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Identifying areas of concern for regional cumulative effects assessments in and around northern national parks in Canada (Yukon)

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IDENTIFYING AREAS OF CONCERN FOR REGIONAL CUMULATIVE EFFECTS ASSESSMENTS IN AND AROUND NORTHERN NATIONAL PARKS IN CANADA

by

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Bachelor of Science Hon. (Biology), University of New Brunswick, 1998

THESIS

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ABSTRACT

This thesis uses a literature review of protected areas selection, park management, comprehensive regional land use planning, and cumulative environmental effects and assessment to develop a methodology that identifies areas with concentrations of social and/or ecological values in and around northern national parks.

The proposed methodology involves two stages. First, a database of values is developed by taking an inventory of social and ecological values through extensive literature reviews, interviews, and consultation with the public. This database is then used in the second step to determine areas with concentrations of social and/or ecological values, or "value hotspots", using a series of tables and maps.

Once developed, the methodology is tested with a case study of the Greater Kluane Region in southwest Yukon. This analysis identified twelve value hotspots that contain a high number of the study area's social and ecological values. It is suggested that these hotspots need to be given special consideration in future planning exercises and when exploring questions surrounding cumulative environmental effects arising in and around Kluane National Park and Reserve.

In light of the case study findings, some potential future applications in regional planning exercises and in cumulative effects assessments are discussed. The primary recommended planning application involves setting development thresholds or limits of acceptable change for the value hotspots so as to take a proactive stance on cumulative environmental effects. In addition, the values database would be useful in project-level environmental assessments, acting as a checklist of local values.

ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS

CAFN - Champagne and Aishihik First Nations

CEAs - Cumulative Effects Assessments

CEEs - Cumulative Environmental Effects

CORE - Commission on Resources and Environment

DIAND - Department of Indian Affairs and Northern Development

DRR - Department of Renewable Resources

EA - Environmental Assessment

KFN - Kluane First Nation

KNPR - Kluane National Park and Reserve

KWS - Kluane Wildlife Sanctuary

LAC - Limits of Acceptable Change

LSRP - Lancaster Sound Regional Land Use Plan

MDBSRP - Mackenzie Delta-Beaufort Sea Regional Land Use Plan

NLUP - Northern Land Use Planning Process

OMNR - Ontario Ministry of Natural Resources

SLUP - Strategic Land Use Planning Process

VAMP - Visitor Activity Management Process

VECs - Valued Ecosystem Components

VSCs - Valued Socioeconomic Components

WRFN - White River First Nation

YTG - Yukon Territorial Government

CHAPTER 1 - INTRODUCTION

1.1 BACKGROUND

The need to establish a network of protected areas has been given considerable attention in the past 20 years. Canada now has a variety of designated sites, ranging from national and provincial parks to wildlife sanctuaries and environmentally sensitive areas. Indeed, Canada's national parks are one of the country's greatest legacies which have unfolded - and continue to expand - over the past century.

Management foci have changed significantly since the establishment of Canada's first national park in 1885. Early management concerns included eliminating predators, suppressing fires, conserving wildlife, and providing recreation facilities. There was little or no consideration of surrounding land use practices, and most management efforts were focused within park boundaries (CEAC, 1991; Nelson, 1979).

As more parks were established and adjacent development activities continued to expand, it became evident that national parks were at risk. This was primarily due to ecologically irrelevant boundaries and poor to nonexistent coordination and cooperation on management issues between protected areas managers and neighbors on adjacent lands. These weaknesses led to the adoption of a more regional, ecosystem-based management approach which encouraged the planning and management of national parks within a regional context. Indeed, it is now commonly accepted that "establishing protected areas in isolation from regional planning and decision-making processes is not an effective way to ensure the maintenance of their long-term ecological integrity" (CEAC, 1991: 39).

This more regional view encompasses larger space and time scales than traditional management approaches. Consequently, it is important to consider the impacts arising from all activities located both inside and outside park boundaries. In addition, it is important to consider the interactions among these stressors since they may combine in space and time in an additive or synergistic manner. These accumulations would result in cumulative environmental effects (CEEs), allowing seemingly harmless, small scale developments to have a significant negative impact on park ecosystems (Spaling, 1994).

The Panel on the Ecological Integrity of Canada's National Parks states that although park staff recognize the importance of understanding CEEs, limited resources have resulted in a focus on small-scale effects. As a result, cumulative and landscape level effects are not well addressed in current park planning and management practices. Indeed, of 36 national parks surveyed in 1995-1996, 21 reported severe or major CEEs, and 14 reported significant or minor CEEs. Only 1 park reported no CEEs, and only 3 parks reported that the overall trend was decreasing (Parks Canada, 1998).

Although most of the national parks sustaining major and severe CEEs are located in southern Canada, many northern parks reported significant CEEs (eg. Aulavik, Ivvavik, Kluane, Nahanni, Wood Buffalo). Since northern ecological systems are quite sensitive to human disturbance and the impacts of adjacent land use activities are becoming increasingly more significant (Parks Canada, 1998), it is imperative that managers of northern parks learn a lesson from the southern parks and take a proactive stance on regional management and CEEs. By addressing adjacent land uses and acknowledging the potential for CEEs before any substantial damage is done to park ecosystems, Canada's northern parks can continue to protect Canada's natural heritage for future generations.

Herein lies the motivation for this study. The purpose of this thesis is to develop a methodology for identifying areas of concern for regional cumulative effects assessments in and around northern national parks. This work also addresses the need to "determine how to manage the increasing flow of development requests as a way of limiting cumulative effects" as recommended by the Panel on the Ecological Integrity of Canada's National Parks (Parks Canada, 2000:12.17).

The methodology is developed by integrating aspects of protected areas selection, northern national park management, comprehensive regional land use planning, and cumulative environmental effects and assessment. A case study of the application of the methodology as well as a discussion of its potential future applications in regional land use planning and cumulative effects assessments is also included.

An overview of thesis goals and objectives (section 1.2) and a brief introduction to some of the major themes encountered throughout this thesis (section 1.3) are provided below. Some key terms used throughout the thesis are then defined (section 1.4), and an outline of the thesis (section 1.5) presented.

1.2 GOALS AND OBJECTIVES

Three main goals have been identified for this thesis. They are: (1) develop a methodology for identifying areas of concern for regional cumulative effects assessments in and around northern national parks; (2) test the method through a case study; and (3) discuss some potential applications of the methodology in regional planning exercises and cumulative effects assessments.

The first goal involves developing a methodology that will help planners and managers of northern national parks to take a proactive stance on minimizing CEEs. Specific objectives are:

i. place the consideration of CEEs in northern parks within the literature of protected areas selection, national park management, comprehensive regional land use planning, and cumulative environmental effects and assessment; and

ii. develop a list of guiding principles to evaluate strengths and weaknesses of the methodology.

The second goal involves testing the proposed method through a case study application in the Greater Kluane Region in southwest Yukon. This location is ideal for the case study as it contains a large national park with significant ecological diversity and CEEs are becoming an increasing concern (Parks Canada, 1998). Specific objectives are:

i. identify key social and ecological aspects of the Greater Kluane Region by reviewing documents and reports; and

ii. create maps as tools for summarizing existing information and making data available to a broad audience.

The third and final goal of this thesis is to discuss some potential applications of the methodology in regional planning exercises and cumulative effects assessments. Specific objectives of this goal are:

i. discuss the potential application of the methodology in regional land use planning exercises;

ii. discuss the potential application of the methodology in cumulative effects assessments;

iii. discuss implications of the case study; and

iv. evaluate strengths and weaknesses of the methodology based on predetermined guiding principles.

1.3 THESIS THEMES

There are four main themes that require a brief introduction to demonstrate the context and significance of the current study: protected areas selection, northern national park management, comprehensive regional land use planning, and cumulative environmental effects and assessment. Although these themes are not commonly tied together, when integrated they can form a solid foundation for planning parks in a regional context in order to minimize potential CEEs.

First, a general introduction to the key themes in the literature on selecting protected areas is provided (section 1.3.1). The benefits of and need for northern parks are then outlined, and key aspects of national park management are highlighted (section 1.3.2). Comprehensive regional land use planning is then defined, followed by a discussion of its application around national parks (section 1.3.3). Finally, cumulative environmental effects and assessments are defined and discussed within the context of national parks (section 1.3.4).

1.3.1 PROTECTED AREAS SELECTION

Protected areas provide ecological, educational, scientific, economic, and cultural/spiritual benefits. Examples include maintaining essential ecological processes, promoting a deeper understanding and respect for nature, recreation, acting as benchmarks for scientific studies, preserving genetic stocks for economic purposes (eg. medicines), and strengthening cultural identity and heritage values (CEAC, 1991).

As economic development continues to expand, it is becoming increasingly important that a complete system of protected areas be firmly established. Various studies have been carried out on criteria for selecting these protected areas, including studies on the selection of natural areas (reviewed by Smith and Therbege, 1986), environmentally sensitive areas (Eagles, 1980), environmentally significant areas (Theberge *et al.*, 1980), and national parks (Parks Canada, 1994). In addition, studies on ecological boundary considerations (Theberge, 1989) also provide some insight into appropriate locations and dimensions of protected areas. Each of these studies is reviewed in Chapter 2.

1.3.2 NORTHERN PARK MANAGEMENT

Canada's national parks are selected based on their level of representation of specific national park natural regions (see section 2.1 for details). In the northern territories, there are currently nine operating terrestrial national parks and park reserves. There are also other protected areas such as territorial parks, heritage rivers, special management areas, bird sanctuaries, habitat protection areas, and national wildlife areas (Figure 1.1; New Parks North, 1999). Although only national parks are discussed in this thesis, it is important to note that these other parks and protected areas are also valuable.

Northern national parks are particularly important because they contain sensitive ecosystems which are highly susceptible to human damage and require long recovery periods. In addition, they display a wilderness character with minimal human impacts to date. They also play an important role in maintaining northern culture, as many wildlife populations sustained by these parks are critical for subsistence hunting and fishing across the North.

Due to the numerous values associated with northern parks, it is desirable to maintain them in as natural a state as possible. To reach this goal, it is often necessary to manage human activities in and around these parks. Generally, management approaches in national parks use a conservation science framework to maintain *ecological integrity*. This is accomplished through the employment of *ecosystem-based management*, which considers *threats* to park ecosystems arising from internal and external sources. Impacts are considered through *environmental assessments*, after which *monitoring* programs are established to ensure the maintenance of ecological integrity (Parks Canada, 1999). Each of these topics is discussed in detail in Chapter 2.

1.3.3 COMPREHENSIVE REGIONAL LAND USE PLANNING

Since many large northern wildlife species are wide-ranging (eg. wolverines, bears, wolves) or migratory (eg. salmon, caribou, waterfowl), they often move outside park boundaries in search of habitat suitable for various stages of their life cycle. Consequently, it is necessary not only to manage and plan within park boundaries, but to expand the scope to include the surroundings in which the park is located. One potential approach to viewing parks in a broader context is through comprehensive regional land use planning (CRLUP).

CRLUP is a planning process that uses specific objectives or a desired future state based on public values to direct the allocation of land among multiple stakeholders in a particular region (Brown, 1996; Fenge, 1987). It goes beyond single-purpose functional planning to integrate environmental, economic, and social objectives at provincial, sub-provincial, and local levels to form a strategic plan which directs all subsequent land use planning within the area towards the desired vision (Branch, 1998; Brown, 1996).

Due to large space and time scales and the dynamic nature of the environment, uncertainty, risk, and ambiguity are inherent to this process. CRLUP is therefore a continuous and flexible process in which review and feedback are integral components (Branch, 1998). The most fundamental characteristics of CRLUP are summarized in Table 1.1.

Table 1.1 – Key Characteristics of Comprehensive Regional Land Use Planning (*source*: Hodge, 1998; Brown, 1996; Richardson, 1989).

Characteristic	Explanation
Direction seeking	Establishes visions and objectives at the outset, and designs plans to identify strategies to attain these goals.
Interactive and interest driven	Encourages stakeholder involvement to determine regional issues and concerns.
Anticipatory	Anticipates future issues before they arise.
Comprehensive	Integrates social, economic, social, and environmental objectives.
Complex	Involves large geographic areas, multiple governmental jurisdictions, and dynamic natural systems.
Continuous	Achieves continuity over time
Issues-focused	Emphasizes on the most promising solutions to key issues.
Clearly defined roles	Specifies the roles and responsibilities of each group of actors.
Time conscious	Sets reasonable time limits and is aware of constraints.
Flexible and adaptive	Accepts uncertainty, recognizes that the environment is dynamic, and responds to unanticipated events and information as they arise.

These characteristics of CRLUP make it a useful tool for viewing parks in a regional context. In particular, the focus on a predetermined vision or set of objectives for a region could help focus on the ultimate goal of maintaining ecological integrity in and around national parks. Furthermore, the comprehensiveness of CRLUP is amenable to the application of ecosystem-based management and the consideration of regional threats. Maintaining a regional view through processes such as CRLUP is extremely important, since scientific research has demonstrated that ecological integrity in parks depends largely on natural processes in areas surrounding parks (Nelson, 1993).

1.3.4 CUMULATIVE ENVIRONMENTAL EFFECTS AND ASSESSMENT

When working with the broad spatial and temporal scales involved in CRLUP, interactions among regional stressors become more apparent. Additive and synergistic interactions give rise to cumulative environmental effects (CEEs). These CEEs have been defined in a number of different ways. Table 1.2 presents some more commonly cited definitions. In general, all CEE definitions refer to the same concept: the presence of multiple stressors interacting in space and time in an additive or synergistic manner to have a cumulatively significant impact.

CEEs can be detected, evaluated, and possibly mitigated through cumulative effects assessments (CEAs). Many authors (CEAWG, 1999; Dias & Chinery, 1994; Spaling & Smit, 1994; Davies, 1993; Peterson *et al.*, 1987; Sonntag *et al.*, 1987) have identified two approaches to CEAs: project assessments and regional assessments. At the project level, a CEA is used as a type of environmental impact assessment. It is viewed as a scientific information gathering activity where the primary focus tends to be on examining the impacts of one project, while considering any potential interactions with past, existing, and future projects. Project-level CEAs are generally carried out in the following manner. First, the scope of the assessments is narrowed through identification of issues, valued ecosystem components, and system boundaries. Potential environmental impacts on valued ecosystem components are then analyzed, and possible mitigation measures identified. The significance of these potential impacts is then evaluated. Assessments also usually have a built-in follow up, in which the accuracy of the assessment is evaluated (CEAWG, 1999). At the project level, CEA is "considered distinct from planning and decision-making, but linked to it through information flow" (Spaling & Smit, 1994).

Table 1.2 – Definitions of Cumulative Environmental Effects.

Source	**Definition**
U.S. Council on Environment Quality, 1978	" ... the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions... Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."
Vlachos, 1982	"...integration of effects of all current and reasonably foreseeable actions over time and space... and ...three interrelated conceptual dimensions ... aggregative [sum of effects] ... interactive [how effects interact]... diachronic [how effects overlap in time] ..."
Dickert and Tuttle, 1985	"Cumulative impacts are those that result from the interactions of many incremental activities, each of which may have an insignificant effect when viewed alone, but which become cumulatively significant when seen in the aggregate."
Sonntag *et al.*, 1987	"... impacts on the natural and social environment which (1) occur so frequently in time or so densely in space that they cannot be 'assimilated', or (2) combine with effects of other activities in a synergistic manner."
Davies, 1991	"... the combined effects of all activities in an area over time; and the incremental effects associated with individual projects in an area over time."
Spaling and Smit, 1993	"...the phenomenon of temporal and spatial accumulation of change in environmental systems in an additive or interactive manner."
Sly, 1994	"... collective effects of many individual, multiple, and interactive forms of stress over time."
CEAWG, 1999	"... changes to the environment that are caused by an action in combination with other past, present and future human actions."

Conversely, regional level assessments consider CEAs as integral parts of proactive environmental planning (Spaling & Smit, 1994). The public are usually consulted to determine social regional characteristics or valued ecosystem components at the start of the process. Public input is also used to identify maximum acceptable levels of environmental change and regional thresholds, a regional overview not considered in project level CEAs. This framework is then used in conjunction with land use plans to judge the acceptability of proposed projects and activities, and to make tradeoffs between environmental, social, and economic objectives (Dias & Chinery, 1994; Eccles *et al.*, 1994). Thus, regional level assessments extend "beyond the analytical function of information collection, analysis, and interpretation to also include value setting, multi-goal orientation and participatory decision-making" (Spaling & Smit, 1994). Indeed, it is widely accepted that regional CEAs are "essential to identifying cumulative effects at a regional scale" (Slocombe, 1994) and necessary for "meaningfully assessing potential cumulative effects" (Dias and Chinery, 1994).

Since the purpose of this thesis is to address the issue of regional CEEs around northern national parks, further CEA discussions will focus on these regional level CEAs.

CEEs may be significant sources of environmental change and may ultimately lead to the degradation of park ecosystems if not planned for and mitigated in advance. To address this concern, several national parks have already carried out CEAs in attempt to incorporate CEEs into park management procedures (eg. Kluane National Park, Kouchibouguac National Park).

1.4 DEFINITIONS

Before proceeding, definitions for three key terms used throughout the remainder of the thesis must be given. First, some clarification regarding the term "regional" is required. This term is often confusing as regions can be considered at multiple scales, with the hierarchical scale involved inevitably affecting the results of a study. The actual scale used also varies tremendously with particular case studies and the goals and objectives of the research. Thus, throughout this thesis, "region" or "regional" is only used to encompass the broad notion of any bounded geographical area which is used in planning and management applications. When discussing a bounded area in the context of a particular case study, the term "study area" is used to avoid any confusion.

