards fire management. Appendix E contains three of the most detailed responses to this question. These illustrate slightly different philosophical views about the role of fire.

About half of the respondents talked primarily about the ecological role of fire. Some respondents spoke more generally about the role of fire in maintaining or restoring ecological integrity. Others provided specific examples, such as "maintaining a diversity of vegetation types and different successional stages", forest health and wildlife management. Eleven respondents saw two roles for fire: in addition to its ecological role, fire has a role to play in protecting communities and facilities (e.g. through landscape level fuelbreaks, or reducing the potential for catastrophic fires). This is an interesting view because it indicates that park staff attach a social value to fire use distinct from its ecological value. This may be an important selling point with the public.

Twenty respondents related the role that fire should play to its "historic" or "natural" role (e.g. "fire should be introduced or allowed to happen at as close to natural levels as possible" and "we should be bringing back a fire regime so that historical fire patterns are duplicated"). Several respondents took into account the range of variability that existed historically (e.g. "it should play some significant proportion of the role it played historically, prehistorically or over the long term – it should still be shaping field unit ecosystems" and "I think the only answer is it needs to play the role it once did - there is a range of variability, but it needs to be within the range it has shown since the ice left.").

Several respondents remarked that fire should play an important role or a bigger role than it does presently. A few respondents wanted to see fires allowed to burn as they would under natural conditions. Thirteen respondents pointed out that there were constraints in terms of the role fire can be allowed to play. Their position was that, due to human development and other values on the landscape, fire must be managed and may not be allowed to play its former role or only in certain areas (e.g. areas where there are low to medium values-at-risk, more remote backcountry areas).

Other points raised by respondents:

- Fire has a role to play in educating the public (e.g. "national parks have a unique opportunity to show that fire has very positive impacts on the landscape under the right conditions and in the right places, because people find the whole concept of fires destructive and scary").
- The LLYK Field Unit offers perhaps the best opportunity in Western Canada to understand fire's natural role on the landscape.
- A mixed approach to fire should be used, starting with prescribed burns and then graduating to managed or monitored wildfires as the program progresses.
- Uncertainty over the historic range of variability makes it difficult to determine what role fire should play.

5.3.3 Role of Random Ignitions

The majority of respondents felt that random ignitions should play some role in the fire management program. Only two respondents argued that there was not "enough room or space for random ignitions" and that there was "too much potential for things to go wrong".

Eleven respondents felt that random ignitions should play a large or important role in the fire management program. Out of these eleven, three respondents felt that they should make a significant contribution to the total area burned. An additional six respondents specified that random ignitions should play a greater role than they do presently.

Table 5.9 Respondent opinions of the role that random ignitions should play in the fire management program

Theme	**Number of Respondents**
They should play a significant role	17
They should play a role	10
They should or will play a limited role	7
More work is needed before random ignitions can play a larger role	5
They should not play a role	2

Ten respondents agreed in concept with random ignitions, stating that it should simply be "part of the program" or "the present role is fine".

Seven respondents foresaw random ignitions playing a limited role in the fire management program. "There is a role but it is going to be small given the nature of the field unit" and Parks Canada will probably have to rely more heavily on management-ignited prescribed burning. Two people remarked that it was a "nice idea", but that given the current political context, random ignitions are unlikely to play a large role, because they will not be allowed to burn.

Five respondents felt that more work (e.g. communications with the public about random ignitions) was needed before a random ignition program could be implemented. They believed that in the future there would be a role for random ignitions in the fire management program and that the role could be an important one.

Nineteen respondents qualified their support for random ignitions by proposing conditions that need to be satisfied before random ignitions can be allowed to play out on the landscape. Chief among these conditions were that containment strategies be in place in advance of any fires (e.g. capping units, good anchors identified, firebreaks, community and facility protection). Other considerations included location, zoning, adequate resources, the regional situation, management and fire management team experience, prescription and whether the fire would meet the objectives of the program.

Other points raised by respondents included:

- the terminology used for this type of fire (i.e. prescribed random ignitions) needs to reviewed, because it is confusing.

- the use of random ignitions is justified because: allowing these fires to burn is consistent with a policy to minimize interference to natural processes; it is a cost effective way to manage fires; fire crews can develop the skills needed to manage larger fires; and they may have important ecological benefits that cannot be replicated through management-ignited prescribed burning.
- several respondents challenged supporters of random ignitions to actually "go out and light the fire" if they feel that it is desirable and safe enough to have a fire in a particular area.

5.4 Factors Influencing Program Implementation

In order to gain more insight into the reasons for program successes and shortcomings, respondents were asked to describe factors helping or hindering various activities. To begin with respondents were asked to list the top three factors constraining the role of fire on the landscape. Five factors were identified most frequently as constraining the maintenance or restoration of fire as a process on the landscape. The three factors most frequently cited by respondents were quite similar to the main challenges facing the program (Section 5.2): public perception and acceptance of fire; internal support for fire management; and the availability of resources or capacity to carry out program activities.

Table 5.10 Factors constraining the role fire should play in the field unit

Theme	**Number of Respondents**
Public Perception / Acceptance	29
Internal Support	20
Availability of Resources	20
Direct Impacts of Fire	20
Indirect Impacts	16
Other (e.g. precedents/credibility, weather, neighbours, fuel loads, knowledge, process)	11

The actual risk that fire poses to public safety and built assets within the field unit or on neighbouring lands was another significant factor mentioned by respondents. Sixteen respondents cited indirect impacts of fire, such as the impacts of smoke on communities, tourism, the local economy and transportation corridors or the impacts of fire on ecological values and aesthetics. Among these indirect impacts, the effects of smoke seemed to be the most important (cited by thirteen people).

Other factors that were perceived to limit the role fire can play include:

- past experience with escaped fires within Parks Canada, which has an impact on the credibility of the organization;
- weather – getting the right conditions for prescribed burning;
- different policies in neighbouring jurisdictions;

- the amount of fuel build up in the field unit;
- competition between field units (e.g. for limited resources);
- jumping all the hoops in the planning process; and
- limits to knowledge about the role of fire.

5.4.1 Fire Control

Next, respondents were asked to describe factors that were facilitating and limiting the implementation of a number of activities: fire control, random ignitions, management-ignited prescribed burning and fuel management.

Table 5.11 Factors facilitating and hindering fire control

Theme	**Number of Respondents**
Factors Facilitating Fire Control	
Capable Personnel	23
Availability of Resources	20
General Preparedness	18
Public Perception	14
National Program	11
Initial Attack	9
Interagency Coordination	6
Management Support	5
Other (geography, communications, weather)	5
Factors Hindering Fire Control	
Availability of Resources	14
General Preparedness	11
Few Limits to Fire Control	10
Cooperation Between Field Units	6
Geography	4
Public Perception	4
Values-at-Risk	3
Communications	3
Other (management involvement, weather data, terrain, experience, fuel loads)	6

Capable Personnel

Twenty-three respondents identified capable personnel as an important factor facilitating fire control in the field unit. Although respondents mentioned fire management staff most often, other field unit staff also received considerable recognition. Qualities that enable personnel to manage fires successfully include experience, knowledge and training. Four respondents commented that this experience, which has been gained in a variety of areas from frontline fire fighting to work on incident command teams, can be attributed to the recent occurrence of several large fires within the field unit and to the export of staff to work on fires outside the field unit. Fire management staff have a strong understanding of fire behaviour and good local knowledge.

Few Limits to Fire Control

Ten respondents remarked that there seems to be little that is hindering fire control in the field unit, although some qualified this comment by adding that there may be some limits due to environmental conditions (e.g. weather) or the regional situation (e.g. multiple fires in other parks or on provincial lands affecting the availability of resources). None of these respondents were fire management staff. Three were managers and seven were specialists.

Availability of Resources

Twenty people highlighted the good availability of resources, including funding, manpower, equipment and aircraft, as factors enhancing the fire control capability. Chief among these points was the "open-ended budget for dealing with fires when they do occur", followed by the availability of dedicated fire management personnel. The availability of non-dedicated personnel in the field unit who are willing to leave their regular positions to assist with fire operations or take on supporting roles was also viewed as critical to the suppression effort.

Many respondents related the availability of resources to the national network for fire management. Access to personnel, expertise and resources beyond the field unit was

seen as facilitating fire control. The "resourcing scheme…doesn't come from the field unit". The network can be activated quickly and there is "excellent cooperation and coordination across the program, so that you can bring experienced staff into those situations".

Fourteen respondents expressed a different view of resourcing. One respondent pointed out that although staff are "capable of dealing with the day of the fire", they find it difficult to catch up in the days or months following the fire. Lack of funding makes it difficult to hire sufficient personnel at the beginning of the season and keep them on strength. Nine respondents felt that manpower in the field unit was insufficient and five pointed in particular to the initial attack crew. With the creation of the field unit, the number of initial attack crews was reduced. An additional initial attack crew would improve coverage of a large geographic area. In addition to limited manpower at the field unit level, the national program would benefit from more dedicated fire management personnel (in regional offices and the national office). One respondent also foresaw a challenge in future years to maintain the "depth of the current program" as the warden service shrinks, because "it takes years and years to build up the expertise".

Preparedness

Eighteen respondents touched on aspects of preparations in advance of fire occurrence that are facilitating fire control. Five respondents noted that good plans are in place. Four felt that policies and processes are well understood and consistent with the practices of other fire management agencies. A well-established organizational structure ensures that "someone is there to take the call and make a decision", and yet it is flexible enough to adapt to different situations. The use of technology to forecast weather, compile indices and then "ramp up in resources" or "man up" in accordance with the change in fire danger was mentioned by seven respondents.

Early lightning detection was another aspect of preparedness thought to improve fire control ability. Three respondents mentioned that the high level of development on the landscape and large number of visitors to the park results in many "eyes and ears" to

help with fire detection. The lightning detection system was also mentioned, as was a centralized dispatch service that relays fire reports to initial attack crews.

Eleven people felt that preparedness is an area where more work is needed, especially when it comes to risk abatement. Whereas only one person suggested that risk abatement (e.g. the proactive use of thinning and prescribed burning to protect facilities) was assisting with fire control, six respondents felt that risk abatement is an area where the field unit is falling short. The field unit is characterized by a fairly unbroken fuel mosaic, and fire control "would be easier if there were more prescribed burns and facility protection" and if structures were constructed so that they are less fire prone.

Parks Canada tends "to move on from one crisis to the next" and there is either an unwillingness or lack of time needed to think ahead or take steps to mitigate the risk. One respondent noted that the way fires are financed (small budgets until the day of the fire, followed by unlimited spending until the fire is out) does not contribute to good preparedness.

Gaps in policy can result in less effective fire control. Such gaps include: an outdated national fire management directive; lack of direction on environmental management during fire operations; and policies that do not support the use of some techniques (e.g. heavy equipment such as caterpillars).

Although four respondents felt that good training of fire personnel was facilitating fire control, two respondents suggested there was not enough training. One respondent remarked that although initial attack crew training was adequate, wardens and the trail crew needed more time to familiarize themselves with fire fighting equipment and that this training would help to build support for the fire management program.

Public Perception

Although public perception and acceptance was the most important factor constraining the role that fire is allowed to play in the field unit, fourteen respondents felt that it tended to facilitate fire control. There is a "strong desire by the public that we be capable of suppressing wildfires because of values-at-risk". Fire control is an accepted practice, because there is an "historical commitment" to it and it is a "traditional warden

service activity". Three respondents mentioned that the awareness of the consequences of uncontrolled fire has been heightened by the events of the summer of 2003. Only four respondents felt that public perception might limit fire control.

Other factors that facilitate fire control include:

- good initial attack capability and the use of well-known and accepted fire suppression techniques,
- the ability to draw on resources from other agencies,
- management support for fire control,
- favourable weather over the past 20 years,
- good communications in most of the field unit,
- geography – most of the field unit is fairly wet.

Other factors that constrain fire control include:

- lack of cooperation or coordination among different field units, particularly with respect to the Banff field unit. "Cooperation from other field units could be stronger … if they have time and resources to direct at our fire…they should be integrated.";
- values that require protection, such as facilities and communities, and less tangible values impacted by smoke, such as tourism;
- misallocation or poor prioritization of resources by management (this may be due to a lack of understanding of initial attack capabilities);
- the size of the field unit and layout, which impacts initial attack crew response times, communications and logistics;
- the lack of phone lines in some areas of the field unit combined with a radio system that does not operate effectively throughout the field unit make it difficult to send and receive information;
- terrain;
- unreliable weather;
- lack of experience in large campaigns; and
- large fuel loads.

5.4.2 Random Ignitions

Respondents were not asked to comment on factors facilitating the implementation of random ignitions, because the direction in the fire management plan for random ignitions has not been implemented to date.