Definitions must also be provided for social values and ecological values. For the purposes of this thesis, social values are defined as activities, species, and locations of particular importance to members of the communities within the study area. These values may stem from a variety of sources such as recreation, subsistence, spirituality, science, or aesthetics. Note that this definition of social values excludes all commercial values such as forestry, mining, agriculture. These development activities were purposely excluded as they represent economic values as opposed to socio-cultural or ecological values. They will be considered in greater detail in Chapter 6.

Ecological values are defined as abiotic and biotic features of special ecological concern or interest. This includes both structural and functional aspects of an environment such as unique species or communities, critical habitats, and hydrological and geomorphological processes.

1.5 THESIS OUTLINE

To meet thesis goals and objectives, and to further develop the ideas expressed above, the remainder of this thesis is presented in five chapters.

Chapter 2: Literature Review. In this chapter, principles of protected areas selection, northern national park management, comprehensive regional land use planning, and cumulative environmental effects and assessment are reviewed and summarized.

Chapter 3: Proposed Methodology. Interactions among the four themes reviewed in Chapter 2 are discussed. Two sets of guiding principles are then developed from the literature reviewed in Chapter 2: one guiding the development of the methodology, the other guiding the application of the methodology. Each step of the proposed methodology is then described, explained, and justified in detail.

Chapter 4: Case Study Background. The methodology developed in Chapter 3 is applied in this chapter. First, a discussion of study area boundaries and justification for the particular location selected is presented. Then, key ecological and social aspects of the Greater Kluane Region are outlined. This chapter concludes with a history of park, planning, and assessment studies in the Greater Kluane Region.

Chapter 5: Case Study Results and Discussion. Key findings from the case study are presented through a series of tables and maps in this chapter. Major differences in the results are then discussed, and general conclusions drawn regarding data quality and future research priorities for the Greater Kluane Region.

Chapter 6: Conclusion. The potential application of the methodology in regional land use planning exercises and in cumulative effects assessments are discussed. Implications arising from the case study are also addressed, followed by an evaluation of the strengths and weaknesses associated with the proposed methodology using the guiding principles developed in Chapter 3.

A discussion on research contributions and areas for future research are also included. Finally, thesis goals and objectives are reviewed and some concluding remarks presented.

To provide a better overview of the many stages involved in the thesis, and to gain a greater understanding of how these stages fit together and develop throughout this document, a "thesis map" is presented at the end of every chapter. In each "map", a shaded box will indicate which stage of the thesis will be explored in the following chapter, specifying what the reader can expect next and providing an overview of all thesis components. For instance, the literature review box is shaded in Figure 1.1. This indicates that the background and problem definition have just been presented and that the next chapter will focus on a literature review of protected areas selection, park management, comprehensive regional land use planning, and cumulative environmental effects and assessment.

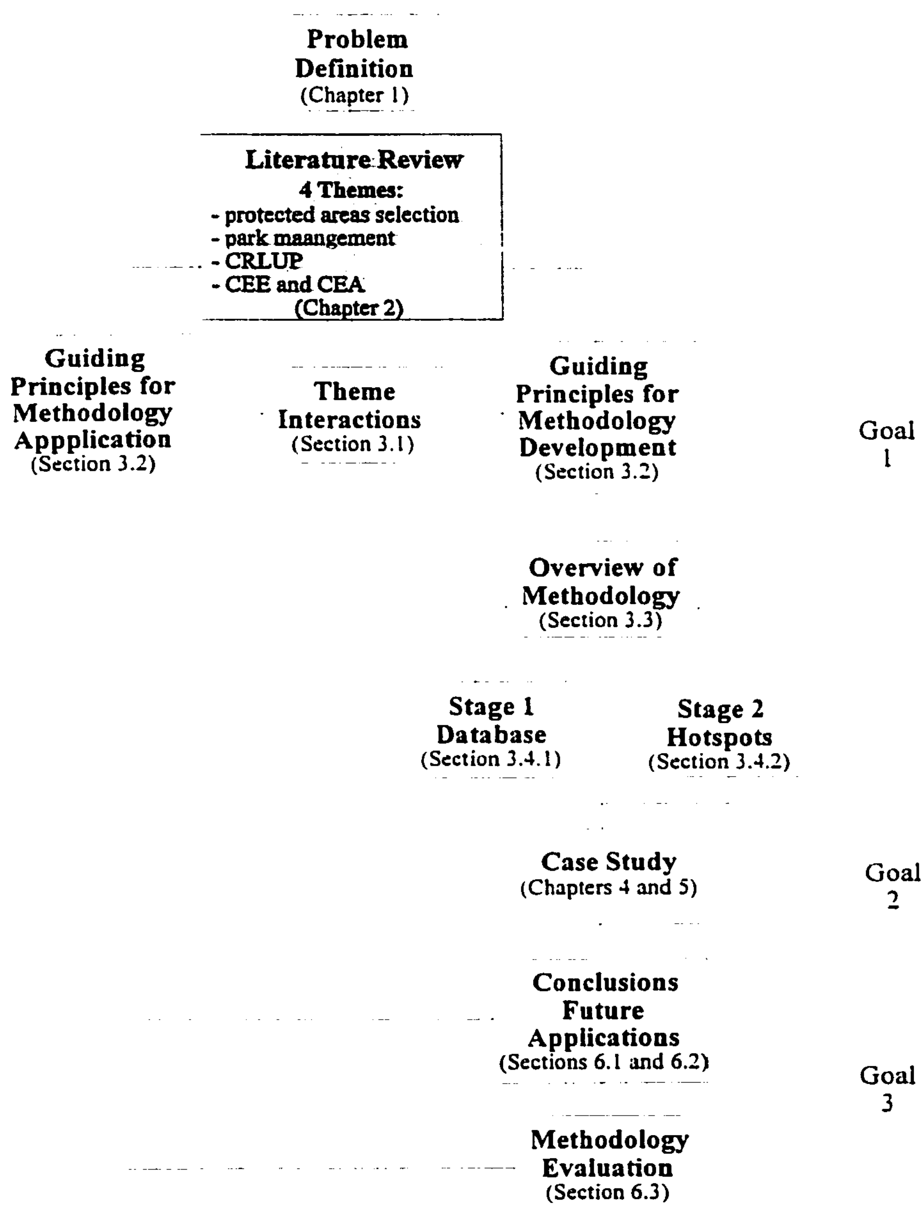


Figure 1.1 - Conceptual Map of Thesis.

CHAPTER 2 - LITERATURE REVIEW

The purpose of this literature review is to set the context for the proposed methodology developed in Chapter 3. This is accomplished by reviewing frameworks proposed in the literature on protected areas selection (section 2.1), northern national park management (section 2.2), comprehensive regional land use planning (section 2.3), and cumulative environmental effects and assessment (section 2.4). A justification for why these themes are being reviewed and how they are expected to aid with the development of the methodology presented in Chapter 3 is also provided.

2.1 PROTECTED AREAS SELECTION

Parks and protected areas play a large role in the long-term maintenance of functioning ecosystems. A review of criteria used to select these natural areas and define their boundaries is used to set the broad context for the methodology proposed in Chapter 3 by providing some insight into the values and criteria that protected areas are established to protect.

In the following sections, natural areas selection criteria are presented, and specific examples of how these criteria are used to define environmentally significant areas, environmentally sensitive areas, and national parks are discussed and compared (section 2.1.1). Ecological boundary considerations are then reviewed and discussed (section 2.1.2).

2.1.1 NATURAL AREAS SELECTION CRITERIA

Selection Criteria

There is a rich body of literature on natural areas selection (reviewed by Smith and Theberge, 1986a). This literature addresses the question "where do we establish parks and protected areas" and questions of the size, shape, and spacing of these areas.

Smith and Theberge (1986a) identified eight biotic and abiotic criteria that were used repeatedly in the literature when evaluating natural systems. These criteria are:

- *geographic and demographic rarity and uniqueness*: widespread rare or declining species, endemic, disjunct, or peripheral populations, and/or unique or rare geomorphological features are highly valued;

- *alpha, beta, and gamma diversity*: areas with high species and/or genetic diversity occurring within, between, or among a specific habitat type, or areas with high concentrations of special geomorphological or hydrological features are valuable;

- *size*: areas capable of supporting wide ranging species, umbrella species, minimum viable population levels, *etc*. are more valuable;

- *naturalness*: an area is of greater value if it is undisturbed by human influences as it can serve as a source for baseline information, and provide aesthetic, spiritual, philosophical, emotional, and recreational benefits.

- *productivity*: areas with a high rate of energy assimilation into organic material serves as an important food base, which particularly important in the North;

- *fragility*: areas with ecological components susceptible to damage or perturbation need more protection;

- *representativeness*: areas representing a full range of natural features and/or characteristics typical of a particular habitat type or biome are considered valuable;

- *importance for wildlife*: areas containing critical wildlife habitats are more valuable.

Cultural considerations also influence the establishment of protected areas. In particular, Smith and Theberge (1986a) identify some cultural criteria that are commonly used in selecting natural areas as:

- *scientific significance*: areas with existing research investment and/or scientific research potential are often considered highly valuable;

- *historical significance*: areas containing representative resources from historic or prehistoric periods are culturally significant;

- *educational significance*: areas with existing or potential educational opportunities are socially valuable; and

- *recreational significance*: areas sustaining various recreational activities are valuable.

In many cases, the boundaries of protected areas are also influenced by competing land uses, such as agriculture, mining, or forestry, and/or political considerations (eg. Theberge, 1978). Although it is not desirable to define protected areas based on politics or land use conflicts, these factors still play a role in selecting natural areas and need to be considered nevertheless.

Applications of Criteria

Theberge *et al.* (1980) developed a framework for identifying environmentally significant areas with the purpose of ensuring the protection of representative examples of biophysical features across the Yukon and Northwest Territories. The ultimate goal was to identify unique, representative, and sensitive areas so that they could be managed in a way to ensure that they continue to function as natural, self-regulating ecosystems. These areas would provide wildlife and renewable resource protection, and opportunities for recreation, science and education (Theberge *et al.*, 1980).

To select environmentally significant areas, five main categories are used: landform, wildlife, vegetation, ecosystem representation, and land use. Landforms with higher diversity and/or the presence of unique or uncommon landforms are considered more valuable. For wildlife, areas containing critical ranges, habitat for rare or endangered species, or a high diversity of species and habitats are recorded as highly valuable. Likewise, areas with rare, disjunct, and/or endangered vegetation species are also considered more valuable. Other prime candidates for environmentally significant areas include areas that are representative of the ecoregion in which it was located, and areas with little or no influence of existing and potential land use activities (Theberge *et al.*, 1980).

Environmentally sensitive areas selection also applies several criteria listed above. Eagles (1980: 8) defines an environmentally sensitive area as "a specifically bounded landscape that fulfils one or more of a set of criteria. [Environmentally sensitive areas] are natural landscapes that contain features such as: aquifer recharge, headwaters, unusual plants, wildlife or landforms, breeding or overwintering animal habitats, vital ecological functions, rare or endangered species, or combinations of habitat and landform which could be valuable for scientific research or conservation education." Nine ecological criteria are used to identify environmentally sensitive areas. These include areas with distinctive and unusual landforms, vital ecological functions, unusual or highly diverse communities, unusual and uncommon habitat, unusual high biological diversity, habitat for rare or endangered indigenous species, large areas capable of supporting spatially-demanding species, suitable for scientific research, and landform and habitat mosaics of high aesthetic value (Eagles, 1980).

Parks Canada's main objective is to "protect for all time representative natural areas of Canadian significance ..." (Parks Canada, 1994:25). To meet this objective, Canada is subdivided into 39 terrestrial natural regions, each of which has distinctive physiographic, vegetation, wildlife and environmental characteristics. The goal is to establish at least one representative park in each of these natural regions in order to complete Canada's system of national parks (Parks Canada, 1997). This is accomplished by selecting an area representative of the natural region and in a healthy, natural state in consultation with federal and provincial/territorial governments and interested public. A particular site for a potential national park is then selected within this natural area based on considerations of the criteria outlined in the National Parks Policy (Parks Canada, 1994:26-27). These criteria are:

- the extent to which the area represents the ecosystem diversity of the natural region;
- the potential for supporting viable populations of wildlife species native to the natural region;
- the ecological integrity of the area's ecosystems, as well as those of surrounding lands;
- the occurrence of exceptional natural phenomena, and rare, threatened or endangered wildlife and vegetation;
- the existence of significant cultural heritage features or landscapes;
- opportunities for public understanding, education and enjoyment;
- competing land and resource uses;
- possible threats to the long-term sustainability of the area's ecosystems; and
- the implications of Aboriginal rights, comprehensive land claims and treaties with Aboriginal peoples.

In summary, environmentally significant areas, environmentally sensitive areas, and national parks are all selected based on uniqueness, diversity, importance to wildlife, and inevitable politics. In addition, both environmentally significant areas and national parks are selected based on system naturalness and representativeness. The selection of environmentally sensitive areas and national parks also includes size, scientific value, and aesthetics. National parks also explicitly include criteria on education, recreation, and cultural resources. None of the three studies reviewed included productivity, fragility, or recorded history/research investment as the major selection criterion.

Ecological Boundary Considerations

Once sites have been selected, boundaries must be drawn. Many boundaries surrounding parks and protected areas today were established for political reasons, and are far from ecologically sound (Landres *et al.*, 1998a, 1998b). To address this issue, Theberge (1989) described an approach to drawing ecologically sound boundaries which maximizes ecological integrity within park boundaries. He presented five abiotic guidelines with the principle objective of maintaining the integrity of hydrological drainage basins, and ten biotic guidelines with the principle objective of reducing "as little as possible the natural diversity of populations in both the total natural area and in the communities directly traversed by the boundary line." These fifteen guidelines are summarized in Table 2.1.

The National Parks Policy also highlights some boundary considerations. These include: protecting representative ecosystems and landscape features; accommodating viable wildlife populations; including an undisturbed core; keeping sensitive, highly diverse or productive natural communities intact; maintaining drainage basin integrity; protecting exceptional natural phenomena as well as vulnerable, threatened or endangered flora and fauna; offering opportunities for public understanding and enjoyment; resulting in "minimum long-term disruption of the social and economic life" in surrounding regions; and excluding permanent communities (Parks Canada, 1994:27).

Table 2.1 – Significant Ecological Criteria (*source*: Theberge, 1989).

Type	Guideline
Abiotic	- Boundaries should sever drainage basins as little as possible; - Boundaries should not leave out headwater areas; - Boundaries should consider subsurface transbasin water flow; - Boundaries should not cross active terrain; and - Boundaries should include and not threaten rare geomorphologic and hydrologic features.
Biotic	- No rare or unique community should be severed; - Boundaries should not sever highly diverse communities, especially wetlands, ecotones, and riparian zones; - Boundaries should not sever communities with a high proportion of faunal species; - Boundaries should not jeopardize the ecological requirements of either numerically rare or distributionally rare (uncommon) species; - Boundaries should not jeopardize the ecological requirements of niche specialists; - Boundaries should not jeopardize populations of spatially vulnerable species (migratory, space demanding, seasonally concentrating, or limited in dispersal); - Boundaries should not jeopardize populations of K-selected species; - Boundaries should not jeopardize populations of range-edge or disjunct species; - Boundaries should take into special account pollution-susceptible species; and - Boundary delineation should take into special account the ecological requirements of ungulate species.

2.2 NORTHERN NATIONAL PARK MANAGEMENT

Many of the criteria and boundary considerations discussed above are used in the establishment of national parks. Once established, national parks are managed through the five main categories reviewed briefly in Section 1.3.2. In meeting the objectives of this thesis, it is important to understand these aspects of park management, since they set the framework for the methodology proposed in Chapter 3.

The following sections therefore discuss ecological integrity (section 2.2.1), ecosystem-based management (section 2.2.2), threats (section 2.2.3), environmental assessments (section 2.2.4), and monitoring (section 2.2.5) in detail. For each category, a working definition is provided, followed by a description of how it relates specifically to national park management, and a discussion of frameworks and methodologies developed for national parks

2.2.1 ECOLOGICAL INTEGRITY

Definition

The concept of ecological integrity has received increasing attention over the past 20 years, and has been defined in a number of ways. Cairns (1977) defined ecological integrity as "the maintenance of the community structure and function characteristic of a particular locale or deemed satisfactory to society". This definition was later revised by Karr and Dudley (1981), who stated "[b]iological integrity is the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats of the region".

As the concept of ecological integrity evolved, some main underlying characteristics were defined as the ability of ecosystems to: regenerate themselves and withstand stress, undergo ongoing change and development unconstrained by human interruptions (Westra, 1995), maintain optimum operations under normal conditions, cope with changes in environmental conditions, and continue the process of self-organization on an ongoing basis (Kay and Schneider, 1995). In addition, ecological integrity implies that "ecosystem structures and functions are unimpaired by human-caused stresses, native species are present at viable population levels [and] ecosystems do not exhibit the trends associated with stressed ecosystems." (Woodley, 1994).

Relevance to National Park Management

The 1988 amendment to the National Parks Act states that the "maintenance of ecological integrity through protection of natural resources shall be the first priority when considering park zoning and visitor use in a management plan" (Canada, 1988). Provisions for ecological integrity are also built into the National Park Policy, requiring a review of park management plans every 5 years to report on the status of park ecological integrity (Sections 2.1.1 and 2.1.2, Parks Canada, 1994). This management goal is becoming increasingly important as many national parks are reporting significant to severe levels of impairment to ecological integrity (Parks Canada, 1998).

There has therefore been considerable research into the application of ecological integrity to the management of Canada's national parks (eg. Skibicki *et al.*, 1994; Woodley, 1994). A panel on the ecological integrity of Canada's national parks was established in 1999 to evaluate Parks Canada's current approach to maintaining ecological integrity using ecosystem-based management principles. The working definition of ecological integrity adopted by this panel, and by Parks Canada in general, is: "the condition of an ecosystem where (1) the structure and function of the ecosystem are unimpaired by stresses induced by human activity, and, (2) the ecosystem's biological diversity and supporting processes are likely to persist." (PEICNP, 2000).

Frameworks and Methodologies

Most frameworks developed around ecological integrity involve the selection of appropriate ecological attributes which can be measured and monitored to evaluate ecological integrity. Two different frameworks are discussed below, addressing the question of how to determine appropriate measures and indicators of ecological integrity in national parks. Methodologies and frameworks dealing with the incorporation of these indicators into national park monitoring systems will be discussed in Section 2.2.5.

Woodley (1993) proposed a framework for assessing ecological integrity involving multiple hierarchical scales. He recommends the use of monitoring measures at individual, population, community, and landscape levels (Table 2.2).

Most of these measures require indicators. Woodley identified the following ecosystem components as key indicators for these monitoring measures: hypersensitive species, rare species, summit predators, keystone species, old-growth species, K-selected species, species with large body size, successful non-native species, species which accumulate toxins, species with ubiquitous distribution, and species which show slow response tiers.

Table 2.2 – Selected Measures for Monitoring Ecological Integrity (*source*: Woodley, 1993).

Hierarchical Scale	Monitoring Measure
Individual	- Growth and reproduction rates of indicator species
Population	- Minimum viable population size - Population dynamics of selected species
Community	- Species diversity - Succession/retrogression - Nutrient cycling
Landscape	- Climate - Primary productivity/respiration - Minimum viable area

Parks Canada's assessment framework for monitoring ecological integrity in national parks is largely based on this initial work done by Woodley (1993). Three broad measures - biodiversity, ecosystem functions, and stressors – are used to monitor and evaluate ecological integrity (Table

2.3). For each park, relevant and measurable indicators, such as those recommended by Woodley (1993), are selected and monitored in order to detect changes in ecological integrity. Indicators are therefore used as early warning signals, instigating necessary changes in management practices when ecological integrity is at risk of being compromised (Parks Canada, 1998).

Table 2.3 – Framework for Assessing Ecological Integrity (*source*: Parks Canada, 1998).

Biodiversity	Ecosystem Functions	Stressors
Species Richness Change in species richness Numbers and extent of exotics **Population Dynamics** Mortality/natality rates of indicator species Immigration/emmigration of indicator species Population viability of indicator species **Trophic Structure** Size and class distribution of all taxa Predation levels	**Succession/retrogression** Disturbance frequencies and size (fire, insects, flooding) Vegetation age class distributions **Productivity** Landscape or by site **Decomposition** By site **Nutrient retention** Ca, N by site	**Human land-use patterns** Land use maps, roads, densities, population densities **Habitat fragmentation** Patch size inter-patch distance for interior **Pollutants** Sewage, petrochemicals, etc. Long-range transportation **Climate** Weather data Frequency of extreme events **Other** Park specific issues

2.2.2 ECOSYSTEM-BASED MANAGEMENT

Definition

Over the past decade, there has been an increasing urgency for the management of the environment in whole ecological or landscape-based units (Slocombe, 1993). This holistic approach to management is often referred to as "ecosystem-based management". After an extensive literature search on the ecosystem approach to management, Grumbine (1994) identified ten recurring themes which authors have identified when discussing the definition, implementation, or overall comprehension of ecosystem management (see Table 2.4). Using these ten themes, ecosystem management has been defined as a process which "integrates scientific and traditional knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term" (Mitchell, 1997). In other words, it is a process by which ecosystems are managed to assure their sustainability (Franklin, 1997).

Table 2.4 - Ten Dominant Themes Relevant to Ecosystem Management (*source:* Grumbine, 1994: 29-30).

Theme	Description
Hierarchical context	- look at interactions between multiple levels of biodiversity
Ecological boundaries	- pay attention to biophysical or ecological units rather than political ones.
Ecological integrity	- protect total natural diversity and the patterns/ processes which maintain that diversity.
Data collection	- we need more biological data.
Monitoring	- document successes and failures in order to learn from them.
Adaptive management	- treat management as a learning experience with continuous adjustments and modifications.
Inter-agency cooperation	- sharing and cooperation among municipal, state, national and international agencies, the private sector and non-government organizations.
Organizational change	- may require alterations in structures and processes used by resource and environmental management agencies.
Humans embedded in nature	- see people as part of natural systems.
Values	- must consider human values when setting management goals.

Relevance to National Park Management

The National Parks Policy encourages the use of ecosystem-based management as the conceptual and strategic basis for protecting park ecosystems for several reasons. For instance, ecosystem management takes a holistic view of the environment, requires that activities influencing park ecological integrity be understood at a regional scale, requires that land use decisions take complex interactions and natural dynamics into account, and recognizes the finite ability of ecosystems to withstand and recover from anthropogenic stress (Section 3.0, Parks Canada, 1994). Ecosystem management therefore complements regional planning, helps planners and managers maintain a holistic view of the environment, and encourages regional collaboration and cooperation. This will become particularly important in the near future since parks rarely contain complete or unaltered ecosystems, and it will be increasingly difficult to sustain parks due to increasing cumulative stress from adjacent land use activities (Parks Canada, 1994).

Frameworks and Methodologies

Parks Canada has developed a framework for ecosystem-based management in national parks including the following characteristics (source: Parks Canada, 1994:34-36):

- Maintain a holistic view of environment.
- Encourage regional integration and collaboration.
- Increase understanding of impacts of human activities on natural environment.
- Intervene only if structure and function of park ecosystems have been seriously altered by human activities.
- Establish clear, practical and measurable objectives.
- Base necessary manipulations on scientific research, using techniques that duplicate natural processes as closely as possible.

- Maintain an integrated database as baseline information.

- Subject all programs, policies and plans to environmental assessment

- Participate in environmental impact assessments for proposed developments outside national parks that may affect park ecosystems.

This framework largely addresses issues surrounding natural resource conservation. However, management in national parks also includes a second aspect: visitor management. Processes developed to deal with visitor impacts can be considered as part of ecosystem-based management because proper management of human impacts greatly influences the maintenance of ecological integrity. In order to deal effectively with the management of visitor impacts, the Canadian Parks Service developed a process known as Visitor Activity Management Process, or VAMP. This framework was designed to work in concert with natural resource management processes to provide information for park management planning (Payne and Graham, 1993).

In the VAMP framework, visitor activity profiles are drawn to connect a particular activity with the social and demographic characteristics of user groups, the activity's setting requirements, and the trends affecting the activity. This information is then used to determine subactivity groups. For instance, cross-country skiing can be subdivided into four subactivities - recreation/day use skiing, fitness skiing, competitive skiing, and back-country skiing - based on differences among participants' sociodemographic characteristics, equipment, motivations, and setting needs. Activities and subactivities appropriate in national parks can then be determined by comparing how well they relate to park mandates and the goals of ecosystem-based management. In addition, park facilities, programs and services can be established to suit the needs highlighted in the visitor activity profile if these needs are compatible with the national park policy objectives of protection, understanding, appreciation, and enjoyment (Payne and Graham, 1993).

2.2.3 THREATS

Definition

Two types of threats can be identified: internal and external. Internal threats are stressors arising within park boundaries which could potentially have a negative impact on park ecological integrity. These could relate to park management processes, visitor activities, and park facilities. In general, these threats tend to be easier to manage because they are within the sphere of influence of park managers and planners. External threats, on the other hand, arise from development activities outside park boundaries. These arise largely due to the presence of political as opposed to ecological boundaries, competing land uses, and due to lack of regional coordination of land management. External threats are difficult to deal with because they are largely out of the control of park managers, but they can have substantial impacts on park ecosystems. In fact, many researchers have identified external activities as the most significant threats to the park interior (Buechner *et al.*, 1992; Schelhas, 1991; Mott, 1988).

Relevance to National Park Management

Since "stressors" arising from internal and external threats were identified as one of the three indicators of ecological integrity, a survey on ecological stressors was carried out in 36 national parks in 1996. From this survey, key stressors can be broken down into three categories: originating outside park, originating inside park, and originating both inside and outside park. Primary external stressors include forestry, agriculture, mining, sport hunting, and urbanization. Internal stressors include visitor use, fire control, park infrastructure, and park management practices, while internal and external sources include heavy metal pollution, vehicle/wildlife collisions, climate change, poaching, solid waste, exotic vegetation, human disturbance, petrochemical pollution, and transportation/utility corridors (Parks Canada, 1998). Ten northern parks were included in this survey. Surprisingly, many of these parks are reporting multiple stresses causing significant ecological impacts (Table 2.5).

Table 2.5 – Stresses Causing Significant Ecological Impacts In Northern National Parks (*source*: Parks Canada, 1998).

National Park	Stresses Reported
Aulavik	- no stresses reported
Auyuittuq	- commercial fishing, park management, sewage, urbanization, utility corridors
Ellesmere	- no stresses reported
Ivvavik	- exotic mammals, solid waste, sport hunting
Kluane	- agriculture, dams, exotic vegetation, human disturbance, mining, solid waste, sport fishing, urbanization
Nahanni	- mining, park management
Vuntut	- no stresses reported
Wapusk	- dams, utility corridors
Wood Buffalo	- dams, visitor facilities

Frameworks and Methodologies

Although no frameworks or methodologies have been developed relating specifically to threats in national parks, threats are incorporated into the process of maintaining ecological integrity. Provisions are made for regional stressors in the measurement of ecological integrity (see Table 2.3) and in natural resource and visitor use aspects of ecosystem-based management, as outlined in Section 2.1.2. In addition, regional threats are incorporated into environmental assessments and monitoring programs, discussed in Sections 2.1.4 and 2.1.5 respectively.

2.2.4 ENVIRONMENTAL ASSESSMENTS

Definition

Environmental assessment (EA) is "an organized information gathering process used to identify and understand the effects of proposed projects on the bio-physical environment as well as on the social and economic environments of the people to be affected." (CEAA, n.d). At the federal level, it is governed by the Canadian Environmental Assessment Act of 1995 and associated regulations, under the direction of the Canadian Environmental Assessment Agency. Provincial and territorial legislation also address environmental assessments independently, but these will not be discussed since the focus of this research is on federal parks.

Associated regulations define four regulations critical to the proper functioning of the Act: law list, inclusion list, comprehensive study list, and exclusion list. The law list highlights existing acts and regulations that require a federal EA. The inclusion list refers to regulations prescribing physical activities not related specifically to physical works. The comprehensive study list includes major projects which must undergo a full assessment, and the exclusion list exempts projects with insignificant effects from EAs.

Relevance to National Park Management

Federal environmental assessments are required by law when a federal authority proposes, contributes funding to, transfers control of land to, or exercises a regulatory duty in relation to a proposed project (CEAA, 199u). Therefore, any project in which Parks Canada exercises one or more of those functions must go through an EA. Specifically, this includes projects listed on the law list (eg. National Parks Act), inclusion list (eg. culling wildlife population in national park), and comprehensive study list regulations (eg. proposed construction of a physical work in a national park).

Parks Canada has also committed itself to perform EAs on proposals which fall outside the scope of the Act, but which could have an adverse effect on ecosystems or cultural resources in Canada's national parks (Parks Canada, 1999). In addition, the national parks policy states that Parks Canada will participate in EAs both inside and outside park boundaries (Sections 3.2.13 and 3.2.14).

Although this commitment to EAs is clearly stated in the EA Act and the national parks policy, recent findings of the panel on the ecological integrity of Canada's national parks indicate that a major weakness of EA in national parks is that it is used as a process to identify mitigative, surveillance, and follow-up measures rather than using the assessments to determine the appropriateness of a proposed project, program, or policy. Furthermore, the panel found that EAs tend to be considered separate from park decision making processes, and that this lack of integration of planning and assessment has reduced the effectiveness of EAs as tools for reducing the "ecological footprint of development". Consequently, the panel strongly recommends that EAs be more fully integrated into park planning, management, and decision-making processes to more effectively reach the goal of maintaining park ecological integrity (PEICNP, 2000).

Frameworks and Methodologies

For project-specific proposals, environmental assessments usually consist of the following components of a standard EA (Davies, 1991):

- Project rationale,
- Assessment of the environmental conditions,
- Public consultation,
- Project alternatives,
- Assessment of environmental effects of the project and its alternatives, and
- Ways to prevent, mitigate, or compensate for the predicted environmental effects.

This is the framework that Parks Canada uses to evaluate the environmental impacts of proposed projects or activities. Recently, Parks Canada has added an additional step which involves screening all proposals through Parks Canada policy first. If the proposal complies with the goals and objectives outlined in the policy, it then undergoes a proper EA. However, if a project is not aligned with the policy, the proposal is rejected even before an official EA is undertaken (PEICNP, 2000).

2.2.5 MONITORING

Definition

Monitoring can be defined as the process in which one or more variables are measured repeatedly over time in order to assess and detect changes in ecosystem structure or function. Conclusions drawn from monitoring programs are then fed into decision-making procedures with the purpose of influencing management decisions (Henry *et al.*, 1995; Woodley, 1994).

Ultimate monitoring goals have been outlined by Freedman *et al.* (1995) as to: "(i) detect or anticipate ecological changes, by measuring appropriate indicators, and (ii) understand the causes and consequences of those changes."

Relevance to National Park Management

The concept of ecological monitoring ties together the other aspects of park management that have already been discussed, as illustrated in Figure 2.1. Monitoring programs contribute to the maintenance of ecological integrity in parks and surrounding regions by following up after environmental assessments, specifically addressing particular threats, and being fed into the ecosystem-based management decision making procedure.

It is therefore not surprising that ecological monitoring programs have already been introduced into many national parks. There are currently programs in place for a variety of issues, ranging from monitoring weather, air quality, and snow accumulation to shoreline erosion, forest succession, and visitor use (Parks Canada, 1999).

Three monitoring objectives have been identified for Parks Canada: (1) to measure and detect changes in the ecological integrity of ecosystem(s) within park; (2) to measure the effects of specific perceived threats to the ecosystem(s) within park; and (3) to provide data on the state of Canadian national parks (Woodley, 1994). Provisions for monitoring are also made in the national park policy. For instance, section 2.1.6 states that "implementation and effectiveness of each park management plan will be monitored continuously", and section 3.2 stresses the importance of monitoring throughout, mostly as a tool to collect data and store it as an integrated data base for baseline information.

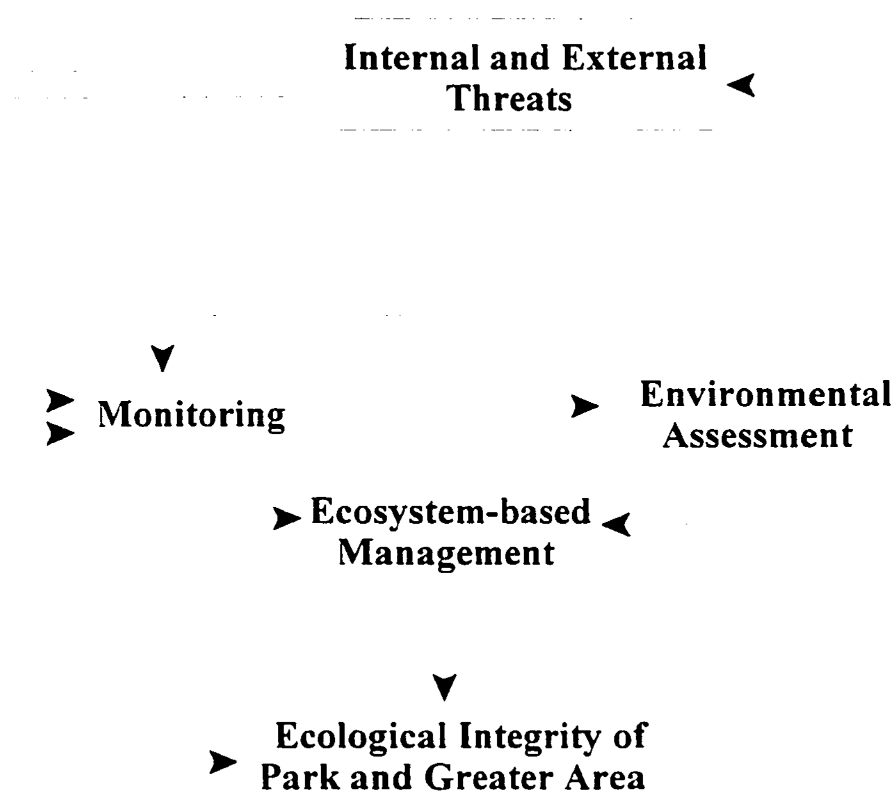


Figure 2.1 – Monitoring Framework (*source:* adapted from Freedman *et al.*, 1995)

Frameworks and Methodologies

In order to meet the aforementioned monitoring goals and objectives, a monitoring framework has been devised for Canadian national parks (Figure 2.2). This framework is two-pronged, involving the monitoring of both ecological integrity and specific threats or stresses. Both types of monitoring are critical to park monitoring plans (Woodley, 1994).

Measures, or indicators, of ecological integrity for monitoring programs have already been discussed in Section 2.1.1. When particular threats are unknown, appropriate measures are selected from Table 2.2 or 2.3, and incorporated into park monitoring programs. Indicators are then selected to measure and keep track of overall regional ecological integrity. If a known threat is identified through the monitoring of ecological integrity, the approach to monitoring shifts to threat-specific monitoring.