Table 5.12 Factors hindering random ignitions

Theme (Factors Hindering Random Ignitions)	**Number of Respondents**
Public Perception	20
Risk to Tangible Values	18
Internal Support	18
Timing	6
Adjacent lands	6
Prescriptions	5
Communications	5
Zoning	3
Resource Availability	3
Other (knowledge/experience, planning, weather, policy)	7

Public Perception

Twenty-two respondents felt that limited social acceptance of fire was restricting the potential implementation of random ignitions. One respondent commented that this is a complicated issue that is perhaps more difficult for the public to understand than management-ignited prescribed burning. Eight people suggested that perceived risk was another reason for poor public support. There is the "perception of lots of risk with this approach" and the "fear of escaped fires" makes it a less acceptable activity. Other respondents suggested that people may not understand what a random ignition is or the "implications of not getting more fire onto the landscape". One respondent remarked that in some quarters there is "a very entrenched perception that we are ruining parks for people who come here to use them". Issues like the impacts of fire and smoke on tourism and public safety and their relationship "to the public's opinion of Parks Canada" need to be weighed carefully.

Indeed, seven respondents talked specifically about the impacts of smoke – the fact that the field unit is upwind of two major tourism destinations, Banff and Canmore, and the impacts of smoke on transportation corridors. Impacts on businesses and tourism result in pressure being brought to bear on Parks Canada by stakeholders and politicians.

Internal Support

A lack of internal support was identified as a factor hindering implementation by eighteen respondents. Again the perception of risk and willingness to accept this risk was a key theme. There is "a lack of confidence to make that appropriate decision at the appropriate time". Although one respondent remarked that "even fire personnel know that it is risky and they are not fully bought into it", respondents assigned concerns about risk more frequently to senior management in the field unit and above. "From a management perspective there is an uncertainty factor that might cause some hesitation". This was attributed to various factors including: the complexity of random ignition issue; a lack of understanding of the need for random ignitions; lack of confidence in the zoning program or the ability to control fire; and outside pressure from management outside the field unit or stakeholders. One respondent pointed out that a "lack of awareness of the overall program" may be an issue.

Actual Risk

Actual risk was another issue pinpointed by nineteen people. "There is more risk associated with random ignitions and is it warranted?" The risk to tangible values, such as roads, towns, outlying facilities and public safety, constrains the ability to allow random ignitions to burn in many areas of the field unit. One respondent noted that fire crews are limited by the absence of information pinpointing the values-at-risk that need to be protected in a particular area. This "still involves someone running up to us and telling us there is an old cabin up there". Nine respondents reported that the substantive risk was related to the lack of capping units, firebreaks and community and facility protection. "Once we get capping units in place we will be able to take better advantage of random ignitions."

The risk to built assets or public safety was discussed more often by fire management personnel and, in particular by those personnel outside the field unit, than by specialists and managers. Specialists and managers may not have as much knowledge of the limitations of fire control (as indicated by the fact that ten of these respondents saw no limits to fire control) and are therefore less aware of the actual risks associated with random ignitions.

Timing

The timing of random ignitions was also a significant factor limiting the implementation of a "let burn policy". Most random ignitions tend to occur in July and August, during the peak tourism season, which can exacerbate social and economic impacts. This is also the period when fire crews are at their busiest, and when the fire hazard may already be too high to assume any additional risks. The length of the fire season was also perceived to be an issue. If an ignition occurs in June, "it is a long time between then and the end of the season".

Transboundary Issues

Transboundary issues were described by six respondents as putting limits on random ignitions. Provincial fire management policies may differ from those of the field unit and, if a forest is slated for harvesting, a fire can cost millions of dollars. There are "not many valleys where fire won't threaten …adjacent lands" and "agreements with neighbours [about what to do in the case of an escaped wildfire] are not in place".

Communications

Five respondents talked about various facets of the communications effort that would be required to implement a successful program of random ignitions. One respondent noted that a significant effort is required to communicate to the public about management-ignited burning and that this lead time is lacking with random ignitions, which makes communication on this topic even more challenging. Given the complexity of this issue, much more communication will be required before a random ignition

program can be implemented. Additionally, the nomenclature or terminology used to describe random ignitions can be confusing or unfamiliar to the public. Parks Canada is perceived to be "ducking responsibility", when a prescribed burn that escapes a containment area is called a wildfire.

Zoning

Some respondents felt that the zoning for random ignitions needed more work. The zones are too big and do not reflect the risk of a fire escaping the zone. Prescriptions may also need to be refined (either broadened or tightened), given that the desired prescriptions are not being obtained.

Other factors hindering the implementation of random ignitions include:

- resource availability (e.g. cost, regional prioritization);
- a lack of direction on random ignitions at the national level (Parks Canada has made little effort to develop tools to manage random ignitions, and has instead focused on management-ignited burning);
- better advanced planning;
- uncertainty or lack of knowledge in terms of how a strategy like this would function, even among fire management staff;
- differences of opinion and divergent strategies in neighboring field units;
- weather (the right conditions have not yet occurred).

5.4.3 Prescribed Burning

Table 5.13 Factors facilitating and hindering prescribed burning

Theme	Number of Respondents
Factors Facilitating Prescribed Burning	
Staff Initiative and Expertise	19
Public Perception	17
Policy and Planning	11
Availability of Resources	9
Science / Knowledge	8
Internal Support	8
National Support	7
Precedents	7
Mountain Pine Beetle	4
Interagency Collaboration	3
Other (same factors as fire control, geography, backcountry use levels, environmental assessment, weather, communication)	7
Factors Hindering Prescribed Burning	
Availability of Resources	23
Public Perception	20
Internal Support	13
Planning and Approvals Process	10
Weather	5
New program / field unit	4
Communications	4
Monitoring	3
Continuous Fuels	3
Other (human development, knowledge, complexity, interagency policies, size of field unit, public safety, no limits)	10

Staff Initiative and Expertise

Eighteen respondents identified knowledgeable and capable staff within the fire management program as a key factor enabling prescribed burning. Many respondents talked about the expertise, drive and initiative of the people within the fire management program, which has helped to generate more awareness and momentum. Parks Canada has more experience in this area now than in past years and the competency of fire management staff to carry out these projects is increasing.

Availability of Resources

Twenty-two respondents identified limited resources as an issue. There are not enough resources at the field unit level to implement a prescribed burning program, therefore field unit projects are dependent on national funding. Projects are prioritized regionally, so that resources are not stretched too thin. This can lead to competition with other field units to move projects ahead. One respondent remarked that if there are adequate resources for suppression right now, "we need to go a step farther to use the same or more resources for prescribed burning". Wildfires have also been competing for resources recently. One respondent felt that the use of interagency crews could help to carry out prescribed burns. As was the case for fire control, limitations in terms of manpower at the regional and national level were believed to be contributing to limited implementation.

In contrast, seven respondents felt that good resourcing was moving the program along. Without Vote 120, prescribed burning would not be possible. Several respondents also noted that staffing seemed adequate, with "full-time, dedicated staff" in the program and other staff available to assist. Parks Canada has been allocating more resources to prescribed burning in the last few years.

Public Perception

Twenty-one respondents felt that public perception was limiting the implementation of prescribed burning. "A social climate that thinks that wildfire is a bad thing" was cited, and this traditional fear of fire was exacerbated by the fire season of 2003. Values that differ from those of Parks Canada also present a challenge. "It just doesn't seem right for Parks Canada to go out and burn forests". The fact that prescribed burning is "a more complicated thing for people to understand" than fire suppression, has repercussions in terms of the political climate.

Smoke management was the issue that was most often mentioned in relation to public perception. The impacts of smoke on the tourism industry, communities within and downwind of the field unit and the low tolerance of stakeholders for smoke, can make it politically undesirable to carry out large burns.

A general concern among the public over the potential for escaped fires was also noted by several respondents. Prescribed burns that have escaped containment units in other field units have contributed to this concern. Changes in the scenic value of the landscape and their acceptability to park users and the tourism industry, was viewed as another potential issue.

In contrast, sixteen respondents felt that public opinion is changing and the public is becoming more supportive of prescribed burning. People are beginning to realize that "suppression is not the greatest thing we should have been doing" and there is "generally more acceptance from the public and politicians". Some respondents felt that the public's understanding of the ecological role of fire is increasing and some members of the public now support the notion of prescribed burning from an ecological perspective. Others suggested that "communities are more willing to support prescribed burning for fuel management". Six respondents pointed out that the 2003 fire season has raised public awareness and the level of "informed opinion". This may facilitate prescribed burning in some respects where there is increased recognition that prescribed burning can protect facilities or communities from catastrophic fires. However, it could hinder prescribed burning where people have heightened concern with the risks associated with fire. One respondent questioned whether public and political support for prescribed burning extends to ecological reasons for burning.

Internal Support

Opinion about the level of internal support for prescribed burning was also divided. Thirteen respondents noted that a lack of internal support was hindering the implementation of prescribed burning (e.g. there is "limited acceptance by local management" and "there is still a certain hesitation to do prescribed burning"). This was generally attributed to concerns over the potential risks associated with prescribed burns. The desire to avoid out of control fires was occasionally ascribed to fire management staff, but more often to upper management. One respondent remarked that there had perhaps been a lack of communications with the management team about changing national policies or the issues associated with prescribed burning. Lack of internal

support can also manifest itself more discretely, in that there is "broad buy in, but every time we propose something, all the reasons we shouldn't burn come out first".

Seven respondents said that internal support had improved among both the broader field unit staff and management. Some respondents linked this to improved public and political support. Others commented that it was due to awareness and understanding of the need for prescribed burning. "If you have the right managers in place who have an understanding of the ecological processes involved, then you will get that support". Some respondents felt that there is currently "strong management support" or that the program is making headway in this area.

National Support

National support was mentioned by ten respondents, who suggested that there is a "national approach to prescribed burning" and Parks Canada has been a forward looking agency when it comes to fire. There has been "good support from top down for prescribed burning - the national support can't be underrated". The involvement of national duty officers and the national review process for prescribed burns were also viewed positively. Fire personnel from other field units review proposed prescribed burns, which ensures that plans are well thought out.

Policy and Planning

Seven respondents mentioned Parks Canada's policy direction as a strong and accepted agency policy with regard to ecological restoration which is facilitating prescribed burning. Three respondents also mentioned the park management plans, which have "a quantitative measure for fire restoration" and which is a "very clear measure" compared to other plan content.

Four respondents also cited strengths in the planning of individual projects. Staff are improving in their "planning and presentation" of these projects and prescriptions generally seem to be good.

Eight respondents identified the planning and approvals process as a hindrance to implementing prescribed burns. At the field unit level, fire management staff "spend a

fair amount of time defending locations" instead of using internal processes, such as the environmental assessment process, as a "starting point for discussing mitigations and dealing with impacts". The planning process may not be adequately addressing social factors. A heavy workload makes it difficult for other field unit staff (e.g. resource management specialists) to participate in planning for these projects in a meaningful way. It has been difficult for the fire management team to "get ahead of the curve" and have a number of prescribed burn plans on the shelf ready for implementation, partly because the program is relatively new. At the national level, the review process could also be more efficient. Some respondents were concerned that new steps in the process could mean that the LLYK Field Unit will have to wait in line behind other field units.

The linkages between individual prescribed burns and the larger fire management plan are also unclear. One reason given for this was the low profile of the fire management plan. One respondent pointed out that "the basic support for that plan may not exist, because people don't know about it and it may not have been formally approved".

A lack of objectives was identified by four people as an issue. One respondent noted that it would be easier to justify prescribed burns if they had "stronger ecological objectives". As noted in the research and monitoring section (5.2.5), the development of strong ecological objectives is prevented by a lack of monitoring. There is uncertainty about the long term benefits of various activities. "We need to be able to close the feedback loop to show positive results. Our current program is not built with enough rigour to withstand critique". The program does not articulate well its response to ecological objectives other than vegetation objectives (e.g. creating good grizzly bear habitat away from townsites).

Other factors facilitating prescribed burning include:

- prescribed burning is supported by a good body of scientific knowledge on the ecological role of fire. More specific research projects related to whitebark pine have pointed to the need for fire to restore habitat or conserve species. Our understanding of the historic role of fire and its ecological impacts has

improved. This has helped to change opinions and increase comfort with the objectives that have been set for fire management.

- the example set by other parks and a successful track record in the field unit. There is "momentum across the country" and there has been "good experience in other parks carrying out successful prescribed burns". Most of the sites chosen to date have been in fairly low risk areas and "every time we do one successfully the comfort level goes up".
- funding from the Canadian Forest Service to address mountain pine beetle issues has enabled the field unit to increase staffing levels and carry out more projects and has also provided an incentive to "work on an interagency basis…to deal with infestations [mountain pine beetle] moving onto provincial lands".
- some of the same factors facilitating fire control are facilitating prescribed burning.
- topographical features (e.g. slopes) can assist with ignition if prescriptions are not quite right.
- interagency collaboration helping to carry out prescribed burns.
- relatively few park users in backcountry areas makes it easier to carry out prescribed burns in these areas.
- the environment assessment office has facilitated these projects.

Other factors hindering prescribed burning include:

- weather (windows for prescribed burning can be narrow);
- the prescribed burning program is relatively new;
- communications (e.g. a lack of communications with the management team; a failure to communicate the economic and recreational benefits of prescribed burning; a legacy of poor public relations with different community groups resulting in assumptions about hidden agendas);
- a lack of monitoring;
- more strategic fireguards or projects breaking up the continuity of fuels;

- the amount of development on the landscape;
- a lack of knowledge in some areas (e.g. fire cycles);
- the complexity of burns (to date most of the burns implemented have been low complexity and low risk);
- interagency policies;
- public safety concerns;
- the size of the field unit.

One respondent did not see any limit and commented that where they exist, they are probably natural limits.

5.4.4 Fuel Management

Public Perception

Cited by thirty-three respondents, increased public awareness and support for risk reduction projects is the most important factor facilitating implementation of these projects by a considerable margin. As one respondent noted, the "current awareness and climate around fuel management and facility protection probably does more for the program than anything we could ever do". Twenty-three respondents attributed this awareness to significant fire seasons over the past few years, and in particular, the fires last year. Although respondents referred most often to the experience in British Columbia and the mountain parks, fires in other areas in North America (e.g. California, Arizona) have also generated significant media coverage.

There is more awareness of the potential for fire in areas such as the Bow Valley and "much more understanding of what years of active fire suppression has done" to increase fuel loads and create the potential for much larger, more intense fires than have been seen historically. Many respondents noted that now is the time to proceed with projects, before memories fade and the momentum is lost. "After last summer they [stakeholders, public] won't disagree about why it should happen, just how it gets implemented".

Table 5.14 Factors facilitating and hindering fuel management

Theme	Number of Respondents
Factors Facilitating Fuel Management	
Public Perception (Awareness and Support due to significant fire seasons)	33
Precedents	8
Management Support	8
Capable Personnel	6
Supported by Policy	3
Financial Feasibility	3
Availability of Resources	3
Other (planning, prerequisite for fire reintroduction, interagency cooperation, aesthetics, liability, techniques)	10
Factors Hindering Fuel Management	
Public Perception (Aesthetics and Logging)	28
Availability of Resources/Capacity	11
Internal Support	9
Environmental Impacts	5
Policy	5
Effectiveness	4
Process	3
Other (scale, same factors as prescribed burning, access, liability, understanding and knowledge, poor precedents, unclear goals / objectives)	9

Although many respondents felt that increasing public awareness is facilitating fuel management, a similar number discussed factors related to public perception that are retarding implementation. Aesthetics was the main factor mentioned. Several respondents observed that the public and park staff have a static view of the landscape and that there is an expectation that national park landscapes will be forested landscapes. There may also be uncertainty about how the final product of fuel reduction efforts will look. Some facility managers may prefer "dense, closed forests" and park users may not want to use a facility where there has been tree removal (Redstreak Campground was cited as an example where users "didn't like the new look").

Some respondents felt that "even though we are making some progress on education, there is still a great lack of understanding of …fuel loads, people don't realize how vulnerable most facilities are". Fuel management is also "fairly new to people". One

respondent remarked that there needs to be more stakeholder and public involvement in defining objectives and priorities and participation in implementation. Another pointed out that owners of private facilities in the field unit do not seem to have taken the initiative to carry out facility protection on their own.

The public's perception of mechanical thinning in the national parks was another issue identified by respondents. Adverse public reaction to "logging" in the national parks and potential discomfort with this reaction at the senior management level were cited. However, this seemed to be an issue that was impacting internal support as well. Respondents expressed concern over "feller-bunchers and logging trucks going through the park". Several respondents felt that logging was a slippery slope and that it "is not far to go to get from logging for fuel management to logging for profit". "We haven't thought through what we are going to do with the wood and how that will influence fuel management projects".

Fire management staff recognized these concerns, commenting that some of the actions related to fuel management may seem "contrary to the way we like to do business" and that "there was negative feedback from internal staff over logging at Redstreak". A lack of understanding of the surplus wood directive and the purpose of logging may be contributing to this lack of support. "The objective is to log for facility protection…we are not taking the logs to pay for a project. We are taking the trees that need to be removed for the purposes of fire management."

Internal Support

A lack of internal support was cited by nine respondents as a constraint on fuel management. This lack was attributed to: "lack of management awareness of how acceptable fuel management would be"; "perception on the management team that trees should not be cut"; a perception at the park manager level "of inadequate consideration of multiple factors like public perception, wildlife habitat values and constraints by policy"; and "an inadequate amount of discussion with various park functions of the need for and how to carry out these fuel management activities". One respondent recommended more

"group sessions with people outside the fire program. We need to bring that level along and make them part of the solution… we need to link park programs more".

Eight respondents felt that management support was facilitating these projects. One respondent felt that fuel management was more accepted by management than prescribed burning.

Availability of Resources

Eleven respondents felt that the capacity to carry out these projects was limited by the availability of resources. The cost of these projects and need to finance them from within the field unit budget (money is not available through Vote 120 as with prescribed burning) was viewed as a stumbling block. Several people pointed out: that these projects are time consuming; there are a limited number of people working on them whose work may be interrupted by wildfires or prescribed burns; and they simply have not had time to get caught up. In addition, fuel management has not been a priority in the field unit in the past. In another field unit, a consultant was hired to assess facilities and provide a work plan. This seemed to move things forward significantly.

In contrast, three respondents reported that adequate resources are available. There seem to be more resources available now than in the past (i.e. personnel dedicated to community protection). Another three respondents pointed out that projects are financially feasible because money from tree removal can be recouped, therefore the field unit can fund these projects without relying on outside funding.

Precedents

Precedents within the LLYK Field Unit and other field units and the work of other agencies are helping to create momentum for fuel management projects. Banff, Prince Albert, and Jasper have provided fire management staff with templates to work from and have shown that these projects are "acceptable from both a policy in-house perspective and the public accepts it as well". Demonstration projects allow people to see what fuel management projects look like as they are being carried out and a few years after the work has been completed.

Parks Canada can also point to other fire management agencies in British Columbia, Alberta and the United States, where fuel management is currently a major focus. "It is a practice being endorsed by other levels of government." Agreements with surrounding land managers (e.g. addressing mountain pine beetle infestations) were also perceived to enable fuel management projects, as were interagency projects, such as the development of the FireSmart manual (containing guidelines for facility protection) which is being adopted by organizations across Canada.

Other factors facilitating the implementation of fuel management projects include:

- the proactive approach and knowledge of fire management staff;
- supportive policies (e.g. the surplus wood directive);
- the integration of fuel management and wildlife management and other objectives and the involvement of other specialists in order to develop "something that contributes to several different outcomes in the end";
- a preference for thinned forests on the part of some facility managers;
- the availability of better techniques (e.g. selective tree removal) than in the past;
- communications to change public perceptions;
- other agencies taking the initiative on facility protection projects from a liability perspective.

Other factors hindering fuel management projects are:

- the "potential conflict between protection objectives and ecological objectives." With large projects, impacts (e.g. on wildlife) have the potential to be significant. These projects are relatively new and it is unclear what the environmental effects will be. The issue is complicated by the different habitat needs of different species.
- unclear or absent policy and procedures. There are conflicts between community plans, guidelines for outlying commercial accommodations and fuel management practices. Some practices, such as logging, seem contrary to

the national park mandate. Parks Canada needs "to clarify and define the ethics around logging".

- unclear goals for fuel management. How will projects be phased and is the goal to design firebreaks from which crews can "burn out" towards an approaching wildfire?
- a slow approvals process and frequently changing priorities. The public consultation process is not clearly defined.
- questions about the effectiveness of fuel management in protecting communities. "How successful you can actually be in reducing the potential for these communities to burn… to make it work in the real environment it would have to be big, ugly, expensive and time consuming". How much fuel needs to be removed to create an effective firebreak? How effective are mechanical fuelbreaks in the absence of prescribed burning to remove surface fuels? The effectiveness of fuel reduction programs has also been questioned by some fire behaviour scientists.
- the sheer scale of these projects. "This is a large undertaking bordering on a commercial operation and it has traditionally been a tough one for Parks to get its head around, although after last summer this is changing".
- NIMBY ("not in my backyard"). Special interest groups may advocate against fuel management actions for environmental or aesthetic reasons.
- similar constraints to prescribed burning (for fuel management projects that involve prescribed burning),
- access issues due to terrain,
- poor precedents within the field unit (e.g. Kootenay Crossing warden station firebreak),
- liability issues. Parks Canada may be assuming liability by carrying out these projects if the fuel reduction does not work.

5.5 Looking Forward

The feedback provided in earlier sections provides a good basis for future planning efforts, in terms of identifying issues that need to be addressed and factors constraining progress. Respondents were also asked what program priorities should be for the next five years and what process should be used to set fire management objectives.

Table 5.15 Priorities for the next five years identified by respondents

Priority	**Number of Respondents**
Community / Facility Protection	22
Prescribed Burning	9
Fire Control	2
Communications	2
Research and Monitoring	2
Interagency Coordination	1
Other	4

A small majority of respondents reported that facility protection should be the fire management program's main priority over the next five years. Prescribed burning was also a significant priority. Several respondents remarked that many of the priorities were so closely related that it was difficult to separate one from the other or choose just one. "I felt that three are very closely related: community and facility protection, interagency coordination and prescribed burning…we need to burn right up next to community and park boundaries because this will give us way more flexibility to burn within the park…community and facility protection should be taken to the landscape scale". Several respondents also noted that they chose facility protection because they felt it would facilitate future work such as prescribed burning.

Other priorities included:

- updating the fire management plan, developing a clear direction for the program and using the plan as a communication piece;
- "building an integrated program, communications and consensus-building";
- allowing naturally occurring fires to burn.

Respondents described many different ways that a process might work to set objectives for fire management at the field unit level. Figure 5.20 combines these comments into one flowchart illustrating a potential process. The first row, or "inputs", represents the types of information that should be considered when developing objectives. The second row, or "objective development", is the first stage in the process of developing objectives. There are two different options for objective development, both of which could involve peer review. "Consultation" is the second stage of this process. It would involve internal and then possibly external review of the objectives for fire management. The boxes on the right list the parties who could be involved in reviewing the objectives.

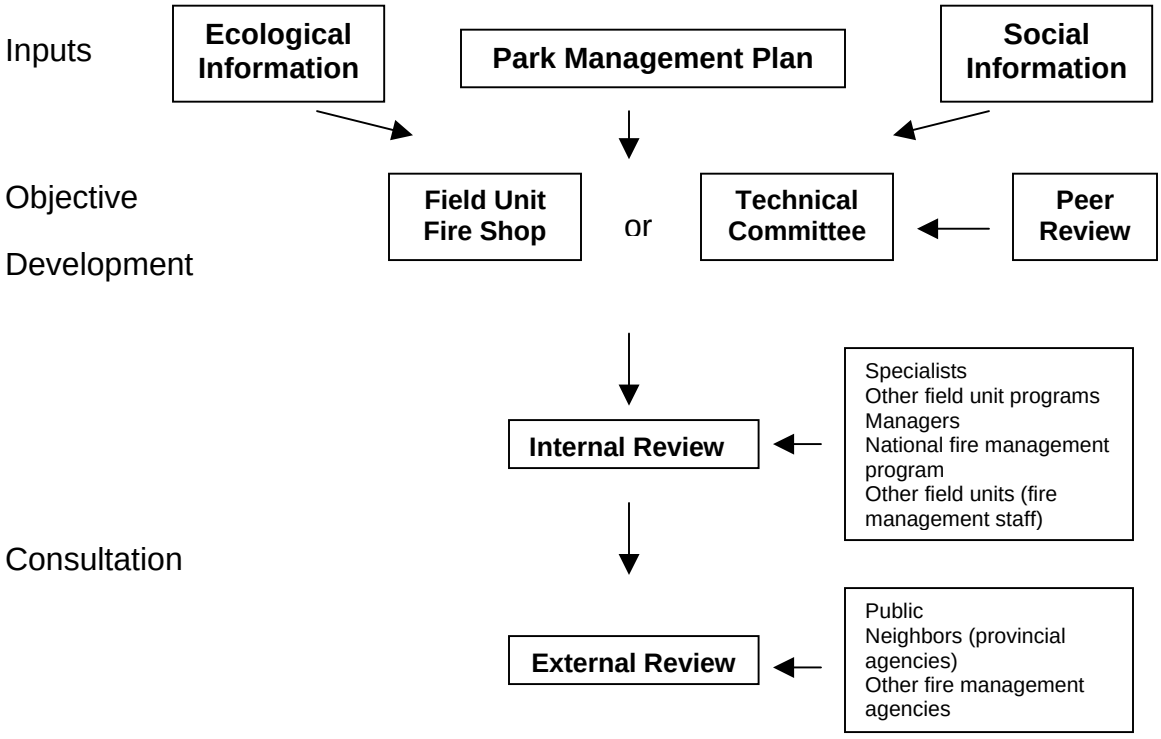

Figure 5.20 Flowchart for development of fire management objectives

Fourteen respondents felt that the starting point for objective development would be available scientific information about fire, such as knowledge of the historic fire regime, the role of fire in regenerating certain habitat types and the habitat requirements

of specific species. Nine respondents followed this up by stating that social considerations, such as the social impacts of fire or social goals for fire need to be built in to the objectives. Several respondents pointed out that objectives would "be moderated by some of our operational realities, such as the location of communities and what can be safely undertaken". Several respondents also mentioned that an adaptive management or iterative approach should be used to set objectives. The desired course of action needs to be linked to science and those linkages need to be explicit (e.g. "stakeholders want to know what model you are using").