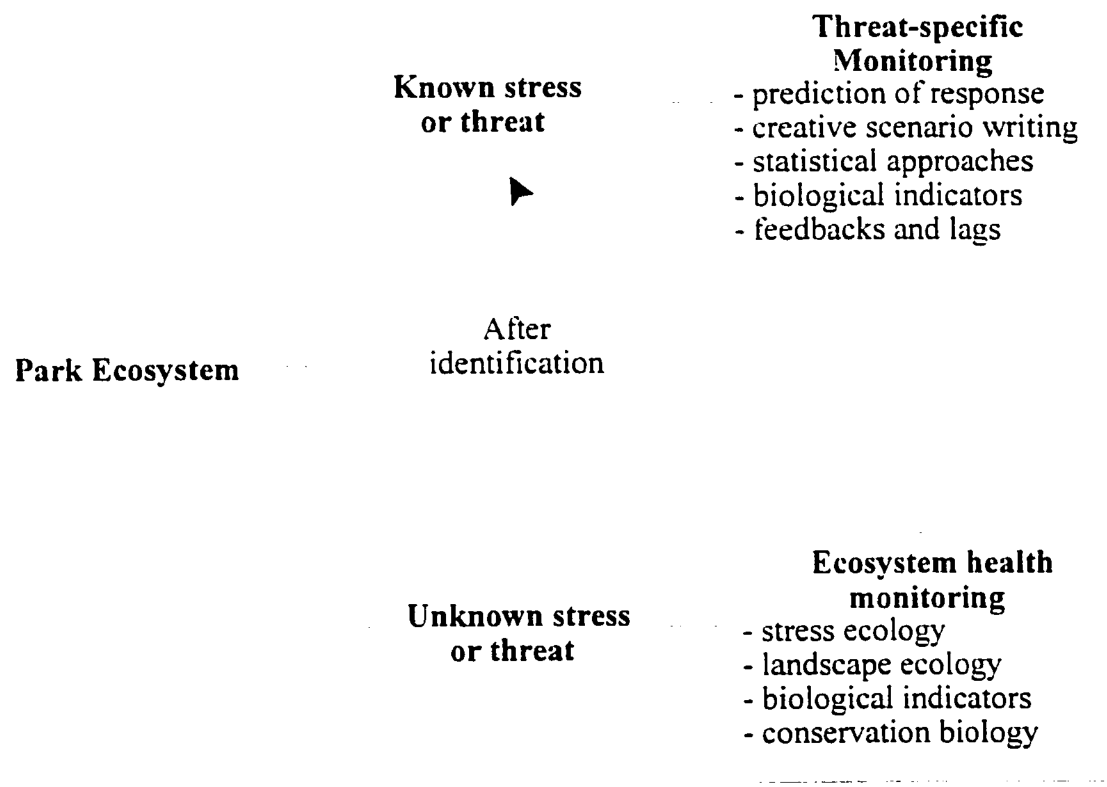


Figure 2.2 – Monitoring Framework for National Parks (source: Woodley, 1994).

The first obvious step to threat-specific monitoring is the identification of stresses and threats, either from ecological integrity monitoring programs, staff and other knowledgeable people, and/or the park conservation plan. Once a threat has been identified, a monitoring program is designed specifically for this threat. To do so, the threat must be fully described, and all potential ecological consequences outlined. A stress-response model can then be developed in order to predict the response to the threat through consideration of relationships, timing, synergistic interactions, intensity and other influencing factors. Next, monitoring measures are refined by applying specialized techniques, such as creative scenario writing, statistical techniques, identification and quantification of stresses, feedbacks, and lags, and the use of biological indicators. A monitoring program is then developed and incorporated into a feedback loop (Woodley, 1994; Munn, 1988).

2.3 COMPREHENSIVE REGIONAL LAND USE PLANNING

All aspects of national park management point to the need to consider parks in a regional perspective. For instance, park ecological integrity is linked to areas outside park boundaries, and ecosystem management embraces the notion of broad scales. In addition, threats arise both internal and external to park boundaries, the scope of environmental assessments falls outside park boundaries, and monitoring programs typically involve regional scales. It is therefore suggested that a proactive, large scale planning approach such as comprehensive regional land use planning (CRLUP) is compatible with overall park management objectives and procedures. Since the methodology proposed in Chapter 3 must function within this park management framework and will be applicable to planning exercises, it is important to review the principles underlying CRLUP.

In the following sections, frameworks used for four CRLUP exercises are presented (section 2.3.1), and some of the key challenges involved in CRLUP are reviewed (section 2.3.2). This is followed by an analysis of the strengths and weaknesses of each framework (section 2.3.3), and a discussion of how CRLUP can help to minimizing CEEs through the encouragement of proactive park planning (section 2.3.4).

2.3.1 FRAMEWORKS

The purpose of this section is to familiarize the reader with four CRLUP frameworks employed over the past 25 years. Frameworks were drawn from the British Columbia Commission on Resources and Environment, Lancaster Sound Regional Land Use Plan, Mackenzie Delta-Beaufort Sea Regional Land Use Plan, and Ontario Strategic Land Use Plan. Although there are other examples of CRLUP, these four in particular were selected because they are well known and two deal specifically with the north. Only four frameworks are reviewed because it is not the intent of this thesis to provide a comprehensive review of CRLUP, but rather to provide a few examples to demonstrate the key characteristics of the planning process and the potential application of these principles to park planning and CEEs.

British Columbia Commission on Resources and Environment

The Commission on Resources and Environment (CORE) was established in 1992 as an independent body mandated to (1) develop a province-wide strategy, (2) develop, monitor and implement a community-based and participatory regional planning process, (3) coordinate with the provincial government, and (4) encourage the participation of aboriginal groups. In general, they were charged with the challenge of developing a province-wide strategy for land use in British Columbia. This land use plan was to emphasize economic, social, and environmental sustainability with extensive public consultation (CORE, 1994).

The framework developed to fulfil this task involves shared decision-making and cooperative involvement of all stakeholders (CORE, 1992). It involves several steps. First, principles and goals are outlined to form a vision. Laws and policies are then developed to provide a direction for attaining this vision. Plans are then created at a variety of scales (eg. provincial, local) so that the laws and policies can be applied. Next, plans are implemented through tenures and approvals. Finally, results are measured and required revisions made (CORE, 1994).

To carry out this framework, CORE defined four study areas (one on Vancouver Island, one in southcentral BC, and two in southeastern BC). Stakeholders were empowered through a round table approach in which each interest group constituency was represented by a negotiating committee and a spokesperson (Penrose *et al.*, 1998). Two professional mediators, two facilitators, and one local expert were also involved. Although CORE ended with a change in government in 1996, much of the work carried out throughout the planning process is currently being incorporated into B.C's Land and Resource Management Planning program.

Northern Land Use Planning Program-Lancaster Sound, Mackenzie Delta-Beaufort Sea

The Northern Land Use Planning program (NLUP) was initiated in the early 1980's for the purpose of developing balanced land use plans for the Canadian north. Two resulting plans are reviewed here: the Lancaster Sound Regional Land Use Plan (LSRP) and the Mackenzie Delta-Beaufort Sea Region Land Use Plan (MDBSRP). A third plan, the Kluane Land Use Plan, is discussed in more detail in Chapter 4.

The need for a regional land use plan around Lancaster Sound became apparent in the 1960s as developers became increasingly interested in the rich renewable and non-renewable resources of Lancaster Sound. The Lancaster Sound Regional Study was carried out between 1979 and 1983 as a precursor to the regional land use plan. In 1986, the Lancaster Sound Regional Land Use Planning Commission was established with the goal of creating a land use plan to minimize conflicts among competing resource user groups while maximizing social benefits to local communities (Fenge, 1989). Particular objectives of the commission included identifying issues, opportunities, and constraints regarding land use, establishing a balance between competing land uses, advising on preferred uses of the land, recommending simple, clear and accountable decision making processes, and recommending methods of publicizing the existence and objectives of the plan (LSRLUPC, 1989).

The LSRP considered issues and concerns arising locally and throughout the entire study area. They also examined land use opportunities and constraints for the study area, which encompassed most of the northeastern arctic islands. The framework developed for this plan involved several steps. First, a series of principles, objectives and actions were developed to guide the process. A policy framework was then drawn to help move towards this vision. Third, locations of present use and values, present and future conflicts and opportunities, and methods of resolving these conflicts were identified through extensive public consultation. The final stage of the framework included monitoring and plan revision as required (LSPC, 1991).

A similar commission was established for the Mackenzie Delta-Beaufort Sea region. The general goals and objectives of this commission included instituting a community-based planning process with the end result of a fair balance of land and resource use, developing land and resource plans based on community priorities, developing ongoing planning capability in northern communities, and establishing a planning process in communities.

As with LSRP, the framework involved visioning first, followed by the identification of goals and recommendations for each land use type based on community consultations. Land and resource plans were then developed based on community and regional priorities. The plan was then to be implemented, monitored, and revised as required (MBPC, 1991).

The NLUP program was terminated in 1992 due to Federal government funding cuts. Although the recommended plans were never implemented, a considerable amount of data had been collected for the LSRP and were used to develop an informative atlas on the region. Very little came directly out of the MDBSRP, although the need for land use planning in the Northwest Territories is being reconsidered through various land claim negotiations.

Ontario Strategic Land Use Plan

The Strategic Land Use Plan (SLUP) was introduced in the early 1970s as an initiative of the Ontario Ministry of Natural Resources (OMNR) in response to increasing land use conflicts arising from single-project plans. It was designed to help OMNR attain its goal of providing "opportunities for outdoor recreation and resource development for the continuous social and economic benefits of the people of Ontario and to administer, protect and conserve public lands and waters." (SLUPP, 1980).

SLUP was designed to: be forward looking and work towards pre-stated objectives, ensure public participation, consider all alternatives and tradeoffs involved, be dynamic and long-term, and allocate land to most efficient use while recognizing that the natural environment has a limited ability to withstand stress (SLUPP, 1980). The framework employed involves three different levels: provincial, sub-provincial and district.

First, provincial objectives and policies were developed and used to produce sub-provincial plans. At the sub-provincial level, specific objectives and policies were then established for each individual resource (eg. forestry, tourism, mining). Subsequently, these objectives and policies were used to develop strategies specific to each resource. All resource strategies were then combined, and integrated with provincial and sub-provincial policies and objectives, to develop a tactical land use plan for each of the study areas. Targets based on these strategies were then specified for each district, and a more local planning process was designed to follow (Miller, 1981).

The final plan arising from the SLUP process was announced in June 1983. Although many details of SLUP were never implemented due to a change of government in May 1985, a significant outcome of the process was the establishment of 155 new parks throughout the province which are still present today (Killan, 1993).

2.3.2 CHALLENGES

Although the idea of large-scale, comprehensive planning is a good one in theory, there are many challenges involved in applying CRLUP in practice. Many of these obstacles arise due to the inherent complexity of planning. For instance, CRLUP is expected to (CORE, 1994:9):

- *integrate economic, social and environmental values;*
- *assist decision-making where decisions have major political, economic, social and environmental impacts;*
- *foster discussion and seek workable and sound accommodations where conflicts exist;*
- *engage the public so that their needs and preferences are responded to;*
- *plan for and maintain land and water ecosystems based on scientific understanding;*

- *bridge jurisdictional gaps;*

- *coordinate the management capabilities of different agencies towards common objectives.*

Several other challenges associated with land use planning were highlighted by Brown (1996). These include dealing with complex and broad scopes, working with poorly defined visions or desired states, and the need to consider multiple and often contradictory viewpoints. Moreover, a lot of pressure arises from the fact that the effects of the decisions are far reaching and long lasting, that stakes are usually high, and good information is typically lacking. Given all these complicating factors, it is almost certain that CRLUP will not and can not meet absolutely all of the expectations imposed on the process. It is therefore necessary to carry out planning exercises in spite of these challenges, as in the four case studies reviewed above. The strengths and weaknesses of each framework are reviewed in the following section.

2.3.3 ASSESSMENT AND EVALUATION

In order to evaluate the effectiveness of these four frameworks, each one is reviewed in light of how well they fulfilled the key characteristics of CRLUP identified in Chapter 1 (direction seeking, interactive and interest driven, anticipatory, comprehensive, complex, continuous, issues-focused, clearly defined roles, time conscious, and flexible and adaptive). For each characteristic, a question was developed. The four frameworks discussed above were then evaluated in light of these questions. Findings are summarized in Table 2.6.

All four frameworks addressed the need for an overall vision or set of goals and objectives to work towards and the need to involve the public right from the outset. In addition, all four were designed to examine large study areas in which all potential future projects would be considered,

Table 2.6 - Evaluation of CRLUP Frameworks

Characteristic	Question	CORE	LSRLUP	MDBSRLUP	SLUP
Direction Seeking	Was a vision/goal determined at the outset?	Yes	Yes	Yes	Yes
Interactive and interest driven	Was stakeholder involvement encouraged?	Yes - through round table representation	Yes - participatory focus	Yes - community based	Yes - public participation program
Anticipatory	Did the plan account for future issues?	Yes - considered future developments through policies	Yes - considered all possible future developments	Yes - considered all possible future developments	Yes - considered future developments through policies
Comprehensive	Were social, economic and environmental issues incorporated?	Yes - policies were integrated	Yes	Yes	No - policies were all resource-specific
Complex	Was the plan developed for a large study area?	Yes - for 4 study areas in BC	Yes - entire Lancaster Sound	Yes - entire Mackenzie Delta area	Yes - NE, NW and S Ontario
Continuous	Is the plan continuous over time?	No - ended with changed government	No	No	No
Issues-focused	Were the most promising solutions emphasized?	Yes - examined alternatives	Yes - examined alternatives	Yes - examined alternatives	Yes - examined alternatives
Defined roles	Were the roles of stakeholders clearly defined?	Yes	Yes	Yes	No
Time conscious	Were realistic and achievable time limits set, and time constraints worked into the framework?	No - no time line provided	Yes - detailed time line provided	No - no time line provided	No - no time line provided
Flexible and adaptive	Does the framework allow for uncertainty?	Yes - included monitoring and review process	Yes - included monitoring and review process	Yes - included monitoring and review process	Yes - included monitoring and review process

to consider multiple alternatives, and to be flexible by incorporating future modifications as required. Only CORE, LSRLUP, and MDBSRLUP appropriately integrated social, economic and environmental concerns and clearly defined stakeholder roles. SLUP designed policies for each category independently and made no effort to integrate them, and never explicitly stated which stakeholders would be involved and how, making role definition unclear. Only the Lancaster Sound plan provided a time line for plan implementation, and all four plans failed to achieve continuity over time, as they were all terminated with changes in government funding before implementation.

2.3.4 LINKS TO PARKS

Scientific research has demonstrated that ecological health in parks depends on natural processes in areas surrounding parks (Nelson, 1993). In addition, since parks generally are too small to withstand stresses arising both inside and outside boundaries, "regional environmental management is an absolute necessary component of managing protected areas" (Theberge, 1993). Recognizing that ecological integrity is linked to the regional ecological setting, Parks Canada is encouraging cooperative regional land use planning and management in areas surrounding national parks (Parks Canada, 1999). Indeed, the notion of regional cooperation and integrating the park with its surroundings is expressed in the national parks policy (section 2.1.7).

In theory, parks would benefit from the application of the key characteristics of CRLUP to park planning. Incorporating more CRLUP principles may also address some of the many concerns raised by Searle in his recent book on the declining state of Canada's national parks (Searle, 2000). Many CRLUP components have already been built into park planning processes.

For instance, all national parks are mandated to maintain ecological integrity, giving individual parks and the system as a whole an end state, or vision, to work towards. Most parks also seem to have a strong sense of which issues are of greatest importance given the park's unique circumstances. In addition, national parks already benefit from continuity over time and clearly defined roles due to the national-level coordination by Parks Canada.

Some CRLUP components are only in place at certain national parks, as park planning and management varies somewhat among different parks. For example, some national parks have incorporated the comprehensive and complex components into their planning and management through the application of the "greater ecosystem" concept (eg. Fundy, Pukaskwa), where parks are managed as components of a larger system.

In general, Parks Canada's performance can be further improved by better incorporating additional aspects of CRLUP such as anticipation and interaction. A greater focus on anticipatory aspects would help identify issues before they arise and allow park staff to take the necessary steps before the issue becomes problematic. In addition, encouragement of greater public participation, particularly of Aboriginal people and other local residents, will help to ensure greater cooperation and long-term maintenance of Canada's national parks.

2.4 CUMULATIVE ENVIRONMENTAL EFFECTS AND ASSESSMENT

Issues can become increasingly complex at the large space and time scales involved in CRLUP. At these scales, the need to address the sources, pathways, and overall impacts of cumulative environmental effects becomes more apparent. Since the ultimate purpose of the methodology to be developed in Chapter 3 is to limit cumulative environmental effects (CEEs) around parks, it is important to review the concepts behind CEEs and their assessment.

In the following sections, sources, pathways, and ensuing impacts of CEEs are outlined (section 2.4.1). General approaches to CEA are then discussed, along with a review of valued ecosystem components (section 2.4.2). Several frameworks for regional CEAs are then presented (section 2.4.3) and analyzed (section 2.4.4). Finally, the need for recognizing CEEs and carrying out CEAs in national parks is discussed (section 2.4.5).

2.4.1 CUMULATIVE ENVIRONMENTAL EFFECTS

The concept of cumulative environmental effects (CEEs) can be divided into three distinct sections: sources of change, pathways of accumulation, and impact accumulation (Spaling and Smit, 1993). The interrelationship among these three dimensions are highlighted in Figure 2.3, and discussed below.