Six respondents pointed out that objectives need to be strongly linked to the park management plan. The process should begin with a review of the plan and its "ecological goals and objectives and visitor use goals and objectives and education goals…to get a sense of where we said we need to be" and proceed from there. Objectives also need to be consistent with other policies, such as national fire management direction and community plans. The park management plan is perceived as particularly important, because this is the main policy document used by the public and others who are not in the fire management program. There was some uncertainty over whether fire management plan "objectives should reflect management plan direction or…drive management plan direction".

Nine respondents described a process that begins with the field unit fire management team developing a set of objectives for review by others. Following the initial development of objectives, broader internal consultation would be required to refine the objectives. This would include specialists (e.g. resource management and social science scientists), fire management staff from outside the field unit and/or a large number of staff from a wide variety of functions.

Another option described by several people was a committee approach to objective development. The committee might be limited to fire management staff and specialists (e.g. similar to the technical committee struck for park management planning), or it might include representatives from the management team. It could eventually grow to include experts from academic institutions or other agencies and some stakeholders. One respondent suggested that objectives should be developed at the mountain park level

by a body similar to the science advisory board, but made up of fire management specialists. They would approach objective-setting on a much broader scale than simply the field unit level. Four respondents suggested that peer review of objectives (by academics outside of Parks Canada) would be a valuable addition to the process.

Some respondents stopped at this point and did not go on to describe any requirements for external involvement. However, seventeen respondents felt that there needed to be some form of stakeholder or public involvement, although opinions on how this should be carried out differed. Opinions ranged widely: "I am reluctant to say that we are going into major consultation or public review" ; there should be "more stakeholder and public involvement, although I am debating on how much of a decision-making role we want them to have - but definitely a high level of involvement in terms of defining the problem and proposing management actions"; fire management staff should "go to the local and regional public and request their input on a draft and be sure they recognize it is a draft".

These comments reflect a theme that was pervasive throughout the questionnaire; fire management staff need to involve more people in planning efforts and program implementation. In the next chapter, the results of the questionnaire are discussed in more detail and recommendations aimed at improving planning processes and program delivery are made.

5.6 Improving the Questionnaire

In general, the questionnaire was an excellent tool for gathering insightful responses. However, there were areas where the questionnaire could have been improved. In the final analysis, the results from four questions were not reported: Q-14, Q-17, Q-21 and Q-38.

Part way through the interviews, it became apparent that different respondents were interpreting Q-14 (How would you characterize the general approach to managing natural disturbances like fire in the field unit?) differently. Some rated the field unit's approach based on the response to disturbances like avalanches or flooding. Others rated the approach relative to fire. Respondents often noted that depending on the disturbance,

there are very different approaches ranging from no management to intensive management, and that the approach to fire rated higher on the scale than the approach to other disturbances. This question would have been more useful if it had been divided into two parts: one rating the approach to managing fire and the other rating the approach to other natural disturbances.

Similarly, the question rating national fire management (Q-22) would have been more valuable had it been paired with a question rating the overall performance of the field unit in fire management.

The results from Q-17 and Q-23 were not included because they did not fit in very well with the overall process evaluation. Q-17 asked "what criteria should be used to evaluate the success of *past* fire management initiatives?" This question would probably have been more valuable had respondents been asked to assess how well the field unit evaluates fire management initiatives. Q-23 asked what messages field unit staff felt should be communicated to the public.

Q-21 (Why do you think this is a major challenge?) was difficult to analyze because there were very few common themes, once responses were sorted by main challenge. Respondents interpreted this question quite differently. For example, if the main challenge was a lack of management support, one respondent might report that this is a major challenge because managers do not understand the scale of work required to implement a landscape level program. They interpreted "why is this a major challenge" as a question about the root cause of the challenge. Another respondent might reply: because it creates much more work for us in terms of having to consult with the public. To this respondent, "why" is asking about the consequences of the main challenge. Fortunately with the open-ended questions, it was relatively easy to take note of these differences.

The questionnaire could have been shorter. There was significant overlap between responses to some questions, such as the main challenges facing the program (Q-21), the most significant factors that might constrain achieving the desired role of fire in the field unit (Q-13), and factors influencing specific activities. In retrospect, Q-21 should probably have been placed at the end of the survey, so that once respondents had

discussed all the different facets of fire management, they had a chance to reflect on the most important challenge out of all the issues discussed.

Some respondents questioned the relevance of collecting data such as classification and age to the stated objectives of the questionnaire. Other respondents struggled with the wording of certain questions. Problematic wording included: "factors…*facilitating* the implementation of…" and "what *process* should be used to evaluate the success of past fire management initiatives or actions"? The response category "I don't know" should have been included for all quantitative questions, although some respondents were quite frank and responded with "I don't know" even when that was not a choice on the scale.

CHAPTER 6: DISCUSSION AND RECOMMENDATIONS

The bulk of the discussion in this chapter relates to the results of the process evaluation (Chapter 5). Although the outcome evaluation (Chapter 4) provided some insights into program performance, the process evaluation provided a more comprehensive picture of the implementation of program activities and generated more content for analysis.

The execution of the outcome evaluation was complicated by a lack of: clear objectives for fire management activities; useful performance measures in the fire management plan; targets against which performance might be compared; and difficulty identifying performance measures for some outputs (e.g. communications, interagency coordination) and most outcomes. Outcome evaluation is better suited to well-established long running programs, where benchmarks have been set and sufficient data collected to make longitudinal comparisons. A successful outcome evaluation could probably be carried out for fire control, since this is an activity that the field unit has been carrying out for many years.

Some of the results from the process evaluation were similar to the findings of the outcome evaluation. For example, the performance measure for fire control suggested that there was strong performance in this area and most respondents reported that the field unit had a good to excellent ability to manage fire. However, the outcome evaluation was generally unable to predict what issues respondents would identify related to program implementation.

Gaps uncovered as plan contents were examined (e.g. unclear direction on fire control) were occasionally mentioned by respondents, however they were not the major issues cited. Such issues generally related to the inputs that influence program activities or processes - from less tangible inputs like public perception and internal support to more concrete inputs like program resources - and the manner in which activities were carried out. Nonetheless, the process used to evaluate outcomes aided in understanding the main activities, procedures and objectives of the program and in formulating focused questionnaire content.

This chapter provides recommendations that are general in nature. For suggestions about how to improve specific activities, the reader should refer to the previous chapter.

6.1 Strong Base for Program Development

In general, there were fewer significant differences in respondents' knowledge of program activities or perception of program performance than expected. However, there tended to be minor differences in: familiarity with the fire management plan, familiarity with interagency initiatives, perception of the need for prescribed burning and performance at a national level, by position and type of involvement with fire management.

There was strong agreement with the goals for fire management as stated in the 1998 plan and most of the concepts underlying the general approach to fire management in the field unit. Respondents share similar ideas about program priorities and the amount of work required in areas such as prescribed burning and facility protection. This suggests that there is a strong internal base of support on which the program can build.

Respondents also had a very good opinion of fire management staff. Thirty-five out of forty respondents viewed fire management staff as a strength of the program. Over half said that knowledgeable and experienced staff are responsible for good fire control. Slightly less than half felt that staff initiative was moving the prescribed burning program forward. Strong capabilities in the areas of fire suppression and management should foster confidence in other aspects of the program, such as prescribed burning. Good precedents in the LLYK and other Western Canadian field units also provide momentum which fire management staff can use to build a stronger program.

As mentioned in Chapter 2, fire management in the 1980s was hampered by poor capabilities in fire control, which in turn limited the implementation of prescribed burning. The results of this evaluation show that there is no longer a deficit in the technical ability of fire management staff. The challenge facing the LLYK Field Unit program is to rise above operational competency and develop competencies in other areas, such as communications, planning and consultation, in order to implement more

complex, landscape level projects. This will ultimately require additional resources and support from outside the field unit, another challenging proposition given the current fiscal climate of restraint within Parks Canada.

6.2 Overview of the State of Fire Management in the Field Unit

Fire control and interagency coordination were rated very favourably by respondents. However, more prescribed burning, facility protection, research and monitoring, and communications work are needed. While fire control is the cornerstone of the fire management program, and that ability needs to be maintained and improved upon where possible, planning efforts in the future should concentrate on the latter four activities.

Performance measures from the outcome evaluation indicated that performance in prescribed burning was mixed and performance in facility protection was limited. Respondents reported that more work was required in both areas, with facility protection the most pressing priority. Neither of these activities can be successfully implemented without a significant communications effort both internally and externally. The implementation schedule must take into account the resources and time required to carry out other activities (e.g. communications, monitoring) in advance of or following these projects. Realistic expectations must be set with respect to the ability of the program to implement these activities with available resources.

6.3 Availability of Resources

Resources were a key challenge identified by many respondents. There was general agreement that adequate resources are available when a wildfire is burning in the field unit and, in fact, Vote 120 funding appears to be unlimited (see Section 4.1 *Inputs* for an explanation of what Vote 120 covers). However, limited operating budgets before and after a fire make it difficult to implement many program activities. The scale of the work required, given the history of fire suppression in the field unit and the fire regime characteristic of the Rocky Mountains (e.g. high intensity stand replacing fires), is

significant. The sheer number of facilities that need to be protected and the size and configuration of the field unit present logistical and operational challenges.

Respondents generally rated the ability to manage wildfires very highly. The availability of resources was a leading factor responsible for this success. However, respondents who participate in fire operations were slightly less enthusiastic and a significant number of respondents (more often fire management staff) perceived a lack of resources (e.g. only one three person initial attack crew) to be hampering effective fire control.

Additionally, insufficient resources were most often identified to be limiting prescribed burning. They were a less important factor constraining facility protection. A lack of funding was also linked to deficits in communications, research and monitoring. Interestingly, only three respondents felt that a lack of resources might be hindering implementation of a random ignition strategy. This is likely because implementation of this strategy has been so limited to date that respondents have yet to see the potential effects of scarce resources on this activity.

More funding delivered in a consistent manner would enable the fire management program to hire more staff (e.g. a dedicated communications specialist, dedicated staff to plan facility protection and prescribed burning projects). The scope of activities for which Vote 120 funds can be used should be expanded, if it can be shown that proactive risk abatement work (e.g. facility protection, prescribed burning) reduces fire suppression costs.

The field unit fire management program is not the only program that would benefit from increased funding. Many respondents identified issues of long term sustainability throughout the national network and at the broader field unit level. More dedicated fire management staff at the regional and national level would facilitate the development of policy or tools at the national level that would assist all field unit fire management programs (see National Network).

At the field unit level, heavy workloads make it difficult for staff outside the fire management program to offer timely feedback on projects and participate in training (e.g. basic firefighting training). This could have long term implications for succession

planning and as the organization shrinks, it may become more difficult to manage extended wildfires or implement a random ignition strategy. The fire management program provides a good argument for more sustainable funding throughout the Parks Canada Agency. This type of landscape level program is difficult to implement without sufficient organizational capacity.

Increased resources might also reduce competition between field units for limited resources. However, funding is not the only issue affecting the ability of the field unit to implement the fire management program. If it were, all the field units would be in a similar position and, although many respondents said that the LLYK Field Unit is comparable to other field units, an equal number felt it was behind other field units. Two other important factors affecting program implementation are public perception and internal support.

6.4 Building Public and Internal Support

Working towards public consensus is an important part of an ecosystem management approach. Public perception was generally perceived as facilitating fire control and facility protection projects (although specific concerns, such as public reaction to logging in national parks and the aesthetics of mechanical thinning may be impeding progress). However, public perception was a very important factor hindering the implementation of a random ignition policy and an important factor limiting prescribed burning, although a significant number of respondents felt that this was changing and that public support for prescribed burning was on the increase.

Despite the fact that public perception was mentioned frequently as a factor limiting the implementation of fire management activities, very little social science research has been conducted in the field unit to evaluate public attitudes towards fire, support for fire management activities or their impacts on the public. Respondents' comments are probably a good barometer of changing public sentiment, given that they interact with residents of park and adjacent communities and other stakeholders on and off the job. However baseline information on public attitudes at this point in program

development would be invaluable, particularly in helping to inform communication strategies (see 6.5 Communications).