In a broad sense, development activities are the main sources of CEEs. According to Sonntag *et al.* (1987), these activities fit into four main types based on time frame and spatial scale:

- *single activity* : a single project which is spatially well-contained and takes place over a short time frame (eg. hydro-electric dam construction).

- *multi-component activity* : a single project with a number of components being developed sequentially or simultaneously (eg. oilfield and associated transportation facilities).

- *multiple activity* : activity involving multiple sources due to the construction of several facility types of a varied nature over an extended period of time over large distances (eg. multiple point source emissions in an area).

- *global activity* : activity with multiple sources that is dispersed over global space scales for long time frames (eg. pollutant emissions from worldwide sources).

Sources of CEEs	Pathways of Accumulation	Impact Accumulation
Single Sources	Additive (crowding)	**CEE Typology**
- Single activity - Multi-copmponent activity	Interactive (compounding)	- Time crowding - Space crowding - Compounding effects - Time lags - Space lags - Triggers and thresholds
Multiple Sources	Additive (crowding)	- Fragmentation - Indirect - Growth inducing - Feedback effects
- Multiple activities - Global activity	Interactive (compounding)	- Magnification

Figure 2.3 – Three Dimensions of Cumulative Environmental Effects (*sources*: adapted from Parker and Cocklin, 1993; Spaling and Smit, 1993)

Given these different sources, CEEs can accumulate through multiple pathways. Two main pathways can be identified: additive and interactive. Additive pathways are those in which sources combine linearly, and where the sum of the parts is equal to the sum of the whole. In such cases, cumulative effects arise from spatial or temporal crowding. Conversely, impacts interact synergistically in interactive pathways, thereby leading to compounding effects in which the sum of parts is greater than the whole (Parker and Cocklin, 1993).

Once various CEE sources have accumulated through various pathways, a number of different impact types can be identified. Although CEEs have been classified in a number of ways (see Spaling and Smit, 1993), a commonly accepted typology of cumulative effects can be summarized as follows (Lawrence, 1994; Spaling, 1994; Sonntag *et al.*, 1987):

1. time crowding: frequent and repetitive impacts on a single environmental medium; inability of system to recover from earlier perturbation

2. space crowding: high density of impacts on a single environmental medium: inability of system to recover from close perturbation before new one

3. compounding effects: synergistic effects due to multiple sources on a single environmental medium

4. time lags: long delays in experiencing impacts

5. space lags: impacts resulting some distance from source

6. triggers and thresholds: impacts to biological systems that fundamentally change system behavior

7. indirect: secondary impacts resulting from a primary activity

8. fragmentation: change in landscape pattern

9. growth inducing: results in spin-off activities or establishes precedent for additional activity

10. feedback effects: indirect impacts that loop back and compound direct impacts

11. magnification: bioaccumulation

2.4.2 CUMULATIVE EFFECTS ASSESSMENT

As was mentioned in Chapter 1, CEEs are analyzed and evaluated through cumulative effects assessments (CEAs). The foundation of the Canadian Environmental Assessment Research Council in 1986 led to the popularization of CEAs (Duinker, 1994). Awareness of CEEs and

CEAs increased further when provisions for the consideration of cumulative impacts were introduced in the 1995 Canadian Environmental Assessment Act (Drouin & LeBlanc, 1994). The legislative basis for CEA is also currently being updated in the five year review of this Act (Bruce, 1999).

CEAs are performed in a number of different ways. Numerous existing methods for CEAs were reviewed by Smit and Spaling (1995), and are summarized in Table 2.7. The first six methods are usually employed more for project-specific CEAs, whereas the last four are more likely to be used for regional CEAs for planning purposes. Generally, a combination of two or more approaches is recommended for the most effective assessments, as each method has associated strengths and weaknesses (Smit and Spaling, 1995).

Since CEAs can become very broad and complex, many practitioners narrow the scope of the assessment by focusing on valued ecosystem components (VECs) and valued socioeconomic components (VSCs). The concept of VECs and VSCs, how they are identified, and how they are used in CEAs is discussed briefly before reviewing frameworks for CEA.

Valued Ecosystem Components

Beanlands and Duinker (1983) defined a VEC as "a biological resource that has ecological, social, and/or economic significance and which, if affected by the project, would be of concern to scientists, managers, government regulators and the public." VECs have been selected at a variety of different hierarchical levels, ranging from population level (Hegmann, 1995; Dome *et al.*, 1982) to habitat (Ecologistics, 1994) and landscape (Ramsay, 1996). Population level VEC

Table 2.7 – Methods for CEA (*source*: Smit and Spaling, 1995).

Category	Main Feature	Mode of Analysis	Representative Method(s)
Spatial analysis	Map spatial changes over time	Sequential geographic analysis	Geographic Information Systems
Network analysis	Identify core structure and interactions of a system	Flow diagrams: network analysis	Loop analysis. Sorenson's network
Biogeographic analysis	Analyse structure and function of landscape unit	Regional pattern analysis	Landscape analysis
Interactive matrices	Sum additive and interactive effects; identify higher order effects	Matrix, multiplication and aggregation techniques	Argonne multiple matrix, synoptic matrix, extended CIM
Ecological modeling	Model behavior of an environmental system or component	Mathematical simulation modeling	Hypothetical modeling of forest harvesting
Expert opinion	Problem-solving using professional expertise	Group process techniques	Cause-and-effect diagramming
Multi-criteria evaluation	Use of a priori criteria to evaluate alternatives	Weighing of parameters and computational ranking of scenarios	Multi-attribute tradeoff analysis
Programming models	Optimize alternative objective functions subject to specified constraints	Mass-balance equations	Linear programming
Land suitability evaluation	Use ecological criteria to specify location and intensity of potential land uses	Define acceptable levels of ecosystem health and target thresholds utilizing ecological indicators	Land disturbance target, ecosystem-based planning
Process guidelines	Logic framework to conduct CEA	Systematic sequence of procedural steps	Snohomish guidelines, CEA decision tree

selection involves the identification of "indicator species" most vulnerable to development. Habitat and landscape approaches, on the other hand, generally have a broader focus on essential ecosystem components. Several case studies which used VECs at these different hierarchical levels are reviewed below, along with a discussion of how VECs were selected for each study and how they were used in the actual assessment.

Hegmann (1995) did a case study of the potential CEEs arising from Kluane National Park and Reserve's 1995 park management plan review. For this study, he identified five population-level VECs as: grizzly bears, moose, Dall sheep, mountain goats, and golden eagles. These particular species were selected because they were identified as the most susceptible to development in the park management plan and there was considerable value and concern associated with these particular species in the literature. Grizzly bears were also selected because they are of prime research importance to the park and there is a relatively high amount of data available. Other than discussions with park staff, no form of public consultation was carried out to determine social, economic, and/or cultural values of residents. Once VECs were selected, potential interactions between these species, projects and associated effects were highlighted. A series of working hypotheses were then drawn based on these interactions, and used to guide the assessment of potential cumulative effects arising from proposed and existing park management practices.

Dome *et al.* (1982) also took a population-level approach when studying the potential impacts of hydrocarbon development in the Mackenzie Delta-Beaufort Sea area. Unlike Hegmann, however, species that were most valuable to the local people were identified as VECs after several rounds of public consultation. This included species valued for meat or furs, such as whales, foxes, waterfowl, and caribou. A series of matrices was drawn, with all potential environmental effects listed vertically and all VECs listed horizontally. Potential impacts were then estimated for each VEC as negligible, minor, moderate, or major. Mitigative measures and other recommendations were then made in light of potential impact severity and the importance of the VEC of concern to the subsistence economy.

A somewhat different approach to the identification of VECs involves the use of habitat. Ecologistics (1994) took a habitat-level approach while assessing the effects of cumulative impacts on the natural characteristics of the Oak Ridges Moraine in the Greater Toronto Area. Habitat level VECs for aquatic, terrestrial, visual/cultural, and natural resources were identified through a literature review. Examples of these VECs include Class 1 wetlands, significant fish habitat, coldwater streams, areas with high forest interior coverage, areas of natural and scientific interest, areas of high aesthetic importance, and aquifers for town water supplies. Once identified, a significance and sensitivity rating was given to each VEC. These scores were then combined to give the overall vulnerability of the VEC, which was in turn compared to the level of anticipated changes to give a final risk level (high, medium, low) for each VEC. It was then recommended that programs be designed to monitor the VECs at greatest risk

On an even broader scale, Ramsay (1996) used VECs at the landscape level to assess cumulative effects along the Niagara Escarpment in southern Ontario. She used a combination of landscape (forest interior) and population (neotropical migrants, rare or endangered species, declining species) level VECs in her assessment. An indicator species was selected for each VEC. The significance of the cumulative effects of landscape change were then assessed with respect to the effects on these indicators. The assessment included the consideration of impacts on landscape features such as patch size, shape and dispersion, as well as internal forest composition and maturity stage, and landscape diversity.

Many studies have also identified VECs at more than one of the aforementioned hierarchical scales. For instance, while considering the potential impacts of diamond mining in the Northwest Territories, the NWT Diamonds Project identified a number of VECs. The main components identified as valuable to local residents at public meetings included wildlife related to subsistence (eg. caribou, grizzly bear, furbearers), water quality for fish, eskers as critical wildlife habitat areas, and wilderness areas for the associated heritage, aesthetic and spiritual values. For each VEC, the potential effects were evaluated, mitigation measures discussed, and monitoring programs and/or research projects suggested (EAP, 1996).

The West Kitikmeot/Slave Study also selected VECs at a variety of scales. Key VECs identified included caribou, critical wildlife habitats, grizzly bears, fish, muskoxen, wolves, eskers, permafrost, quality and quantity of ground and surface water, and air quality. As with many of the previous studies, the potential interactions of these VECs with development activities and effects were then used to focus the CEA and to identify future research needs (GeoNorth and AXYS, 1997).

There are numerous other studies which have used VECs to narrow the scope of environmental assessments. However, the cases reviewed above provide a sufficient overview of the varying approaches to how VECs are identified and applied in CEAs. From these studies, it is clear that VECs can be identified at a variety of hierarchical scales, ranging from population

(Hegmann, 1995) to landscape (Ramsay, 1996). Species and population level VECs are good because they provide a clear focus, and are easily observable. However, some important community, landscape or ecosystem level features may be overlooked if only a few key species are selected. Although the VECs selected vary widely based on the location and scope of the assessment, it would be ideal to select a variety of VECs at multiple hierarchical levels. This way, species or populations of prime importance socially (eg. subsistence) and ecologically (eg. vulnerable) can be included while also considering larger scale attributes which provide a more holistic view of the ecosystems.

The case studies also demonstrated that there are a number of different approaches to identifying VECs, ranging from the public-oriented approaches of Dome *et al.* (1982) and EAP (1996) to the more theoretical approaches of Hegmann (1995) and Ramsay (1996). Since a focus on too many theoretical aspects may not be entirely representative of public opinion, and likewise popular public opinion may not represent all ecosystem components which are of value ecologically, a balance between theory and public opinion will likely result in the most realistic VECs.

Valued Socioeconomic Components

Since cultures and lifestyles are also considered as valuable components, many assessments include not only VECs but also VSCs. This is particularly true in northern areas where the well being of the residents is still highly interrelated with the surrounding environment. A VSC can be defined as a "cultural, social or economic aspect of the environment which, if affected by development, would be of concern to regional residents and/or government regulators." (GeoNorth and AXYS, 1997:6).

It is important to note that not all assessments use the term "VSC". In many cases, socioeconomic factors are included under the VEC listings. For instance, in the study by Ecologistics (1994) discussed above, aesthetics and town water supply were identified as VECs along with fish habitat and forest cover. In other cases, valuable ecological and social components are combined into one term, valued ecosystem and cultural components, or VECCs (eg. DIAND, 1998). Regardless of the terminology used, it is important that cultural and socioeconomic values be addressed in CEAs.

The BHP Diamonds Project identified the following VSCs in addition to VECs mentioned above by EAP (1996): community stability/immigration, economic development, employment/training, families, historical sites/burial grounds, human health, traditional knowledge, traditional lifestyle, territorial lands, benefit sharing/partnership, wage economy, culture, outfitters, and land use and stewardship (BHP, 1995). Likewise, the West Kitikmeot/Slave Study identified aboriginal land use, aboriginal resource use, commercial land use, cultural/historical sites, and human health as VSCs (GeoNorth and Axyys, 1997). In general, VSCs are identified through public consultation and are used in assessments in the same manner as VECs.

2.4.3 APPROACHES TO REGIONAL CEA

There are many conceptual frameworks that have been proposed for CEAs to apply the approaches mentioned above. Since the focus of this thesis is on regional CEAs and northern national parks, a brief discussion is provided for conceptual frameworks dealing specifically with regional level assessments either in the Canadian north or around national parks. Four frameworks are reviewed from: the West Kitikmeot/Slave Study (1997), Kluane National Park and Reserve (1995), Prince Edward Island National Park (1996), and a general framework for Canada's national parks (1995).

The West Kitikmeot/Slave Study was initiated in 1994 as a joint initiative between the Department of Indian Affairs and Northern Development (DIAND) and the NWT Department of Renewable Resources. One objective of this study was to examine the potential cumulative impacts arising from existing and potential mining developments and related infrastructure. To do so, the CEA framework employed involved four steps. At the outset, VECs and VSCs were identified through a series of public consultations. All potential developments, associated activities, and environmental effects were then identified. Next, possible interactions of VECs/VSCs with activities and effects were evaluated and ranked on a scale of 1 to 5, with 5 representing potentially significant interactions. This ranking was derived from a predetermined scheme based on the extent (local, regional, provincial, national), magnitude (more or less than 10% of the resource affected), and duration (short, medium or long) of the activities and effects. The various pressures and effects of all potential developments were compiled into a "master list", which was then used in conjunction with the valued components/activity effects framework rankings to guide future discussions on cumulative impacts (GeoNorth and AXYS, 1997).

CEEs are also becoming of greater concern around Kluane National Park in southwest Yukon due to the presence of numerous small-scale developments. A case study by Hegmann (1995) used a framework consisting of four levels: baseline, screening, analysis, and summary/conclusions. During the first stage, baseline information to be used in the analysis was collected. This included information on past, present and future regional projects, park resources, and the driving forces and implications of human use in the region. VECs were also selected in this stage. Next, the screening level involved identifying the environmental effects of each project, synergies in space and time arising among projects, and the potential effects of projects on wildlife. Known cause and effect relationships were then used to develop a few impact hypotheses to be used in the next stage. In the analysis level, hypotheses were analyzed by predicting effects on population viability and ecosystem function, projecting these effects into the future (ie. scenarios), and evaluating the potential combined effect of increased activity throughout the study area. Finally, significant effects and the projects causing them were summarized. Potential CEEs were then used to draw conclusions regarding the proposed projects and implications of these projects for park management.

Parks Canada has also expressed concern over the declining ecological state of Prince Edward Island National Park (PEINP). This concern arises mainly because the park is small in size, it is easily accessible and receives high visitation, and there is a high level of existing development. A CEA was therefore performed for the park and surrounding areas by T. Keith (1996). In carrying out the assessment, Keith (1996) used the following framework. First, historical environmental change for the study area, such as forest removal, coastal erosion, and road construction were outlined. Individual and cumulative effects of previous and current developments and activities in the park were then described in detail. Subsequently, potential CEEs arising from proposed concepts, developments or activities in the draft park management plan were discussed in order to gain a perspective on potential future developments. Once the potential CEEs of past, present and future developments within park boundaries were discussed, effects originating outside the park boundary were then considered. The significance of all impacts arising inside and outside park boundaries were then assessed with respect to key resources or VECs. Given these potential impacts, possible mitigation measures were highlighted, and monitoring strategies suggested for each key resource.

Kalff (1995) developed a framework specifically for CEAs in Canadian national parks. One main goal of developing this framework was to allow the better integration of park planning and EIA at a scope beyond park boundaries. The proposed framework is outlined in Figure 2.4. It consists of 3 interconnected subsections: sources of CEEs, assessment of CEEs, and management of CEEs. Sources of CEEs include effects arising from policies, programs and projects. Note that these effects can arise both inside and outside park boundaries. To assess CEEs, a three-tiered assessment framework was designed. This framework considers CEEs at three nested scales: regional, park-level, and project specific. For all tiers, the first step is to establish park goals and identify valued ecosystem components (VECs). For national parks, the critical park goal should always be the maintenance of ecological integrity. Once goals and VECs have been defined, all three tiers follow somewhat different procedures, as indicated in Table 2.8. However, they all have the same general components of defining boundaries, describing the surrounding environment, describing past, present and future land use activities, assessing effects of CEEs on VECs, and monitoring. The final subsection involves managing the CEEs through park policies and planning and regional planning initiatives. This step is crucial to the maintenance of park ecological integrity, as park management actions and regional plans can encourage impact mitigation, limit future harmful developments, and minimize the overall potential for the accumulation of future CEEs.