Scientific data characterizing public attitudes towards various aspects of fire management might also help to improve internal support, if the public is indeed more tolerant or supportive of fire management activities than most field unit staff believe. Although questionnaire results indicate that internal staff are generally supportive of program goals, many respondents cited a lack of internal support as a weakness or factor hindering the program implementation.

Internal support tended to mirror public support. For example, public support was perceived to be enabling fire control, a well-accepted and traditional Parks Canada activity, as was internal support. In some cases, the same respondent cited both public support and internal support as factors influencing fire management activities, however in many cases, different respondents commented on either internal or public support. When the numbers were tallied a similar trend was noted for public and internal support. A lack of internal support surfaced with prescribed burning (although once again, several people mentioned that support had recently improved) and was a very important factor limiting implementation of random ignitions.

Internal opinions were most diverse when it came to defining the role of random ignitions in the fire management program. Although seventeen respondents felt they should play a significant role, a quarter were more ambivalent and a few felt they should not be allowed at all. Fire management staff from outside the field unit expressed the most reservations about random ignitions. Whereas respondents did not generally point to development or infrastructure as factors constraining prescribed burning or even fire control, the tangible risk to built assets was perceived to be a factor limiting where random ignitions could be allowed to burn, particularly among fire management staff.

Given the range of opinions among internal staff, much more discussion of the implications of a random ignition policy is required and this should start at the national level among fire management staff. Based on the outcome evaluation, there is also a need to review zoning and prescriptions if the field unit hopes to allow more random

ignitions to burn. A well-thought out zoning system, defined and defended in the fire management plan, could help to allay internal concerns.

Only nine respondents felt that internal support was slowing facility protection, whereas eight thought internal support was facilitating these projects. Any reservations that might exist were attributed to: conflicting philosophies about park management; concerns over the ethics of mechanical thinning in national parks; a failure to recognize how acceptable these projects are to the general public; and a failure to communicate with and involve other staff in planning these projects. In order to build internal support for these projects, planning processes and policies on mechanical thinning need to be better defined (see 6.9 Planning).

6.5 Communications

The preceding sections hint at the increasingly important role that good communication plays in fire management activities. Effective communications can moderate public and internal perceptions and foster the awareness and support required to move the program forward. For example, if the public does not support prescribed burning because of a lack of understanding of its objectives, communication may help to change this by improving general awareness of the reasons for prescribed burning.

For this reason, social science research could help to focus external communication efforts, particularly if it identifies: audiences that need to be reached; the best methods for reaching them; and the type of information they need. This would help communications staff to determine which groups need to be better informed about fire management issues or wish to be involved in planning efforts, and how this should happen.

Like the broader fire management program, communications have improved greatly over the past few years and there is a good base on which to build. Many respondents felt that the field unit does a good job at communicating on large events like the Kootenay fires of 2003 and generally rated communications as consistent. However, respondents felt that the field unit needs to be more proactive in communicating about fire management outside of these events. This will require more advanced planning, so

that the field unit is better positioned to take advantage of opportunities as they arise. It will also require thought into how fire messages can be incorporated into other ecological messages. Strategic communications planning should be incorporated into the fire management plan. Dedicated communication resources would go a long way to improving the ability to communicate on an ongoing basis.

6.6 Science

Although some respondents questioned the need for more science or the value of information generated by research and monitoring, a majority reported that there was a need for more research and monitoring. Once again, a good foundation has been built over the past 20 years (e.g. fire history studies, vegetation studies), so that research can now focus on specific questions related to management objectives.

It was very important to several respondents that the fire management program be based on good science. This was seen as a strength of the program. For example, scientific knowledge was perceived to be a factor supporting the implementation of prescribed burning by providing both a rationale for fire use and information to be used in planning these operations. Many respondents defined the role of fire in terms of concepts defined by natural science research, such as the natural range of variability characteristic of ecosystems or historic fire regimes. A clear understanding of the relationship between ecological integrity and the maintenance or restoration of fire on the landscape was expressed by the majority of respondents.

Only two respondents touched on the validity of the approach to fire management in the field unit. One respondent speculated that the field unit had failed to recognize that a human-caused regime underlies the lightning regime. The other remarked that there is a tendency for fire management staff to select a particular point in time as the goal for ecosystem restoration rather than a range of points. Several respondents talked about the uncertainty that comes with a lack of scientific information but no one delved into the issue of contradictory scientific evidence (as described in Chapter 2). As respondents described the role that fire should play in the field unit, some subtle differences in viewpoints were noted (see Appendix E for a full account). However, there appears to be

little knowledge or concern among the majority of respondents that the current approach to fire management may be a subject of some debate.

A more prevalent theme was the lack of clear objectives for the program. Knowledge of how ecosystems have varied historically has helped to set overarching targets for fire use in the park management plans. However, more detailed objectives related to specific issues or projects are lacking. The outcome evaluation showed that some objectives have not been clearly articulated. The process evaluation indicates that the development of other objectives requires more scientific enquiry.

More rigorous monitoring would help fire management staff to better define objectives, evaluate whether or not the program is meeting these objectives and build support for management interventions, such as prescribed burning. A regular program of monitoring is required for the fire management program to be truly adaptive – another cornerstone of the ecosystem management approach. More national direction or coordination might assist individual field units in implementing monitoring programs. For example, methodologies could be developed so that all field units are collecting the same information. Field units with common ecosystem types could each monitor a particular ecosystem component a forum developed to share the results of monitoring.

That the results of research and monitoring need to be better communicated to field unit staff was another important finding of the process evaluation. Fire management staff need to demonstrate how the scientific information that exists is being incorporated into the objectives for specific projects. The fire management plan would be a good vehicle for this type of discussion.

6.7 Interagency Coordination

Interagency coordination was viewed very positively by respondents, although the level of awareness of interagency activities could be improved among certain groups, particularly managers. Successful interagency initiatives, such as the Redstreak restoration project, should be profiled internally, as excellent examples of the integration of different field unit programs, interagency collaboration, and broader community building. These successes should also be communicated externally as proactive stories

that engage the public and help to improve support for fire management and other park programs. This is one area where ecosystem management is being effectively carried out.

6.8 National Network

The national network was cast in a very positive light by respondents. National resources can be mobilized rapidly when required. Temporary staff transfers to manage fires in other field units enable field unit fire management staff to gain valuable experience. Field unit staff can draw on national expertise while retaining a significant level of autonomy, which allows them to develop programs that respond to local conditions. A national approach to fire management was perceived to be critical to the success of individual programs. For example, clear policy supporting prescribed burning at a national level has been very helpful in moving that aspect of the program forward.

However some aspects of policy at the national level could be improved. Among these aspects are: keeping directives current; standardizing terminology; and developing a policy on random ignitions to encourage greater consistency among field units. Despite a strong national network, several respondents commented that the field units (particularly those that are geographically contiguous) need to cooperate more. A lack of coordination can complicate communication with the public about fire control and prescribed burning. More national direction is needed to encourage field units to work more closely together. Where this is already occurring, the results of this work need to be communicated to other field unit staff as examples of best practices.

6.9 Planning

The program evaluation is only one stage in the planning cycle. Issues identified through an evaluation are ideally addressed by articulating new goals and objectives and developing a new implementation plan (see Figure 3.1). The fire management plan is the document in which the field unit details its strategy for program implementation.

Although some issues, such as resourcing challenges, cannot be "solved" through planning alone, other more specific issues, such as the ethics around mechanical thinning

can be addressed during plan development. The general support noted at the beginning of this chapter suggests that staff do not question the need for fire management. However, there is significant interest in *how* fire management staff go about implementing fire management initiatives.

The profile of fire management plan needs to be raised, particularly among managers. Field unit staff must understand more clearly the implications of the overall fire management strategy on their sphere of responsibility and how individual projects relate to broader direction contained in national documents and the park management plan. Staff should be able to say with confidence that they are familiar with plan contents. A plan that is written for a broader audience than fire management staff, coupled with more internal communication of plan contents (e.g. through workshops or informal presentations), would assist greatly in this endeavour.

A broad cross-section of field unit staff needs to be involved early on in plan development in order to: ensure that issues are properly identified; other programs' objectives are incorporated into the plan; and program priorities are aligned with those of the field unit. Involvement should not be limited to field unit staff. Fire management staff in other field units need to be consulted to ensure that there is a consistent approach to fire management.

While a significant number of respondents thought that public involvement in the planning process was warranted, there were differing views on the scope of this involvement. Communications with the public provide an opportunity to explain the positive aspects of fire management and obtain public feedback to improve the field unit's understanding of the social and economic impacts of fire management activities as the public sees them. External involvement during plan development would help to build support for the plan among stakeholders. Dialogue that welcomes a diversity of viewpoints at the problem definition stage can help to create a stronger plan. Consultation with peers (e.g. provincial agencies, other government departments, universities and colleges) when setting goals and objectives for fire management would also result in a stronger and more credible plan.

The outcome evaluation showed that clearer goals and objectives for fire management are required. A planning process that is more inclusive (as described above) would be a good first step in this process. Goals must be established at the park management plan level that reflect the current direction of the fire management program and demonstrate that goal-setting is occurring at a larger scale than just the park or field unit. These goals could be expanded upon and translated into more detailed objectives at the fire management plan level. Clear objectives are required to develop useful performance measures and would help to define the type of data that needs to be collected for these measures. At the fire management plan level, efforts should concentrate on developing a few key performance measures related to outputs. Performance measures related to outcomes should be detailed in the park management plan. These measures would allow fire management staff to track progress over time and provide another means to communicate with other staff and the public about program accomplishments and needs.

In order to build internal support for the program, the plan should respond to internal concerns and answer questions that are specific to current realities (e.g. Is more prescribed burning required given the large area burned in Kootenay National Park in 2003? Is mechanical thinning for facility protection the thin edge of the wedge leading to commercial logging?). The fire management plan is the appropriate place to fill in policy gaps or smooth out inconsistencies that relate specifically to fire management.

Several respondents reported that project implementation was complicated by unclear processes and that staff were unsure how to go about planning for these projects. The fire management plan should clarify the principles according to which projects will be conducted and outline the steps (e.g. internal staff to be consulted, extent of public involvement required) to be followed in planning individual projects. These steps or expectations, should be defined in consultation with other internal staff, documented in the fire management plan and endorsed by the management team.

In closing, it will be interesting to observe how the LLYK Field Unit fire management program evolves over the next five years. Clear issues and areas for

improvement have identified in this MDP. Many of the issues identified revolve around less tangible program elements, such as objective setting, communications and the involvement of other staff and stakeholders in the program. Both fire management staff and other field unit staff recognized the requirement for more work in areas such as facility protection, prescribed burning and monitoring in the next five years. The ability of the fire management program to respond to these issues and priorities remains to be seen. Will fire management staff be able to build and maintain the internal and public support required to implement fire management activities more effectively than in the past? Will the resources required to implement proactive projects be available in a consistent fashion? Another program evaluation in five or ten years time would help to: answer these questions, chart the performance of the program, determine if some of the factors currently affecting program implementation have been addressed and what new issues have emerged.

Table 6.1 Summary of recommendations from program evaluation

6.2 Overview of the State of Fire Management in the Field Unit
• Future planning efforts should concentrate on prescribed burning, facility protection, research and monitoring and communications.
6.3 Availability of Resources
• The field unit fire management program, the national fire management program and the field unit need to be better funded. Current funding is adequate for fire control, but is insufficient to effectively carry out landscape level projects.
6.4 Building Public and Internal Support
• Social science research is needed to improve Parks Canada's understanding of public attitudes towards fire management and could assist in defining audiences, delivery methods and messages to be communicated. • More internal discussion about the implications of a random ignition program is needed. • Zoning and prescriptions should be reviewed when the fire management plan is updated. • More work is required to define the ethics around mechanical fuel reduction.
6.5 Communications
• More proactive communications would help to build internal and external support for the fire management program. • More strategic communications planning is required to position the field unit to take advantage of opportunities to communicate about fire and integrate fire messages with other park messages. • Communications planning should be incorporated into the fire management plan. • A dedicated communications person attached to fire management program would facilitate the implementation of proactive communications.
6.6 Research and Monitoring
• New research questions should be tightly linked to fire management objectives. • More monitoring is required. • Fire managers need to make more of an effort to communicate the results of research to internal staff. The fire management plan should demonstrate how the results of research are being incorporated into objectives for fire management. • A national framework that provides guidance on monitoring and a forum for sharing results would be helpful.
6.7 Interagency Coordination
• Successful interagency activities should be profiled as best practices to internal and external audiences.
6.8 National Network
• More national direction is required in key areas (e.g. directives kept current, terminology standardized, a policy on random ignitions developed). • The national program should provide incentives for field units to work together.

6.9 Planning
• Raise the profile of the fire management plan through increased internal involvement and communication. • Involve more field unit staff in fire management planning (e.g. issue identification, objective development and priority setting). • Provide opportunities for public and stakeholder involvement in plan development and review. • Establish clearer goals and objectives for fire management; identify data needs and develop relevant performance measures to track program performance and assess needs. • Keep the plan current; it should address the issues of the day and gaps in policy. • Clarify internal processes and procedures. Outline principles by which projects will be conducted.

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APPENDIX A: GLOSSARY

Anchor Point: An advantageous location, usually a barrier to fire spread, from which to start or finish construction of a control line.[1]

Control a Fire: To complete a control line around a fire and any interior islands to be saved; burning out any unburned areas adjacent to the fire side of the control lines; burning off any unwanted island(s) inside the control lines; and cooling down all hot spots that are immediate threats to the control line until the lines can be expected to hold under foreseeable conditions.[1]

> Out of control: Describes a wildfire not responding or only responding on a limited basis to suppression action such that perimeter spread is not being contained.[1]
>
> Under control: Having received sufficient suppression action to ensure no further spread of the fire.[1]

Control Line: A comprehensive term for all constructed or natural fuel barriers and treated fire perimeter used to control a fire.[1]

Crown Fire: A fire that advances through the crown fuel layer (the standing and supported forest combustibles not in direct contact with the ground [e.g. foliage, twigs, branches, cones]), usually in conjunction with a surface fire.[2]

Crown Fraction Burned (CFB): A measure of the degree of potential crown fuel consumption expressed as a proportion of the total number of tree crowns.[2]

Direct Attack: A method whereby the fire is attacked immediately adjacent to the burning fuel.[1]

Escaped Fire: A wildfire (or prescribed fire that has burned beyond its intended area) that remains out of control following initial attack.[1]

Escaped Fire Analysis: The process of deciding what action to take on an escaped fire.[2]

Fire Analysis: See Escaped Fire Analysis.

Fire Behaviour: The manner in which fuel ignites, flame develops and fire spreads and exhibits other related phenomena as determined by the interaction of fuels, weather and topography.[2]

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[1] From *2003 Glossary of Forest Fire Management Terms*, by CIFFC, 2003, pp. 1-46.
[2] From *2003 Glossary of Forest Fire Management Terms*, by CIFFC, 2003, pp. 1-46. Text altered slightly from original (e.g. shortened or explanatory remarks added).

Firebreak: See Fuelbreak.

Fire Cycle: The number of years required to burn over an area equal to the entire area of interest.[1]

Fire Danger: A general term used to express an assessment of fire environmental factors that determine the ease of ignition, rate of spread, difficulty of control and fire impact. Steps such as deployment of additional resources or implementation or fire bans are taken in accordance with the change in fire danger.[2]

Fire Detection: A system for or the act of discovering, locating and reporting wildfires.[1]

Fire Effect(s): Any change(s) on an area attributable to a fire, whether immediate or long-term, and on-site or off-site.[2]

Fireguard: A strategically planned barrier, either manually or mechanically constructed, intended to stop or retard the rate of spread of a fire, and from which suppression action is carried out to control a fire. The constructed portion of a control line.[1]

Fire History: The study and/or compilation of evidence (e.g. historical documents, fire reports, fire scars, tree growth rings, charcoal deposits) that records the occurrence and effects of past wildfires for an area.[1]

Fire Load: The number and magnitude of all fires requiring suppression action during a given period within a specified area.[1]

Fire Management: Those activities associated with the protection of people, property and landscapes from fire, as well as the use of prescribed burning to achieve land management objectives.[1]

Fire Occurrence: The number of fires started in a given area over a given period of time.[1]

Fire Prevention: Activities directed at reducing fire occurrence; includes public education, law enforcement, personal contact, and reduction of fire hazards and risks.[1]

Fire Regime: The kind of fire activity or pattern of fires that generally characterize a given area. Some important elements of the characteristic pattern include fire cycle or fire interval, fire season, and the number, type and intensity of fires.[1]

Fire Season: The period(s) of the year during which fires are likely to start, spread and do damage to values-at-risk sufficient to warrant organized fire suppression.[2]

Fire Suppression: See Control a Fire.

Fire Use: All activities aimed at attaining ecosystem management objectives or fire risk reduction through the use of prescribed fires.[3]

Fire Weather Index (FWI): A numerical rating of fire intensity that forms the basis of fire danger indices throughout forested areas of Canada.[1]

Fuelbreak: An existing barrier or change in fuel type (to one that is less flammable than that surrounding it), or a wide strip of land on which the native vegetation has been modified or cleared, that act as a buffer to fire spread so that fires burning into them can be more readily controlled.[1]

Fuel Load: The dry weight of combustible materials per unit area.[2]

Fuel Management: The planned manipulation and/or reduction of living or dead forest fuels for forest management and other land use objectives.[2]

Indirect Attack: A method whereby the control line is strategically located to take advantage of favourable terrain and natural breaks in advance of the fire perimeter and the intervening strip is usually burned out or backfired.[1]

Initial Attack: The action taken to halt the spread or potential spread of a fire by the first fire fighting force to arrive at the fire.[1]

Out of Control: See Control a Fire.

Planned Ignition Fire: A fire ignited a pre-planned location and time by authorized personnel.[3]

Planned Prescribed Fire: See Planned Ignition Fire.

Prescribed Burning: The knowledgeable application of fire to a specific land area to accomplish predetermined forest management or other land use objectives.[1]

Prescribed Fire: Any fire utilized for prescribed burning; usually ignited according to agency policy and management objectives.[1]

Prescribed Natural Fire: See Unplanned Prescribed Fire.

Prescription: A written statement and/or list defining the objectives to be attained from prescribed burning, the geographical limits of the area to be burnt, as well as the acceptable values of the various parameters that can affect fire behaviour.[3]
Pre-suppression: Those fire management activities in advance of fire occurrence concerned with the organization, training and management of a fire fighting force and the

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[3] From *Interim Management Bulletin 2.4.4: Fire Management* by Parks Canada, Ecological Integrity Branch, April 28, 2004, pp. 1-3.

procurement, training, and management of a fire fighting force and the procurement, maintenance and inspection of improvements, equipment and supplies to ensure effective fire suppression.[1]

Random Ignition Fire: A fire ignited at a random time and location by natural causes or accidental human sources.[3]

Strategy: The general plan or direction selected to accomplish incident objectives.[1]

Suppression: See Control a Fire.

Under Control: See Control a Fire.

Unplanned Prescribed Fire: A fire ignited at a random time and location by natural causes that is allowed to spread within prescription.

Values-at-Risk: The specific or collective set of natural resources and man-made improvements/developments that have measurable or intrinsic value and could be destroyed or otherwise altered by fire in any given area.[1]

Wildfire: An unplanned natural or human-caused fire, as contrasted with a prescribed fire.[1]

APPENDIX B: QUESTIONNAIRE

QUESTIONNAIRE: FIRE MANAGEMENT IN THE LAKE LOUISE, YOHO AND KOOTENAY NATIONAL PARKS FIELD UNIT (LLYK FIELD UNIT)

The goal of this questionnaire is to gather information about the implementation of the 1998 LLYK Fire Management Plan, the state of fire management in the field unit, and the factors that influence implementation efforts. Recommendations arising from this work are intended to assist fire management and other field unit staff with future fire management planning efforts. First I would like to start with some questions about you.

Q-1. How long have you worked for Parks Canada? _____

Q-2. How long have you worked in your current position? _____

Q-3. What year were you born? _____

Q-4a. What is your position title?_____

Q-4b. What is your classification (e.g. GT-02, PC-01?)_____

Q-5. In your current position, what tasks or responsibilities do you participate in related to the fire management program? *Please check all the categories that apply to you.*

___Participate in fire suppression operations
___Plan fire management initiatives (e.g. prescribed burning, facility protection, research, communications)
___Implement fire management initiatives (e.g. prescribed burning, facility protection, research, communications)
___Provide advice about resource management or social/human use implications of fire management activities
___Develop fire management policy
___Review proposed fire management initiatives or policy
___Approve proposed fire management initiatives or policy

Other:_____

_____

Q-6. How familiar are you with the 1998 LLYK Field Unit Fire Management Plan? *Please rate your familiarity with the plan on a scale of 1 to 5, where 1 means you have never looked at the plan and 5 means you have read the plan thoroughly.*

Not At All Familiar	----------	**Somewhat Familiar**	----------	**Very Familiar**
1	2	3	4	5

CONTEXT

I am going to start by asking you some questions about the historical and current role of wildfire in the field unit, and the fire management program in general. I am considering "historical" to mean the period before active suppression began (ca. 1909 when the warden service was established). *Please rate the following statements on a scale of 1 to 5, where 1 indicates that you disagree strongly and 5 indicates that you agree strongly.*

Q-7. Historically, infrequent stand replacing fires played an important role in shaping subalpine ecosystems.

Strongly Disagree	----------	**Uncertain**	----------	**Strongly Agree**
1	2	3	4	5

Q-8. Historically, frequent low to moderate intensity fires played an important role in shaping montane ecosystems.

Strongly Disagree	----------	**Uncertain**	----------	**Strongly Agree**
1	2	3	4	5

Q-9. Aboriginal fire played an important role in shaping the landscape prior to park establishment.

Strongly Disagree	----------	**Uncertain**	----------	**Strongly Agree**
1	2	3	4	5

Q-10. Fire suppression has resulted in a reduction in area burned by wildfires.

Strongly Disagree	----------	**Uncertain**	----------	**Strongly Agree**
1	2	3	4	5

Q-11. Fire creates a mosaic of vegetation types that provides habitat for a variety of animals.

Strongly Disagree	----------	**Uncertain**	----------	**Strongly Agree**
1	2	3	4	5

Q-12. What role should fire play in the field unit today?

Q-13. Considering your response to Question 12, what are the three most significant factors that might constrain achieving the desired role of fire in the field unit?

Q-14. How would you characterize the general approach to managing natural disturbances like fire in the field unit? *Please rate this approach on a scale of 1 to 5, where 1 indicates that no action is taken until the event occurs and 5 indicates that there is a significant attempt to anticipate events and plan how they will be managed.*

Very Reactive	----------	**Neutral**	----------	**Very Proactive**
1	2	3	4	5

Q-15. How appropriate are the goals for fire management in the LLYK field unit? *Please rate each goal on a scale of 1 to 5, where 1 indicates that you disagree strongly with the goal, and 5 indicates that you agree strongly with the goal.*

A. To ensure protection of life, property, cultural and natural resources on park and adjacent lands by suppression of wildfire, while minimizing the environmental effects of suppression activities.

Strongly Disagree	----------	**Uncertain**	----------	**Strongly Agree**
1	2	3	4	5

B. To maintain or restore, as closely as possible, the role of fire within park ecosystems.

Strongly Disagree	----------	**Uncertain**	----------	**Strongly Agree**
1	2	3	4	5

Q-16. What process should be used to set objectives for fire management at the field unit level?

Q-17. What criteria should be used to evaluate the success of past fire management initiatives or actions?

Q-18. What are the strengths of the LLYK field unit fire management program?

Q-19. What are the weaknesses of the LLYK field unit fire management program?

Q-20. What do you think is the main challenge facing the fire management program in the LLYK field unit?

Q-21. Why do you think this is a major challenge?

Q-22. If you had to pick one priority for fire management in the LLYK field unit in the next five years, what would it be? *Please circle your choice.*

Communications	Interagency Coordination
Community and Facility Protection	Prescribed Burning
Fire Control	Research and Monitoring
Other:_____	

Q-23. How is Parks Canada performing in fire management overall?

5 Excellent
4 Good
3 Fair
2 Poor
1 Don't know

Q-24. How does implementation of the fire management program in the LLYK Field Unit compare to other field units (e.g. Banff, Jasper, Waterton, Glacier/Revelstoke, Prince Albert, Elk Island, Riding Mountain)?

FIRE MANAGEMENT ACTIVITIES

Next I would like to take a closer look at each of the activities associated with fire management. I am interested in finding out what factors are influencing the implementation of these activities, in either a positive or negative way. Factors may include things like resources, policies, processes, knowledge, perceptions or values.

FIRE CONTROL

Fire control involves a series of activities aimed at controlling and extinguishing a wildfire following its detection. Ninety-two fires have occurred in the field unit since 1998. Ninety-three percent of these fires were smaller than 5 ha (about the size of 10 football fields), but the field unit has also managed several large mid-summer lightning fires, including the Mt. Shanks fire in 2001 (3,800 ha) and the Kootenay complex in 2003 (16,700 ha).

Q-25. Looking back on these events, how would you rate the field unit's ability to manage unplanned fires? *Please circle your choice.*

5 Excellent
4 Good
3 Fair
2 Poor
1 Don't know

Q-26. What factors do you think are facilitating the implementation of fire control**?**

Q-27. What factors do you think are hindering the implementation of fire control?