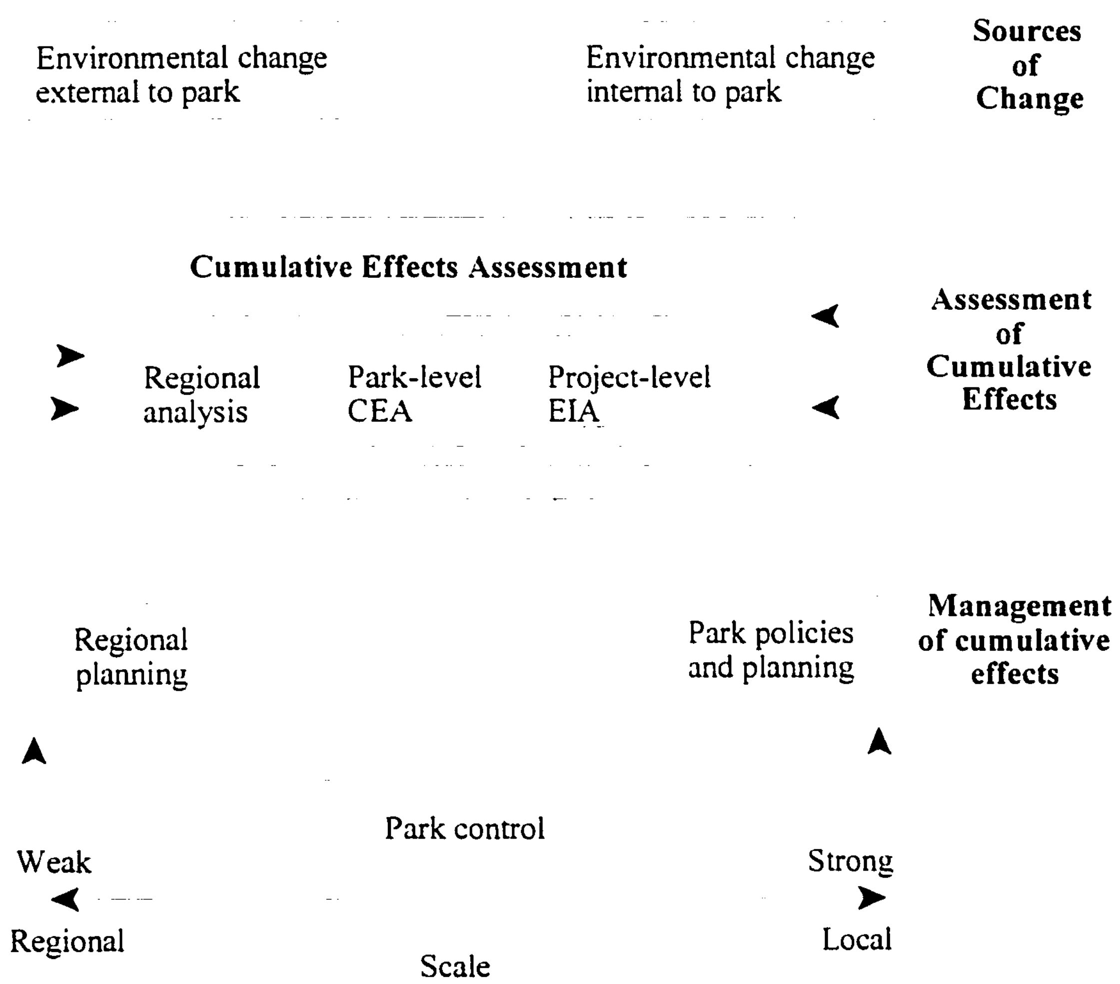


Figure 2.4 – CEA framework for Canadian National Parks (*source*: Kalff, 1995)

Table 2.8 – CEA steps for Canadian National Parks (*source*: Kalff, 1995)

Step	Regional Analysis	Park-level CEA	Project-level EIA
1	Establish park goals and identify VECs		
2	Define regional boundaries	Describe park ecology	Describe project and receiving environment
3	Describe regional ecology	Assess current status of VECs	Establish project boundaries
4	Describe and map regional land use	Establish specific goals for each VEC	Identify environmental effects of proposed development and the VECs most likely to be affected
5	Identify and map economic growth patterns in region and sketch likely economic land use scenarios	Describe past, present, and likely future development	Analyze cumulative effects
6	Identify ecological problems which are affecting, or may affect, park VECs	Establish cause-effect linkages	Assess significance of cumulative effects
7	Monitor changes in human activities and land use	Assess significance of cumulative effects on VECs	Ensure that information is fed into park assessment
8	---------	Undertake cumulative effects monitoring	---------

2.4.4 ASSESSMENT AND EVALUATION

Evaluation Criteria

With so many possible approaches to regional CEAs, some key criteria for these assessments would be useful to guide the discussion of strengths and weaknesses. In a recent report, Kennett (1999) highlighted five main components essential to regional CEAs in his new planning-based paradigm for CEA. First, he recommends that a proactive, planning-based approach must be adopted to replace project-specific CEAs as the main tool for identifying CEEs. This is because a regional, comprehensive scope is more consistent with the nature of CEEs than the traditional more localized scope. Second, the new paradigm calls for strong government leadership, as opposed to the traditional proponent-driven approach. This component is included in order to partially circumvent the often inappropriate and unattainable expectations placed on project proponents. The third component involves establishing objectives, thresholds, and explicit limits for land and resource use, with the aim of creating a list of priorities and thresholds to guide future decisions. Fourth, Kennett suggests that cumulative effects management must take on a regional focus since CEEs often occur over broad landscapes. Finally, the fifth component of the new paradigm involves the establishment of a direct linkage between planning and environmental assessment. Kennett argues that this linkage is necessary if project-specific cumulative impacts are to be consistent with regional land use objectives.

All five of these principles are repeatedly mentioned throughout the regional CEA literature (eg. Clark, 1994; Cooper and Zedler, 1980). In addition, since all five components relate to the goals of this thesis, they will be used in the following section to evaluate the strengths and weaknesses of the various frameworks presented above.

Framework Evaluation

As with the CRLUP evaluation in section 2.3.3, a series of questions have been derived based on the criteria suggested by Kennett (1999). These criteria and questions are presented in Table 2.9 along with an evaluation for each of the CEA frameworks discussed above.

Table 2.9 - Evaluation of Regional CEA Frameworks.

Criteria	Question	GeoNorth & AXYS, 1997	Hegmann, 1995	Keith, 1996	Kalff, 1995
Planning-based	Does the framework specify regional planning goals?	No tie between framework and regional planning goals.	Aligned with park planning goals, but not regional goals.	Aligned with park planning goals, but not regional goals.	Aligned with park planning goals. Recommends cooperation for regional management.
Government leadership	Has government assumed any responsibility in the CEA?	Yes - DIAND and NWT-DRR.	Yes - Parks Canada.	Yes - Parks Canada	Yes - Parks Canada
Establishment of goals and thresholds	Were thresholds or limits to acceptable change identified?	No.	Recommends setting quotas/use limits in heavily impacted areas.	Recommends determining limits of acceptable change in affected areas.	Goals or thresholds identified for VECs; no development thresholds specified.
Regional focus	Were appropriate region-wide boundaries and monitoring programs established?	Regional focus; Monitoring recommended.	Boundaries park-specific, not regional; Monitoring recommended.	Yes - entire area surrounding park was considered; Monitoring recommended	Yes - entire area surrounding park was considered; Monitoring recommended.
Linkage between planning and EA	Could regional goals, priorities and thresholds be tied to future project review processes?	No tie between framework, EA, and planning.	Linkage between CEA and park EAs was recommended; no regional ties.	Linkage between CEA and park EAs was recommended; no regional ties.	Linkage between CEA and park EAs was recommended; no regional ties.

No frameworks were specifically tied to a regional planning process or regional goals. The three park frameworks were tied into the park planning process, but didn't go beyond. Government involvement was much more successful, as all studies were initiated and funded (at least partially) by a government agency. There was a wide variety of application of thresholds - Hegmann and Keith both recommended the implementation of use limits and visitor quotas in the most heavily used areas. Kalff also incorporated the idea of thresholds, except these were not set as limits of development but were rather used to determine the amount of stress VECs could undergo. Since all frameworks were designed for regional CEAs, the study area boundaries are broader than one would expect in a project-specific assessment. However, Hegmann restricted his study to the area within park boundaries, which detracts from the comprehensiveness of the study. Surprisingly, none of the frameworks effectively addressed the question of making a link between planning and environmental assessment. All of the park assessments recommended that cumulative effects be considered when evaluating project-specific assessments and when planning within park boundaries, but these recommendations did not go beyond jurisdictional boundaries.

2.4.5 LINKS TO PARKS

The plight of Canada's national parks with respect to cumulative impacts has been discussed in Chapter 1. CEEs can accumulate anywhere and transcend all political boundaries, and parks are no exception. For this reason, it is becoming increasingly important for parks to specifically address the potential for impact accumulation arising from sources both internal and external to park boundaries. Application of the CEA criteria discussed above in park planning and management could assist in the identification and mitigation of CEEs accumulating in and around national parks in a number of ways.

Indeed, aspects of Kennett's new CEE paradigm have already been incorporated into national park planning and management. For instance, it is already widely accepted that parks need to be managed in a regional context both to maintain park ecological integrity and to gain a better understanding of environmental effects arising outside park boundaries. Some examples include the Greater Fundy Ecosystem around Fundy National Park in New Brunswick (Franklin, 1997) and various applications of UNESCO's Biosphere Reserve Model (IUCN, 1979). In addition, since national parks are governed by a federal agency, there is already substantial government involvement in any park-initiated CEA. A good example of this is the initiation of the Banff-Bow Valley Study in 1994 (BBVS, 1996). More and more parks are also starting to incorporate the notion of thresholds within their boundaries through park zoning and the establishment of visitor use quotas.

However, there are a few areas of the CEE paradigm that could be improved upon in order to maximize understanding of CEEs in and around national parks. For instance, if Parks Canada were to take an anticipatory, large-scale planning approach in which park goals and objectives are linked to the broader objectives, this would encourage all stakeholders to work towards a compatible vision for the park and surrounding areas. This vision could involve setting development thresholds which go beyond park boundaries to help limit activities before environmental effects accumulate, and enable a proactive stance on CEEs. Lastly, a stronger link must be made between regional planning and environmental assessments in order to provide a broader planning context for project-specific decisions. This would limit the CEEs arising from incremental project approvals and ensure that all developments would be aligned with regional objectives (Kennett, 1999).

2.5 SUMMARY

Four main themes have been reviewed in this chapter: protected areas selection, northern national park management, comprehensive regional land use planning, and cumulative environmental effects and assessment. For protected areas selection, criteria used in selecting natural areas were reviewed (Smith and Theberge, 1986) and three examples of the application of these criteria were provided (Parks Canada, 1994; Eagles, 1980; Theberge *et al.*, 1980). Ecological boundary considerations highlighted by Theberge (1989) and Parks Canada (1994) were also discussed.

Five aspects of northern national park management were then discussed. These were: ecological integrity, ecosystem-based management, threats, environmental assessments, and monitoring. For each section, a definition was provided, its relevance to park management discussed, and existing frameworks reviewed (PEICNP, 2000; Parks Canada, 1998; Parks Canada, 1994; Woodley, 1994).

Frameworks from four comprehensive regional land use planning exercises were then reviewed (CORE, 1996; MBPC, 1991; LSRLUPC, 1989). This was followed by a discussion of the key challenges of CRLUP and an assessment and evaluation of the four frameworks. The utility of CRLUP in park management was then discussed.

Finally, CEEs and CEAs were reviewed. First, sources and pathways leading to CEEs were highlighted (Spaling and Smit, 1993). Common methods of CEA were then briefly presented (Spaling and Smit, 1995), along with a discussion of VECs and VSCs (eg. EAP, 1996;

Ecologistics, 1994). Several frameworks for regional CEAs in the North and in national parks were then reviewed, assessed and evaluated (GeoNorth and AXYS, 1997; Kalff, 1995). This section concluded with a discussion of how CEEs and CEAs are relevant to national parks today.

In Chapter 3, the interactions among these four themes are highlighted, and the underlying principles of the themes are used to develop a set of guiding principles for the development and implementation of the proposed methodology. An overview of the proposed methodology is then given, and each stage described in detail (Figure 2.5).

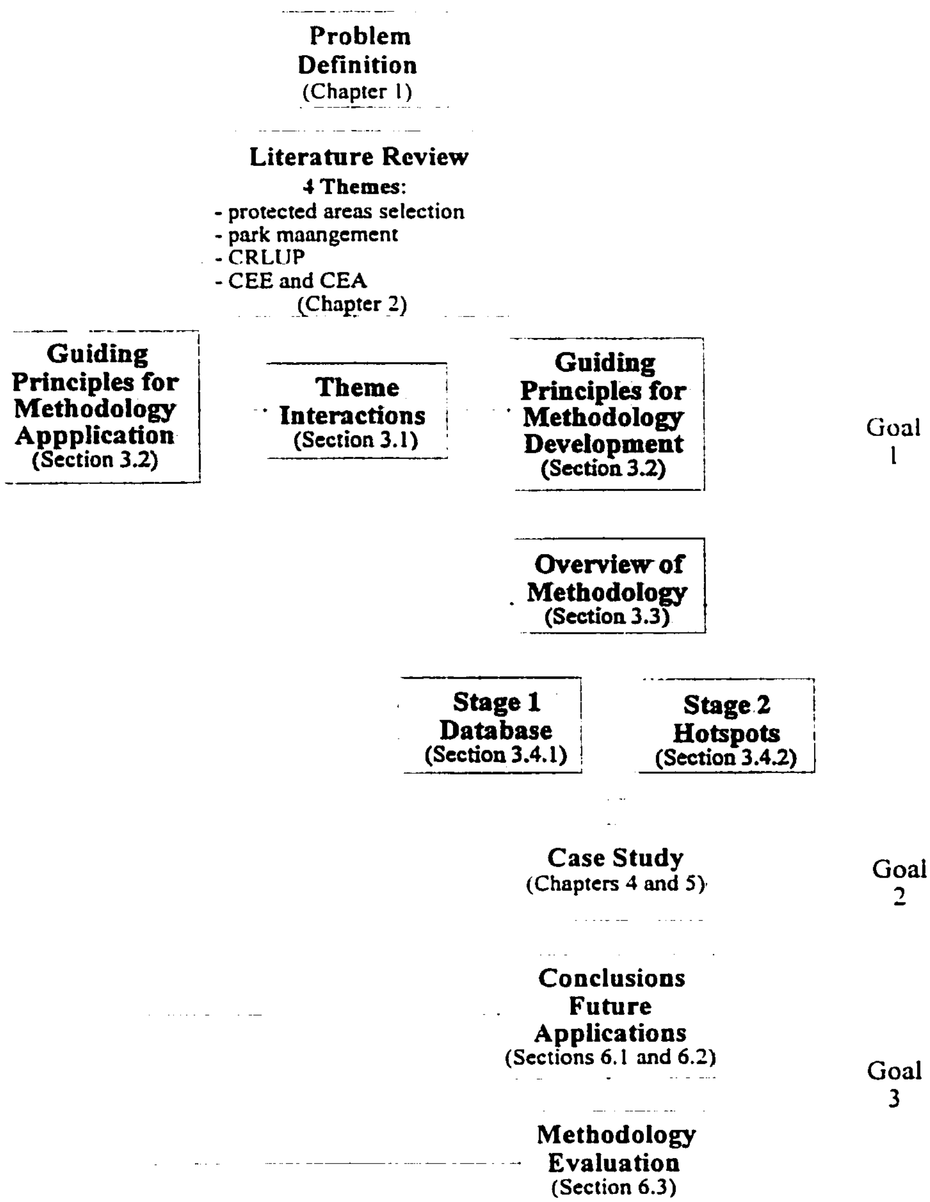


Figure 2.5 - Conceptual Map of Thesis.

CHAPTER 3 - PROPOSED METHODOLOGY

The purpose of this chapter is to develop a methodology to be used to help identify areas of concern for regional cumulative impact assessments in and around northern national parks. In this chapter, the interactions among the four themes reviewed in Chapter 2 are discussed (section 3.1). Principles derived from the four themes in Chapter 2 are then used to develop a set of guiding principles for the methodology (section 3.2). An overview of the proposed methodology and broad links to the literature are then presented (section 3.3). This is followed by a step-by-step description of the methodology (section 3.4).

3.1 THEME INTERACTIONS

Although discussed independently in Chapter 2, the four themes - protected areas selection, park management, cumulative environmental effects and assessment, and comprehensive regional land use planning - are actually highly interrelated, as illustrated in Figure 3.1. These interactions are important to understand as all four themes are used together to develop the methodology proposed in the following sections. A brief overview of these interactions is provided below, with letters in brackets referring to the arrows in Figure 3.1.

Protected areas selection methods provide the selection criteria and boundary considerations required to establish national parks (a). Within national park management, we see a feedback loop starting with the park's mandate to maintain ecological integrity (b) through ecosystem-based management practices (c). This entails specific inclusion of threats (d), both internal and external, which are evaluated through project-specific environmental assessments (e). Monitoring programs (f) can then be established for potential impacts or other sources of concern, giving feedback to ecosystem-based management and helping to ensure the maintenance of ecological integrity (g).