PRESCRIBED BURNING

The LLYK Field Unit initiated a program of management-ignited prescribed burning in 1997. Since then, fourteen prescribed burns have been carried out (see Map 1 at end of survey), covering a total of 530 ha. The majority of these prescribed burns targeted montane meadows. The largest prescribed burn carried out to date was the 300 ha Simpson River prescribed burn in 2001.

Q-28. What is your opinion of the amount of prescribed burning in the field unit? *Please rate your response on a scale of 1 to 5, where 1 means that the field unit should be conducting much less prescribed burning, and 5 means that the field unit should be conducting much more prescribed burning.*

Much less prescribed burning required	----------	**Level of prescribed burning is adequate**	----------	**Much more prescribed burning required**
1	2	3	4	5

Q-29. What factors do you think are facilitating the implementation of prescribed burning**?**

Q-30. What factors do you think are hindering the implementation of prescribed burning?

PRESCRIBED RANDOM IGNITIONS

Another way to achieve ecological gains is by allowing random ignitions to spread within the Random/Planned Ignition Zone (see Map 2 at end of survey) when they are within prescription, instead of suppressing them immediately. Thirteen random ignitions occurred in the Random/Planned Ignition Zone over the last 5 years. Only one was within prescription, and it was suppressed.

Q-31. What role do you think random ignitions should play in the fire management program?

Q-32. What factors do you think are hindering the implementation of prescribed random ignitions?

FUEL MANAGEMENT

Fuel management includes activities, such as fuel reduction programs around specific facilities or townsites, construction of landscape level fuelbreaks, and work with stakeholders to implement fire protection measures. Over the last five years, facility protection has been carried out at Mosquito Creek Hostel, Kootenay Park Lodge and Redstreak Campground. Landscape level fuelbreaks have been created at Redstreak and in the Simpson River drainage.

Q-33. What is your opinion of the amount of fuel management in the field unit? *Please rate your response on a scale of 1 to 5, where 1 means that the field unit should be conducting much less fuel management, and 5 means that the field unit should be conducting much more fuel management.*

Much less fuel management required	----------	**Level of fuel management is adequate**	----------	**Much more fuel management required**
1	2	3	4	5

Q-34. What factors do you think are facilitating the implementation of fuel management?

Q-35. What factors do you think are hindering the implementation of fuel management?

RESEARCH AND MONITORING

The research and monitoring program is intended to fill in gaps in our understanding of fire behaviour and effects, and the effects of management interventions on the landscape. Over the past five years, sixteen different research projects have been started and/or completed, with topics ranging from mountain pine beetle, to whitebark pine, to avian monitoring in burned areas.

Q-36. How familiar are you with research and monitoring related to fire in the LLYK field unit? *Please rate your response on a scale of 1 to 5, where 1 means that you are very unfamiliar with research and monitoring in the field unit, and 5 means that you are very familiar with research and monitoring in the field unit.*

Very Unfamiliar	----------	**Somewhat Familiar**	----------	**Very Familiar**
1	2	3	4	5

If you answered 1 or 2, please go to Q-38 (do not answer Q-37).

Q-37. What is your opinion of the information being generated by fire research and monitoring?

COMMUNICATIONS

Communications activities aim to deliver fire management messages to both internal audiences (e.g. field unit staff) and external audiences (e.g. park visitors, key stakeholders).

Q-38. What are the fire management messages that should be communicated to the public? *Please rank the messages below in the order in which you think they should be communicated, where 1 is the most important message the public should receive and 5 is the least important message the public should receive.*

____How fire is managed by the field unit
____The ecological role of fire in the field unit
____The importance of preventing unwanted fire and how to report a wildfire
____The need for fuel management around facilities and communities
____The reasons for prescribed burning
Other:_____

_____

_____

Q-39a. How consistently are fire management messages being communicated by the field unit? By consistent, I mean that the communications conform to a regular pattern (i.e. under similar circumstances, the same messages are communicated in the same way). *Please rate your response on a scale of 1 to 5, where 1 means that the communication of fire management messages is very inconsistent, and 5 means that the communication of fire management messages is very consistent.*

Very Inconsistent	----------	**Somewhat Consistent**	----------	**Very Consistent**
1	2	3	4	5

If you answered 3, 4 or 5, please go to Q-40a (do not answer Q-39b).

Q-39b. Why do you think messages are being communicated less than somewhat consistently?

Q-40a. Are the right people being reached? *Please circle your choice.*

1 Yes
2 No
3 I don't know

If you answered "yes" or "I don't know", please go to Q-41 (do not answer Q-40b).

Q-40b. Which audiences are not being reached?

Q-41. How can communications be improved?

INTERAGENCY COORDINATION

Interagency coordination involves work with other agencies (e.g. mutual aid agreements, agreements for boundary areas) to achieve common fire management objectives. Two major initiatives over the past five years have been: work with the Province of Alberta on an interagency fire management plan for the Upper North Saskatchewan watershed and with the Province of BC on a prescribed burn plan for the Redstreak/Stoddart Creek area.

Q-42. How familiar are you with interagency initiatives related to fire management in the LLYK field unit? *Please rate your response on a scale of 1 to 5, where 1 means that you are very unfamiliar with interagency initiatives in the field unit, and 5 means that you are very familiar with interagency initiatives in the field unit.*

Very Unfamiliar	----------	**Somewhat Familiar**	----------	**Very Familiar**
1	2	3	4	5

If you answered 1 or 2, please go to Q-44 (do not answer Q-43).

Q-43. What is your opinion of the work being carried out with other land management or fire management agencies?

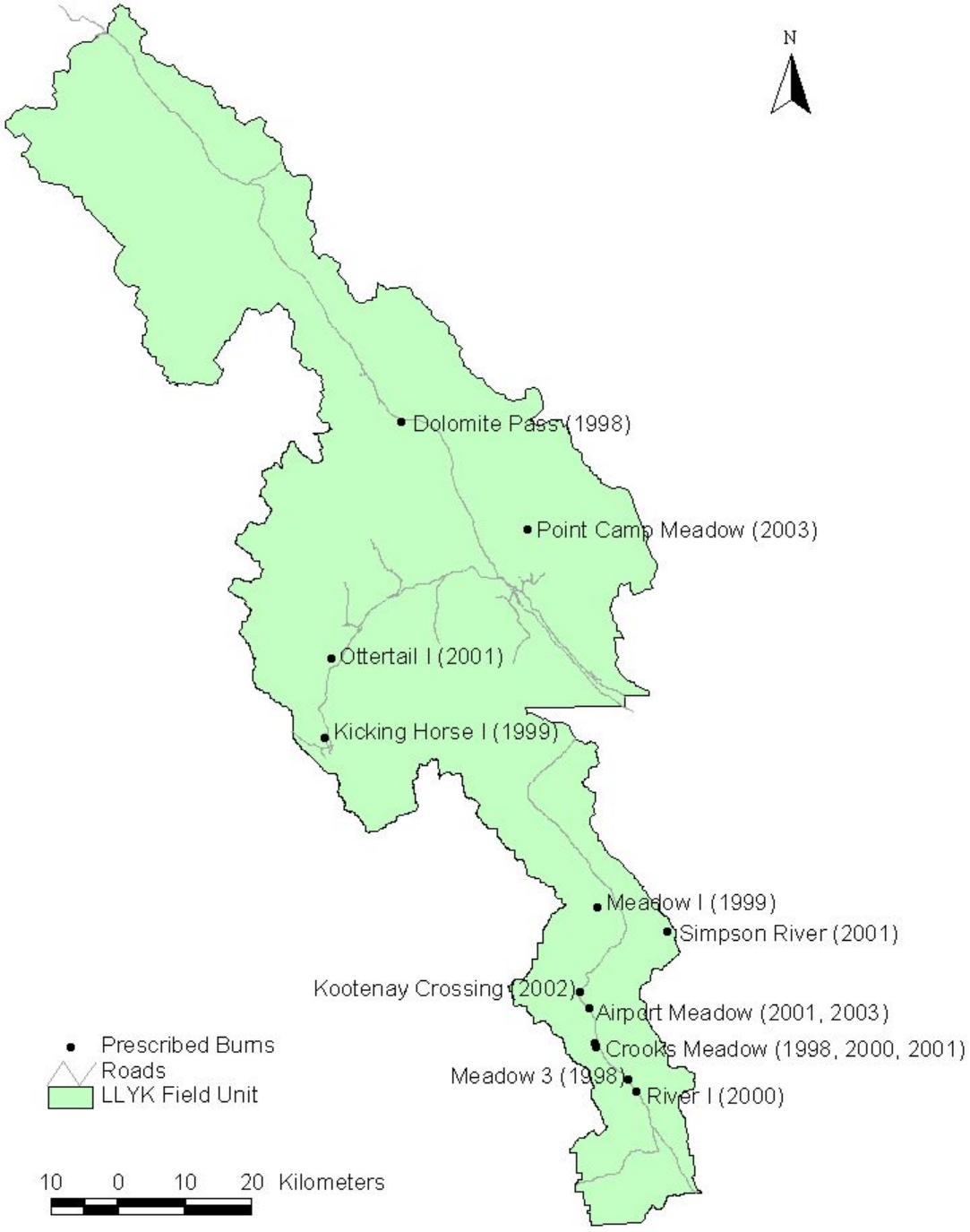
Before I complete this interview:

Q-44. Are there any questions you would like to go back to elaborate on?
Q-45. Do you have any comments that you would like to make about this interview?
Q-46. Do you have any questions that you would like to ask me about the research project?

I will be sending you the transcript of your answers to the open-ended questions by e-mail within the next couple of days, so that you can verify that I have captured your comments accurately. Any additional information that you wish to add is welcome. If you have any questions or comments at a later date, please feel free to contact me.

This concludes the interview. Thank you very much for taking the time to talk to me.

Map 1. LLYK Field Unit Prescribed Burns 1998 to 2003



Map 2. Fire Management Unit Zoning (from 1998 Fire Management Plan)

APPENDIX C: INFORMED CONSENT AGREEMENT

Professional Faculties Building
Telephone: (403) 220-6601
Fax: (403) 284-4399
Email: info@evds.ucalgary.ca

Informed Consent Agreement

Research Project Title: From Suppression to Prescription: Evaluating the Implementation of Fire Management Planning in Lake Louise, and Yoho and Kootenay National Parks

Investigator: Amber Stewart

Sponsor: Parks Canada

Thank you for agreeing to be interviewed for this research project. This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of this research is to gain a better understanding of the issues surrounding implementation of the fire management program in the Lake Louise, and Yoho and Kootenay National Parks (LLYK) Field Unit. This questionnaire will be used to gather information about the implementation of the 1998 LLYK Fire Management Plan, the state of fire management in the field unit, and the factors that influence the effectiveness of implementation efforts. Recommendations arising from this work are intended to assist fire management and other field unit staff with future fire management planning. You have been selected because of your involvement with or knowledge of the fire management program in your professional capacity.

This interview will take approximately 1 hour to complete. I will ask you various questions about fire management and will take notes on a lap top computer to record your answers. There will also be some multiple choice questions for you to fill out. Following the interview, I will e-mail the interview notes to you so that you can verify that your comments were accurately captured. Please return these to me as soon as possible – they will become the final record of the interview.

I will be very careful in dealing with confidential information. Questionnaires and associated notes and files will be coded with a number. Only I will have the key linking the codes to participants' names. Access to the raw data from the interviews will be limited to me and my academic committee at the University of Calgary. No information

that discloses your identity will be released or published. All information will be reported anonymously or as part of data pooled in general categories (e.g. field unit managers, fire management personnel).

Completed hard copies of questionnaires and notes will be kept by my supervisor for two years following completion of research as required by the University of Calgary. They will be destroyed at the end of this period. Participation in this interview involves no risk of personal harm. Your participation is voluntary and you may withdraw from the study at any time, in which case any information collected from you will be destroyed.

I hope that the final results of this research will be of some benefit to you in your current work, either through improved knowledge of the state of fire management in the field unit, or improved fire management planning and implementation. If you are interested in the results of this project, I would be pleased to supply a summary upon completion of my research. A copy of the final report will be placed in various libraries so that there is public access to all of the results.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact:

Principal Investigator: Amber Stewart, Faculty of Environmental Design, University of Calgary; PHONE: (403) 522-2913; E-MAIL: acstewar@ucalgary.ca

Supervisor: Dr. Michael Quinn, Faculty of Environmental Design, University of Calgary; PHONE: (403) 220-7013; E-MAIL: quinn@ucalgary.ca

If you have any questions or issues concerning this project that are not related to the specifics of the research, you may also contact the Research Services Office at 220-3782 and ask for Mrs. Patricia Evans.

Participant's Signature Date

Investigator and/or Delegate's Signature Date

A copy of this consent form has been given to you to keep for your records and reference.

APPENDIX D: NON-PARAMETRIC STATISTICAL TESTS

5.1.2 Familiarity with the Fire Management Plan by Position

Kruskal-Wallis

Position; p = 0.017

Mann-Whitney U

	Field Unit Fire Management Staff	Other Fire Management Staff	Specialists	Managers
Field Unit Fire Management Staff	---	p = 0.658	p = 0.035	p = 0.027
Other Fire Management Staff	p = 0.658	---	p = 0.042	p = 0.043
Specialists	p = 0.035	p = 0.042	---	p = 0.455
Managers	p = 0.027	p = 0.043	p = 0.455	---

5.1.2 Familiarity with the Fire Management Plan by Task

Mann-Whitney U

	Participate	Plan	Implement	Advice	Policy	Review	Approve
p-value	.007	.036	.036	.095	.006	.292	.045
Median “no”	2.0	2.0	2.0	2.0	2.0	2.5	3.0
Median “yes”	3.0	3.0	3.0	3.0	3.0	3.0	3.5

5.2.1 Fire Control

Kruskal-Wallis

Position; p = 0.075

Mann-Whitney U

	Field Unit Fire Management Staff	Other Fire Management Staff	Specialists	Managers
Field Unit Fire Management Staff	---	p = 0.442	p = 0.973	p = 0.093
Other Fire Management Staff	p = 0.442	---	p = 0.042	p = 0.046
Specialists	p = 0.973	p = 0.042	---	p = 0.455
Managers	p = 0.093	p = 0.046	p = 0.455	---

Mann-Whitney U

	Participate	Plan	Implement	Advice	Policy	Review	Approve
p-value	.074	.095	.258	.276	.604	.356	.108
Mean “no”	4.0	4.0	4.0	4.0	3.0	3.0	3.0
Mean “yes”	3.0	3.0	3.0	3.0	3.0	3.25	4.0

5.2.2 Management-Ignited Prescribed Burning

Kruskal-Wallis

Position; p = 0.081

Mann-Whitney U

	Field Unit Fire Management Staff	Other Fire Management Staff	Specialists	Managers
Field Unit Fire Management Staff	---	p = 0.393	p = 0.250	p = 0.025
Other Fire Management Staff	p = 0.393	---	p = 0.880	p = 0.094
Specialists	p = 0.250	p = 0.880	---	p = 0.053
Managers	p = 0.025	p = 0.094	p = 0.053	---

Spearman's Correlation

Fire Control / Prescribed Burning

Correlation Coefficient = -0.519
Sig. (2-tailed) = 0.001
N=38

Plan Familiarity / Prescribed Burning

Correlation Coefficient = 0.451
Sig. (2-tailed) = 0.005
N=38

5.2.3 Fuel Management

Kruskal-Wallis

Number of Years in Current Position; p = 0.059

Mann-Whitney U

	Less than 3 years in current position	3 to < 6 years in current position	6 to < 8 years in current position	8 years or greater in current position
Less than 3 years in current position	---	p = 0.08	p = 0.069	p = 0.028
3 to < 6 years in current position	p = 0.08	---	p = 0.544	p = 0.319
6 to < 8 years in current position	p = 0.069	p = 0.544	---	p = 0.458
8 years or greater in current position	p = 0.028	p = 0.319	p = 0.458	---

5.2.5 Research and Monitoring

Spearman's Correlation

Plan Familiarity / Research and Monitoring

Correlation Coefficient = 0.316
Sig. (2-tailed) = 0.047
N = 40

5.2.6 Interagency Coordination

Kruskal-Wallis

Position; p = 0.008

Mann-Whitney U

	Field Unit Fire Management Staff	Other Fire Management Staff	Specialists	Managers
Field Unit Fire Management Staff	---	p = 0.293	p = 0.024	p = 0.006
Other Fire Management Staff	p = 0.293	---	p = 0.162	p = 0.068
Specialists	p = 0.024	p = 0.162	---	p = 0.036
Managers	p = 0.006	p = 0.068	p = 0.036	---

Mann-Whitney U

	Participate	Plan	Implement	Advice	Policy	Review	Approve
p-value	.003	.008	.008	.167	.048	.305	.013
Median “no”	2.0	2.0	2.0	2.5	3.0	3.0	3.0
Median “yes”	3.0	3.0	3.0	3.0	4.0	3.0	4.0

Spearman’s Correlation

Interagency Correlation / Plan Familiarity

Correlation Coefficient = 0.446
Sig. (2-tailed) = 0.004
N = 40

Interagency Correlation / Research and Monitoring

Correlation Coefficient = 0.538
Sig. (2-tailed) = 0.000
N = 40

5.2.7 Comparing the LLYK Field Unit to other Field Units

Kruskal-Wallis

Position; p = 0.032

Mann-Whitney U

	Field Unit Fire Management Staff	Other Fire Management Staff	Specialists	Managers
Field Unit Fire Management Staff	---	p = 0.382	p = 0.208	p = 0.021
Other Fire Management Staff	p = 0.382	---	p = 0.571	p = 0.065
Specialists	p = 0.208	p = 0.571	---	p = 0.238
Managers	p = 0.021	p = 0.065	p = 0.238	---

	Participate	Plan	Implement	Advice	Policy	Review	Approve
p-value	.064	.040	.114	.146	.612	.454	.548
Median "no"	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Median "yes"	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Spearman's Correlation

	Familiarity with Fire Management Plan	Amount of Prescribed Burning	Ability to Manage Fire
Correlation Coefficient	-0.357	-0.403	0.619
Sig. (2-tailed)	0.032	0.015	0.000
N	36	36	36

5.3 Support for Fire Management

Q-7: Infrequent stand replacing fires played an important role in shaping subalpine ecosystems
Q-8: Frequent low to moderate intensity fires played an important role in shaping montane ecosystems
Q-9: Aboriginal fire played an important role in shaping the landscape prior to park establishment
Q-10: Fire suppression has resulted in a reduction in area burned by wildfires

Q-11: Fire creates a mosaic of vegetation types that provides habitat for a variety of animals

Kruskal-Wallis

- No significant difference for Q-7 through Q-11 by position, gender, age, number of years with Parks Canada, or number of years in current position
- Significant difference in level of agreement among statements; p = 0.000

Mann-Whitney U

	Q-7	Q-8	Q-9	Q-10	Q-11
Q-7	---	p = 0.097	p = 0.174	p = 0.015	p = 0.000
Q-8	p = 0.097	---	p = 0.006	p = 0.445	p = 0.006
Q-9	p = 0.174	p = 0.006	---	p = 0.000	p = 0.000
Q-10	p = 0.015	p = 0.445	p = 0.000	---	p = 0.041
Q-11	p = 0.000	p = 0.006	p = 0.000	p = 0.041	---

Spearman's Correlation

		Q-7	Q-8	Q-9	Q-10	Q-11
Q-7	Correlation Coefficient	1.000	.449	.034	-.067	.188
	Sig. (2-tailed)	.	.004	.837	.680	.245
	N	40	40	40	40	40
Q-8	Correlation Coefficient	.449	1.000	.473	.326	.456
	Sig. (2-tailed)	.004	.	.002	.040	.003
	N	40	40	40	40	40
Q-9	Correlation Coefficient	.034	.473	1.000	.357	.144
	Sig. (2-tailed)	.837	.002	.	.024	.374
	N	40	40	40	40	40
Q-10	Correlation Coefficient	-.067	.326	.357	1.000	.148
	Sig. (2-tailed)	.680	.040	.024	.	.362
	N	40	40	40	40	40
Q-11	Correlation Coefficient	.188	.456	.144	.148	1.000
	Sig. (2-tailed)	.245	.003	.374	.362	.
	N	40	40	40	40	40

Mann-Whitney U: Degree of agreement with Q-10 by task

	Participate	Plan	Implement	Advice	Policy	Review	Approve
p-value	.630	.957	.592	.167	.048	.190	.120
Mean "no"	4.0	4.0	4.0	3.5	4.0	4.0	4.0
Mean "yes"	4.0	4.0	4.0	4.0	5.0	4.0	5.0

5.3.1 Fire Management Goals

Kruskal-Wallis

- No significant difference for two goals by position, gender, age, number of years with Parks Canada, or number of years in current position

Mann-Whitney U

- Significant difference in level of agreement with each goal; p = 0.016

Spearman's Correlation

	Goal A (Protection) / (Q-25) Fire Control	Goal A (Protection) / Q-33 (Amount of Fuel Mgmt)	Goal A (Protection) / Q-10 (Suppression)
Correlation Coefficient	0.367	0.333	0.431
Sig. (2-tailed)	0.023	0.041	0.006
N	38	38	39

APPENDIX E: THREE DIFFERENT VIEWS ON THE ROLE OF FIRE

Views expressed by three different respondents on the role that fire should play in the field unit are presented in this appendix. Their responses to the questionnaire question Q-12 (What role should fire play in the field unit today?) are reported verbatim. These three excerpts were chosen because: 1) they represent three slightly different views on the role of fire, and 2) they are more sophisticated and detailed than the majority of responses to this question.

The first view reflects a process-based approach, where the potential for ecological processes to operate freely is maximized within limits, such as other park management goals. The goal to manage for a range of ecosystem states is clearly articulated.

The second view reflects a slightly different approach, where a park would be managed to achieve a particular regime. In this view humans played an active historic role in moderating fire regimes, and that role simply continues into the present day. The third view reflects more explicitly than the second, a structure-based approach. Ecological goals are set in the park management plan and fire is used as a tool to achieve these ends.

Interestingly, all views are consistent with and recognize the need for an active management approach.

View 1

Ideally it should play a similar role to the one it has played in the past and ideally even that is not the whole story. We should allow ecological processes to govern the role in which fire functions. So in the ecology of fire management, there is no holy grail, we want there to be one - what fire cycle we should manage for? But there is not magic number, there is a range of numbers, and variability in that, and changes over time as a result of climate. So we should allow ecological processes to function as other things govern them, so for example, fire is driven by the regional and local climate, so the role fire should play is the role that those larger factors would dictate.

In national parks, there should be as little interference from man as possible to these ecological processes. The crux is that we have societal needs, the national parks are representative of our natural heritage, but we still have to live with them as representative areas - where there are impacts to humans and human values, there will be compromises that have to be made. When fires threaten to escape and affect public safety, townsites and neighboring lands, we will have to come up with solutions to minimize risk firstly and then mitigate impacts.

The next issue that is interesting in parks, is that as fires burn in parks, other values related to the Parks Canada mandate are affected, like the dual mandate for visitation and appreciation get impacted. An example is the Kootenay complex, where the Rockwall trail was threatened. We have to decide do we want all these areas black at once?

Even though ecological processes may move us that way, we need to look at other goals for parks, we need to provide opportunities to appreciate a variety of vegetative states in the park. That is the crux that Parks faces all the time.

So fire should play the role that shaped existing vegetation in the context of those processes that govern their frequency. We are now getting into the complication that these processes are being affected by human impacts, like fossil fuel burning, so that now the ecological processes may move us towards more frequent large-scale fire. Is that really a natural disturbance?

At the same time we can simplify things by saying that in the last 50 or 60 years there has been very little fire in the case of Kootenay and LLYK as a whole, with the exception of the last few years. There has been little fire since probably the 1920s and earlier, so to allow a significant amount of fire on the landscape can't go off the rails.

View 2

I would argue that we should move towards the park management target of 50% and there should be some attempt to manage on a microsm, because there is currently high potential for large wildfires due to past management practices. There should be some attempt to move back to a regime of small fires that are representative of when had

lightning fire interacting with anthropogenic fire, it would reflect the long term range of variability, and would reflect parks as a microcosm of the real world. Even if we commonly had large fires once, why would we want to let a large fire run in a park? We have obligations with respect to biodiversity, because parks are not big enough anymore to let fires burn large areas. Public safety is another factor - why argue for a big puff regime when it is bad for the economy? Hopefully that was visible in Kootenay, where the fire stopped where it hit the old Vermilion fire. We have altered the regime for the worse, so we can't say we will let nature make it up, because she will, but not in a way you like.

View 3

I think you need to refer to your park management plan, you can't have a process under discussion that large without having it in the forefront of the park management plan, it is what the public sees and it has legal standing, so that is the key document to have it in - if it is not in there, it is not going to go anywhere. Fire has a huge role … so it should be playing a leading role in the park management plan, it is a tool. Fire in and of itself serves no role other than an active disturbance role, it needs to be quantified through the park management plan: what kind of habitat do we want, what kind of mosaic, what kind of heterogeneity? Just to say "we need this much black" is not going to cut it.

The park management plan is a public expression of what you are going to do In [our field unit], we have to have a fire management plan, but it is a subsidiary document, to make sure we do things properly, it is not the justification for fire. That comes in other documents, like the park management plan, because no one else outside Parks Canada reads the fire management plan.