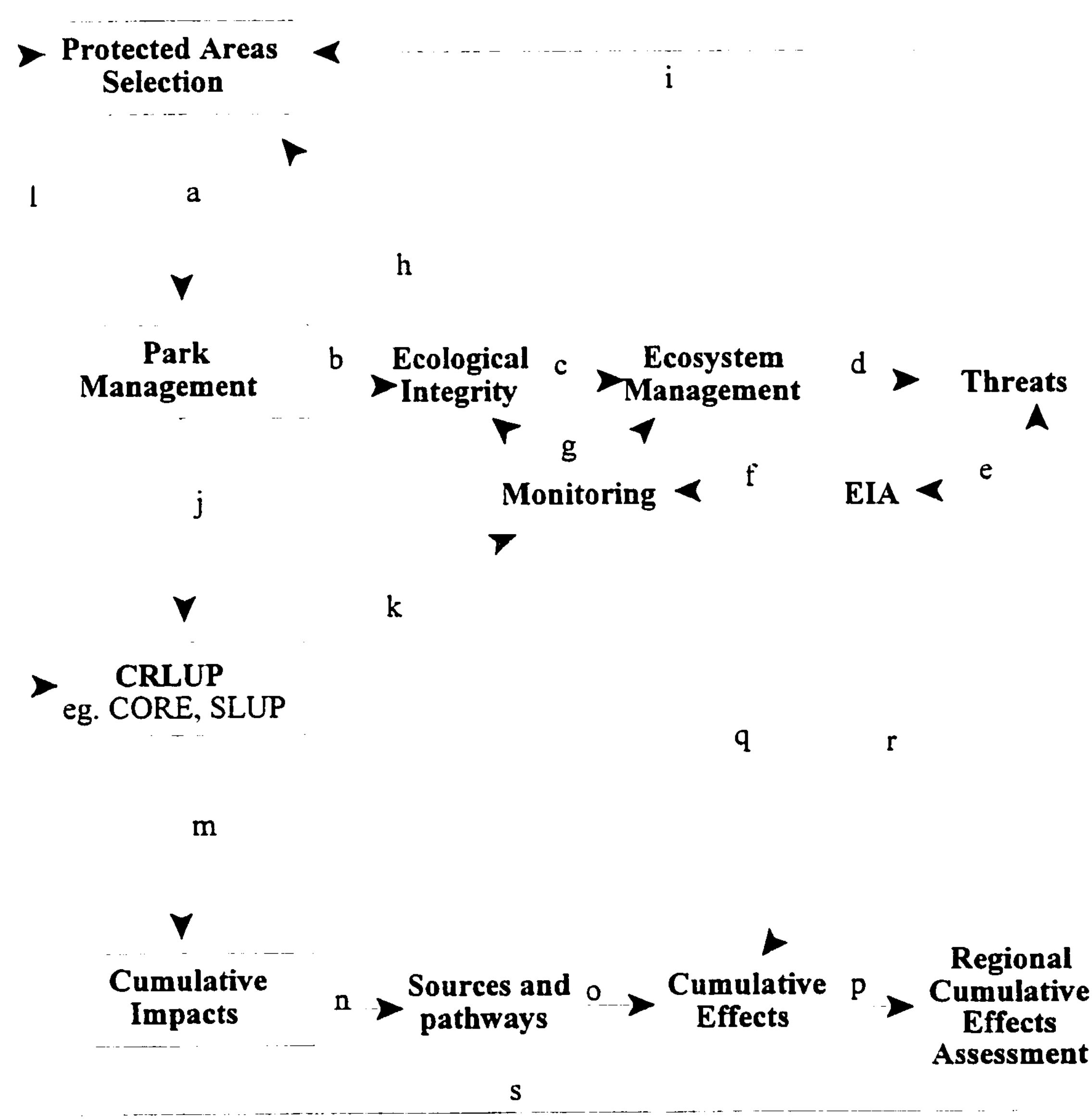


Figure 3.1 – Interrelations Among Four Thesis Themes, as described in text.

Park ecological integrity (h) and regional threats (i) also both feed back into the protected areas category, potentially influencing the establishment of future protected areas in the same region. For instance, if a park's ecological integrity was declining due to the presence of numerous threats, this might encourage the establishment of another nearby protected area and/or result in modified park boundaries.

Park management is also connected to CRLUP (j) because a key aspect of managing parks today is to go beyond park boundaries and view the park in a regional context. By doing so, CRLUP can influence the effectiveness of all aspects of park management (k). In addition, CRLUP exercises may contribute to the establishment of new protected areas, such as in SLUP (l). CRLUP also feeds into the cumulative impacts category (m), as it becomes necessary to address sources and pathways (n), overall impacts of cumulative environmental effects (o), and the need for regional CEAs (p) at the large scales involved. Sources and pathways of cumulative impacts also lead to threats affecting national park management (q), while these threats in turn give rise to other potential cumulative effects (r). Finally, regional CEAs can be carried out in conjunction with CRLUP processes (s).

3.2 GUIDING PRINCIPLES FOR DEVELOPMENT AND APPLICATION OF THE METHODOLOGY

Figure 3.1 shows that the four themes reviewed in Chapter 2 are highly interrelated. The four themes may therefore be integrated to provide guiding principles for the development and application of the proposed methodology. To develop these guiding principles, the key characteristics of the themes presented in Chapter 2 are briefly reviewed, and guiding principles recommended in each of the sections below. All guiding principles are then compiled and classified in the final section.

Protected Areas Selection

Protected areas selection criteria were reviewed to set the broad context by providing some insight into the values and criteria that protected areas are established to protect. This literature contains two main aspects. First, the need to identify priority areas as a focus for implementing conservation initiatives is inherent to the whole idea behind establishing protected areas. Second, the literature provides an overview of numerous social and ecological values requiring special attention when considering future land use activities and regional impacts (eg. Parks Canada, 1994; Theberge, 1989; Smith and Theberge, 1986).

Thus, if the methodology is to take account of the protected areas selection literature, it needs to incorporate the following guiding principles:

- provide a means to select areas where achieving the proper balance between environmental protection and economic development is of greatest importance; and
- explicitly address the social and ecological values of the study area.

Northern National Park Management

Since these aspects of park management set the framework within which the methodology will have to function, several guiding principles must be derived from park management procedures. Five components of national park management were reviewed in Chapter 2.

The ecological integrity literature focuses on the need to have measures and/or indicators at a variety of hierarchical scales, and provides some measures and indicators useful for identifying ecological values (Parks Canada, 1998; Woodley, 1993). Ecosystem management encourages the consideration of social and ecological values at broad scales using ecologically sound boundaries

(Grumbine, 1994). It also emphasizes the importance of understanding human impacts through EAs and CEAs, assimilating existing data, and viewing ecosystems holistically (Parks Canada, 1994). The notion of internal and external threats emphasizes the need for a regional perspective in order to effectively minimize regional stressors. The environmental assessment literature highlights the need to be proactive and predict or address potential impacts before they become problematic (CEAA, n.d) and to more fully integrate assessments into park planning (PEICNP, 2000). Finally, the monitoring literature focuses on helping to understand long-term human impacts, the need to recognize threats, and the importance of long-term maintenance of ecological integrity (Woodley, 1994).

In order to effectively function within the existing park management process, the methodology needs to incorporate the following guiding principles:

- take account of the recommended ecological integrity monitoring measures;
- consider social and ecological values of the study area while assimilating existing data, and working towards a better understanding of human impacts;
- take a regional perspective on threats;
- maintain a proactive stance on environmental impacts and integrate environmental assessment more fully with park planning; and
- focus on long-term human impacts.

Comprehensive Regional Land Use Planning

Since the methodology proposed below is intended to be used for planning purposes, it is important that it also be developed with principles derived from the CRLUP literature in mind. All CRLUP examples reviewed in Chapter 2 were goal oriented and forward looking. CRLUP is a regional exercise by nature, and thus highlights the need to consider regional developments and their impacts at larger spatial and temporal scales. In the case study, there was also a substantial effort to integrate social, economic and environmental aspects of the study area, incorporate public values, and be flexible. In addition, most plans were issue-focused and anticipatory (CORE, 1994; LSPC, 1991; MBPC, 1991; SLUPP, 1980). Other aspects of CRLUP that were not particularly well incorporated into the examples in Chapter 2 include reasonable time lines, clearly defined stakeholder roles, and continuity in time.

In order to effectively function within the CRLUP framework, the methodology needs to incorporate the following guiding principles:

- establish clearly defined goals at the outset;
- work at a larger spatial and temporal scales;
- integrate social, economic and environmental aspects;
- incorporate public values;
- maintain flexibility;
- focus on key issues and most promising solutions;
- clearly define stakeholder roles;
- achieve continuity over time;
- work with realistic time restrictions; and
- anticipate future developments before they arise.

Cumulative Environmental Effects and Assessment

The CEA literature was reviewed because the ultimate purpose of the methodology is to limit cumulative environmental effects (CEEs) around parks. The VEC /VSC literature highlighted the need to consider social and ecological values at multiple hierarchical scales. Several case studies were also reviewed and evaluated in light of how well they satisfied five criteria: (1) proactive and planning-based, (2) government leadership, (3) use of objectives, thresholds, and explicit limits for land and resource use, (4) regional focus, and (5) direct linkage between planning and environmental assessment.

In order to effectively address CEEs, the methodology needs to incorporate the following guiding principles:

- incorporate social and ecological values at multiple hierarchical scales;
- be proactive and planning-based;
- have government leadership;
- identify land use objectives and thresholds;
- maintain a regional focus; and
- link planning with environmental assessments.

Compilation and Classification of Guiding Principles

The guiding principles listed above can be classified into two sets of principles: one set to guide the development of the actual methodology, the other set to guide the potential for future applications of the methodology. These two sets are presented in Boxes 3.1 and 3.2 respectively.

The guiding principles outlined in Box 3.1 are used to develop the methodology presented in the sections 3.3 and 3.4. The principles in Box 3.2 are used to guide the discussion on potential applications of this methodology and to evaluate its overall utility in Chapter 6. They are listed in no particular order, as all criteria are considered equally important.

Box 3.1 - Guiding Principles for the Development of the Methodology

Guiding Principles for Methodology Development
1. Provide a manner to select areas where achieving the proper balance between environment and development is of greatest importance. 2. Incorporate social and ecological values of the study area. 3. Take account of the recommended ecological integrity monitoring measures. 4. Work at a regional scale. 5. Assimilate information within study area boundaries.

Box 3.2 - Guiding Principles for Potential Applications of Methodology

Guiding Principles for Methodology Application
1. Take a regional perspective on threats. 2. Maintain a proactive stance on environmental impacts and integrate environmental assessment more fully with park planning. 3. Focus on long-term human impacts. 4. Establish clearly defined goals. 5. Integrate social, economic and environmental components. 6. Maintain flexibility. 7. Focus on key issues and most promising solutions. 8. Clearly define stakeholder roles. 9. Achieve continuity over time. 10. Work with realistic time restrictions. 11. Anticipate future developments before they arise. 12. Work towards a better understanding of past, present and future human impacts. 13. Be proactive and planning-based. 14. Have government leadership. 15. Identify land use objectives and thresholds. 16. Link planning with environmental assessments.

3.3 OVERVIEW OF PROPOSED METHODOLOGY

The proposed methodology involves creating a database of social and ecological values, and locating areas with high concentrations of these values, or value hotspots. This database and spatial overview of value concentrations may then be applied in proactive regional planning exercises and CEAs to help minimize CEEs. These potential applications are reserved for discussion in Chapter 6. This section provides an overview of why the methodology was developed (section 3.3.1) and the stages involved (section 3.3.2).

3.3.1 JUSTIFICATION

The methodology has been developed around the notion of social and ecological values for two main reasons. First, the guiding principles outlined in Box 3.1 specify the need to assimilate existing information to select priority areas while integrating regional-level social and ecological values. In addition, since the methodology is designed to deal with CEEs, a parallel has been drawn between the role of VECs/VSCs in focusing the scope of a CEA and the role of the values database and hotspots in selecting priority areas for proactive regional planning. CEAs often use VECs/VSCs, or environmental components identified as valuable to people and likely to be affected by development, as a means of narrowing the scope of an assessment. The same idea is applied with the methodology, except that rather than focusing on one particular ecosystem aspect (eg. sand dune, moose) and assessing the impacts of development on that component, areas with concentrations of values are identified to be incorporated into a planning framework to establish land use limits and levels of acceptable change before CEEs arise (see Chapter 6 for further discussion). The methodology also makes provisions for the presence of outstanding values through the option of using a weighted approach as discussed in section 3.4.2.

3.3.2 METHODOLOGY DEVELOPMENT STAGES

Note that an underlying assumption of the methodology is that study area boundaries have already been defined based on the goals and objectives of the particular case study. It is not the intent of this thesis to review issues surrounding definition of appropriate study area boundaries and scales. Nevertheless, study area boundaries must be properly documented and justified before carrying out either of the two stages involved in this proposed methodology.

Stage 1

The first stage involves developing a database of values by taking an inventory of all social and ecological values within the study area. This stage is included to fulfil the second, third, fourth and fifth guidelines listed above: incorporate social and ecological values of the study area, take account of the recommended ecological integrity monitoring measures, work at a regional scale, and assimilate information within study area boundaries.

A broad overview of potential social and ecological values is given in Tables 3.1 and 3.2 respectively. All these potential values were derived from the literature on protected areas selection, ecological monitoring measures, and VECs/VSCs.

In general, most social values arise from consumptive, non-consumptive, and recreational activities. The importance of consumptive wildlife based activities was revealed through a review of VECs/VSCs in section 2.4. For instance, Hegmann (1995), LGL *et al.* (1985) and Dome *et al.* (1982) all used ecosystem components that were valuable to the local economy and/or subsistence when carrying out environmental impact assessments. Non-consumptive and recreational activities were also included in this table because several authors have identified criteria such as areas of recreational, educational, scientific, and interpretive value (Smith and Theberge, 1986: Margules and Usher, 1981), aesthetic importance (Eagles, 1980), or cultural, archeological, and native importance (Hans-Bastedo, 1986) as valuable, reviewed in section 2.1.

It is important to note that this list is by no means comprehensive but rather it may serve as a guide to provide suggestions for determining the most important social values.

Table 3.1 - Social Values Derived from Literature.

Activity	Values
Consumptive wildlife-based activities	- Subsistence hunting - Subsistence fishing - Recreation and Sport fisheries - Trapping - Big game outfitting and recreation hunting
Non-consumptive activities	- Wildlife viewing and photography species and locations - Aesthetics of large tracts of undisturbed wilderness - Cultural/heritage appreciation sites - Sites of educational/interpretive value - Sites of scientific value a. International Biological Programme sites b. Heritage Rivers c. Special Preservation Areas d. Environmentally Significant Areas - Canoeing - Kayaking and rafting - Motor boating - Hiking - Biking - Natural appreciation sites - Camping sites - Skiing - Dog mushing and snowmobiling - Ice fishing

As per ecological values, most abiotic values were derived from discussions on ecological boundary considerations (Theberge, 1989), environmentally sensitive areas (Eagles, 1980), and valued ecosystem components (Keith, 1996). Biotic criteria were derived from national park management, protected areas, and VEC/VSC literature discussed in Chapter 2, especially from Parks Canada (1998), Woodley (1994), Theberge (1989), Smith and Theberge (1986), and Theberge *et al.* (1980). Most of these values either deal with rare, endangered, threatened, vulnerable, or unique biotic and abiotic attributes which increase landscape heterogeneity and contribute to regional biological diversity, or with species or populations that are either particularly sensitive or vulnerable to human activity and/or play a major role in maintaining ecosystems. Again, it is important to note that the purpose of the list was not to be comprehensive but rather to provide a general framework to guide the selection of valuable areas, so new criteria may be added when desired. Details on how to inventory these values are discussed in section 3.4.

Table 3.2 - Ecological Values Derived from Literature.

Criteria		Values
Abiotic	Geomorphological features	- Rare, endangered, threatened, vulnerable or unique geomorphological features
	Hydrological features	- Rare, endangered, threatened, vulnerable or unique hydrological features
Biotic	Species/population level features	- Rare, endangered, threatened, vulnerable or unique floral and faunal species - Hypersensitive species - Key prey species - Summit predators - Migratory and spatially demanding species - Habitat specialists
	Community/Ecosystem level features	- Regionally uncommon or rare vegetation communities - Highly diverse communities or ecosystems

Stage 2

The second stage to developing the methodology involves using the values database to determine areas with concentrations of ecological and social values, or "value hotspots". When identifying these hotspots, it will be useful to enter all data collected into a Geographic Information System (GIS) and analyse the spatial distribution of values across the study area through a series of maps. Using a GIS would also enable the data to be stored in a format that is both easy to access and update. Details of how to identify value hotspots are discussed in section 3.4.

3.4 STEP-BY-STEP METHODOLOGY DESCRIPTION

Section 3.3 provided an overview of the two stages involved in developing the proposed methodology. This section provides detailed descriptions of how to carry out those stages.

3.4.1 STAGE 1: CREATE DATABASE OF REGIONAL VALUES

As was mentioned above, this stage involves taking an inventory of social and ecological values within the study area. The necessary steps required to identify these values and store the data in a useful manner are reviewed below.

First, the social values listed in Table 3.1 must be identified. The most obvious way to learn the social values of the study area is to deal directly with the public at large. A variety of public consultation approaches exist, such as public meetings, workshops, one-on-one interviews (eg. with government workers, trappers, hunters, outfitters, First Nations, NGOs, etc.), mail questionnaires, or telephone surveys (Babbie, 1995). The method used may be selected based on time availability, responsiveness of the public, and the financial budget of the project. The extent of public consultation - from local to national - would also vary, depending upon the nature of the research. For instance, research involving values associated with a municipal park would be more localized than, say, research involving values associated with a national park.

A review of the existing literature will also provide insight into social values. In particular, consulting past environmental assessments and protected areas studies that have been carried out in the study area will show ecological aspects that were recorded as socially valuable. In addition, local reports on issues such as indigenous and local knowledge, wildlife, tourism, visitor surveys, and local planning issues will also be a valuable tool when determining social values.

In addition to social values, the methodology also requires that ecological values be defined. These values may be identified by extensively surveying the literature on critical wildlife habitats, traditional ecological knowledge, planning, and environmental assessments. Interviews with knowledgeable individuals who have worked and/or lived in an area for an extended period of time (ie. indigenous and local knowledge) will also be key resources in determining all potential regional values. Primary field surveys would also be ideal, both to confirm existing data and to collect new data, if time and financial resources permit.

Once all social and ecological values have been identified, they may be inserted into the first column of Table 3.3. Then, key species listed for consumptive wildlife based activities and wildlife viewing may be specified and specific geomorphological, hydrological, and species/population level features listed under the appropriate value. Next, key locations for each of these values may be listed in the second column. Finally, information sources may then be recorded in the third column for future reference. These data may also be stored in a GIS for the reasons discussed above in section 3.3.2.

Table 3.3 - Tabulating Social and Ecological Values.

Values		Key Location (s)	Source(s)
SOCIAL VALUES			
Subsistence hunting species and location	Species 1		
	Species N		
Sites of educational value			
Etc...			
ECOLOGICAL VALUES			
Unique geo-morphology features	Feature 1		
	Feature N		
Highly diverse community			
Etc...			

3.4.2 STAGE 2: IDENTIFY VALUE HOTSPOTS

The second stage involves identifying areas within the study area that support a high number of values, or social and ecological value "hotspots". This stage is included as it provides a basis for implementing the methodology by identifying sites requiring special consideration in future studies on the long-term well being of the park and surrounding region, as required by the first guideline in Box 3.1. Again, specific examples of how the methodology may be used in future studies are discussed in Chapter 6.

Value hotspots are identified through three steps. First, the study area must be subdivided into smaller zones to form a zoning system that will provide a basis for future planning applications. Recall that the boundary guidelines outlined by Theberge (1989) - summarized in Table 2.1 - focus on keeping wildlife ranges and key abiotic features intact. Based on these guidelines, the following approach to zoning is recommended. At the outset, key wildlife habitats, abiotic components, and dominant physiographical features must be mapped. Given the size of the study area, a decision must be made as to how many zones are desired and the approximate area each zone should encompass. Wildlife habitat maps and physiographical features can then be overlaid, and zone boundaries drawn based on obvious habitat-physiography associations. For instance, in a study area that contains both mountains and valleys, one may see that moose habitat is largely concentrated in the river valleys while mountain goat habitat is concentrated in the mountains. Given these associations, two different zones can be drawn - one to encompass the riparian habitat, the other to include alpine habitat. Zone delineation will vary considerably based on study area topography and the characteristics of the wildlife species present (eg. migratory, habitat specialists). However, boundaries must always be drawn to be ecologically relevant by encompassing units of critical wildlife habitat and major physiographic features while keeping zone area as close to the desired size as possible.

It may also be possible to use an existing zoning system that is based on physiographical and ecological features as opposed to deriving a new one. For instance, the ecodistrict level of the Ecological Land Classification procedure may be suitable for these purposes if the data are available for the study area. Discretion must therefore be used when selecting or creating a zoning system, with due consideration to both the data availability and the ecological characteristics of the study area.

Second, once a zoning system has been derived for the study area, the total number of values in each zone can be tabulated and stored in the data table framework presented in Table 3.4. All locations identified as valuable in Table 3.3 are listed in column 1 of Table 3.4, and all social and ecological values listed across the top of the matrix in row 1. The values present in each zone are then recorded in this matrix and summed across the entire row. It is at this stage that storing the values database in a GIS becomes useful, as the maps may be used to spatially display the key locations for each of the social and ecological values and how these key locations overlap with the zoning system.

An underlying assumption at this stage is that the values attributed to all social and ecological attributes are equal. If this is not the case, for instance if there are outstanding features which are considered more valuable than others, there is the option of devising a weighting system in which exceptional values would be given a higher weight in the tallying process. This weighting system would have to be derived through extensive consultation with community members and wildlife specialists for the outcome to be acceptable.

Finally, once all regional values have been tabulated, zones may be ranked in decreasing order of values per zone. In order to consider the effect of area, the number of values present in each zone should also be divided by total zone area and zones ranked again in decreasing order of values per area. The results from ranking by values per zone can then be compared to the results from ranking by values per area per zone, and the differences discussed.

Table 3.4 - Determining Most Valuable Locations.

Zones	**Social Values**				**Ecological Values**				**Total Values per Zone**	**Total Zone Area**	**Values Per Area**
	1	**2**	**..**	**N**	**1**	**2**	**..**	**N**			
1											
2											
...											
N											

3.5 SUMMARY

Two sets of guiding principles were derived from the literature reviewed in Chapter 2. The first set of guidelines was then used to develop a methodology. A broad overview of the methodology was provided first, followed by a step-by-step description of the proposed methodology. In general, the first stage involves developing a database of social and ecological values through public consultation, interviews, literature reviews, and field surveys. Key locations for each of these values are then identified after a thorough literature review, incorporating indigenous and local knowledge, and field surveys. The second stage involves determining social and ecological value "hotspots" through the use of a series of tables and GIS overlays. These areas may then be given key consideration in future studies on long-term goal setting, limits of acceptable change, and studies on the cumulative impacts of human activities, as discussed in Chapter 6.

Although this methodology appears useful in theory, it must be tested in practice. A pilot application of the recommended methodology was therefore carried out in the Greater Kluane Region of southwest Yukon. Case study background and results are presented in Chapters 4 and 5 respectively (Figure 3.2).

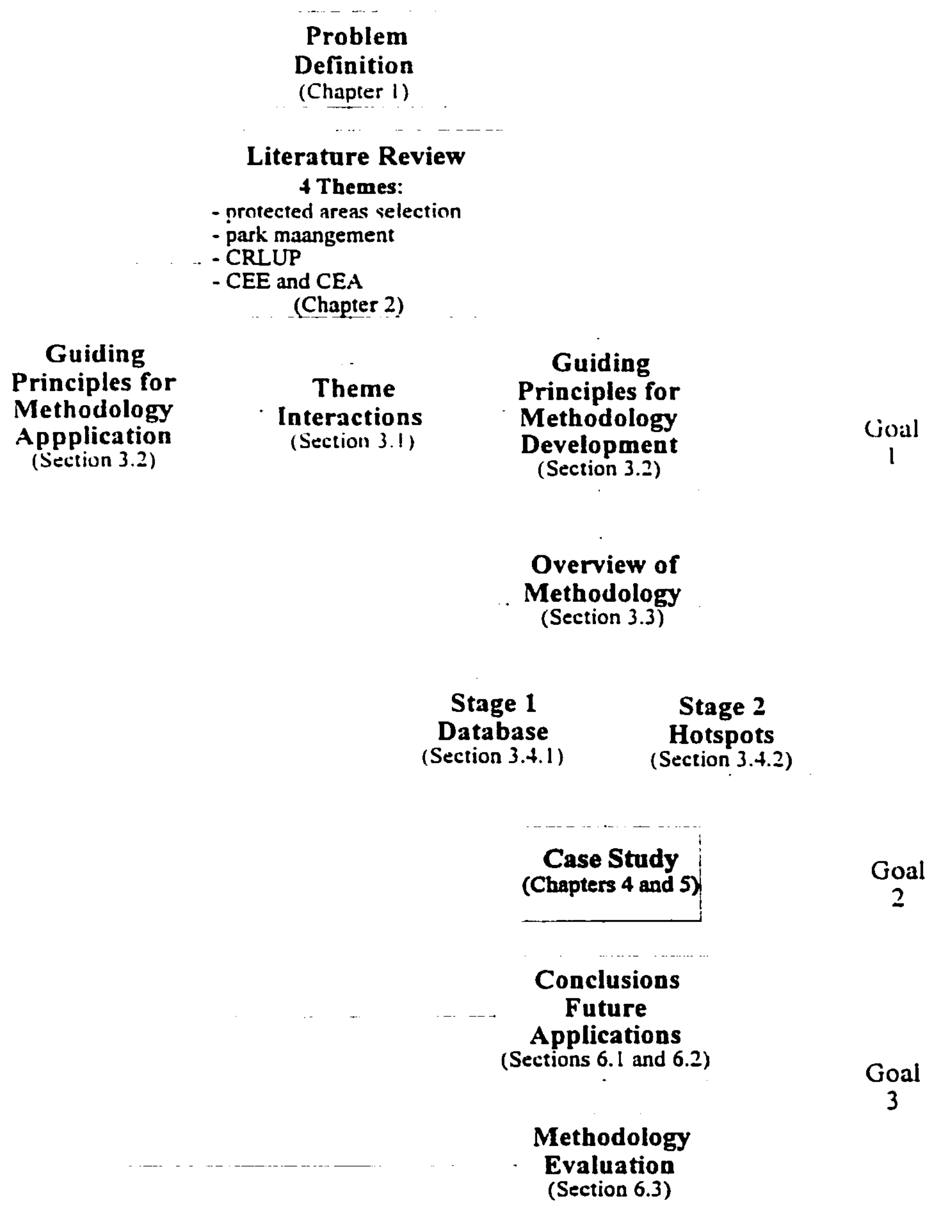


Figure 3.2 - Conceptual Map of Thesis.

CHAPTER 4 - CASE STUDY BACKGROUND

The applicability of the methodology developed in Chapter 3 was tested through a case study of the Greater Kluane Region (GKR) in southwest Yukon. The purpose of this chapter is to present relevant background information for the GKR. First, the exact location and boundaries of the study area are outlined. The main reasons Yukon and the GKR were selected for the case study are also discussed (section 4.1). Second, abiotic and biotic characteristics of the GKR are examined to give an ecological overview of the study area (section 4.2). Third, past and present land use, and present land administration in the GKR are outlined to explain the social and managerial aspects of the study area (section 4.3). To conclude, a brief history of park, planning and assessment studies is provided (section 4.4). Case study results and discussion are reserved for Chapter 5.

4.1 LOCATION

The GKR is located in the southwest corner of Canada's Yukon Territory. The official boundary of the study area was defined according to the Greater Kluane Land Use Plan, and is presented in Figure 4.1 (YLUPC, 1990). The area is bounded by the British Columbia and Alaska borders to the south and west respectively. The northeastern boundary extends from the Alaska border at approximately 63°North, and continues southeast along the Nisling River past the eastern side of Kusawa Lake to the British Columbia border.

The GKR includes several small communities, Kluane National Park and Reserve (KNPR), the Kluane Wildlife Sanctuary (KWS), and portions of the Haines and Alaska highways.

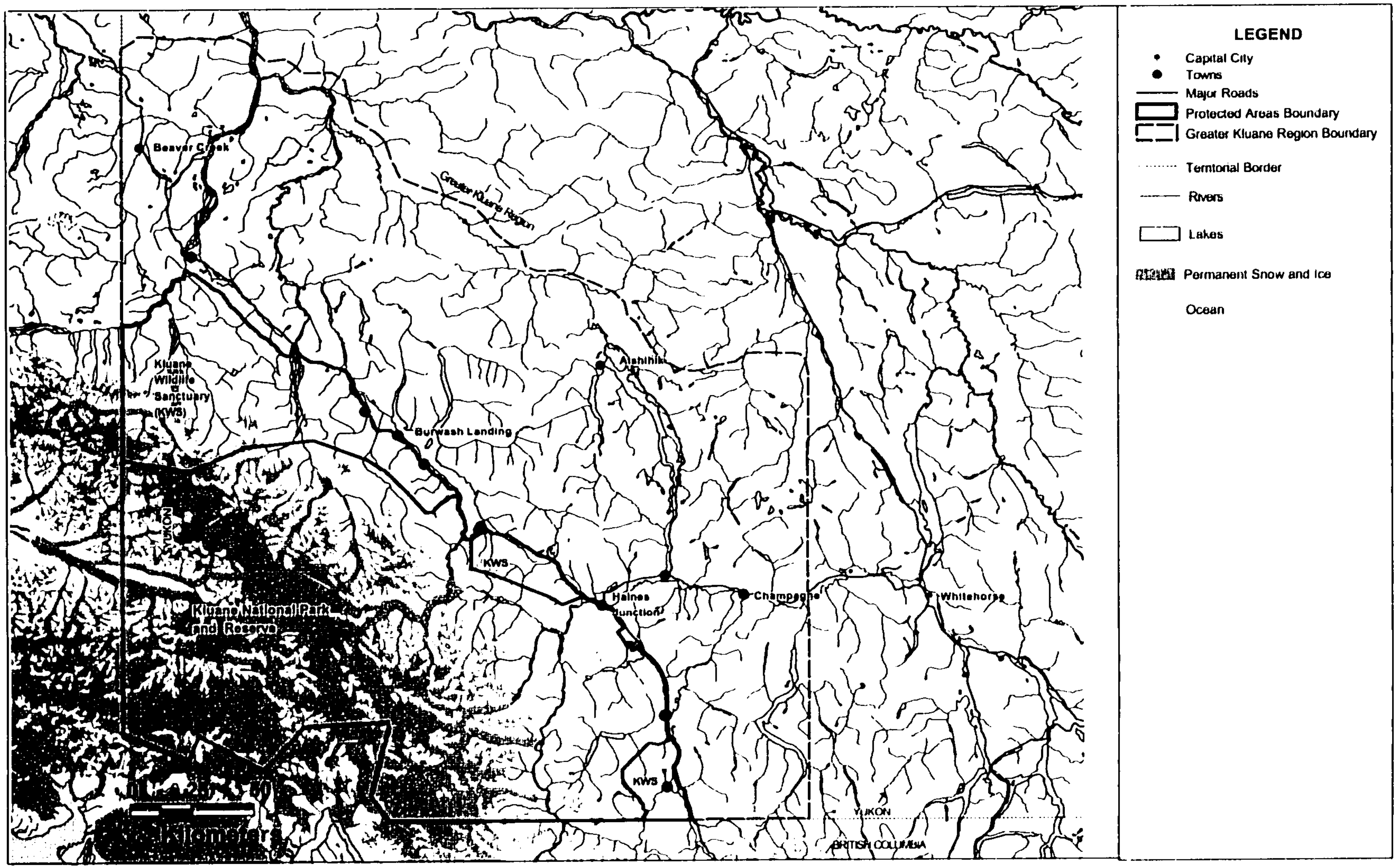


Figure 4.1 - Greater Kluane Region, Southwest Yukon

Yukon, and the GKR in particular, were selected for the case study for a number of reasons. First, northern ecosystems are quite sensitive to human disturbance and hence cumulative effects may have pronounced impacts in northern regions such as Yukon. In addition, the Environment Branch of the Department of Indian Affairs and Northern Development (DIAND) has been putting substantial effort into developing a suitable CEA methodology for the Yukon Territory, and was interested in suggestions for approaches to proactive regional planning to minimize cumulative effects (Mueller, pers. comm., 1999). However, the entire Territory was too large to use as a case study given the goals of the thesis, so the study was narrowed to focus on the GKR. This area was suitable for the methodology application because it contains a large and ecologically diverse national park with impending threats from potential CEEs arising from internal and external sources (Parks Canada, 1998). Also, a considerable amount of data for the region were available due to previous work on cumulative effects (Hegmann, 1995), environmentally significant areas (eg. Hans-Bastedo, 1986; Theberge *et al.*, 1980), regional land use planning (YLUPC, 1990), and many other research projects.

Ecologically speaking, it would be desirable if the case study boundaries extended beyond the politically defined territorial border into Alaska and British Columbia. However, for practical reasons such as additional travel expenses and the difficulty of dealing with varying data collection and storage approaches, the case study only considers the area located within the Yukon Territory. In addition, although trans-border planning has been receiving increasing attention in the past few years, it is likely that there will still be a higher chance of implementing the methodology if the study area boundaries overlap with existing territorial planning frameworks. For a fuller discussion of the regional ecology and trans-border park planning considerations in the St. Elias region, see Danby (1999).

4.2 ECOLOGICAL ASPECTS

In this section, both abiotic and biotic aspects of the GKR are discussed. The physiography, climate, geomorphology, and hydrology are presented first, followed by a description of flora and fauna.

4.2.1 ABIOTIC FEATURES

Physiographically, southwest Yukon can be subdivided into 3 major parts (from west to east): the St. Elias Ranges, Shakwak Trench, and Ruby Ranges. The western part of the St. Elias Mountains, often referred to as the Icefield ranges, is dominated by icefields, widespread glaciers, and sharply serrated peaks that reach elevations of up to 6,800 metres above sea level. Canada's highest mountain, Mount Logan, is located within these ranges. The eastern part, or front ranges, of the St. Elias Mountains consists of the Kluane, Donjek, Bates, and Alsek ranges, and is characterized by alpine glaciers, talus screes, narrow ridges, elevation-graded vegetation communities, and multiple river valleys. Average elevation for these ranges is approximately 2,000 metres above sea level. The Shakwak Trench is a long, straight valley covered by glacial, glaciofluvial, and aeolian deposits (Environment Canada, 1987). The Ruby Ranges are characterized by older mountains with several periglacial features such as collovium, moraines, and glaciofluvial sediments (Sauchyn, 1986).

A continental-subarctic climate dominates the GKR (Coates & Morrison, 1988). Within the GKR, the climate is influenced greatly by physiography, so the dominating climate in the northern and southern parts differs considerably. In the north, moisture from the Alaskan coast condenses and precipitates in the icefields before reaching the front ranges. The northern part of the GKR is therefore dominated by semi-arid, continental air masses due to the rainshadow effect of the St. Elias Mountains. Conversely, the southern part of the GKR is considerably damper, as wet air is channeled from the Alaskan coast up the Alsek valley into the GKR (Environment Canada, 1987). For instance, estimated annual precipitation levels range from 1200 to 2800 mm in the icefields, 800 to 1200 mm around Haines Junction in the south, and 400 to 800 mm around Burwash Landing in the north (Environment Canada, 1987).

The geomorphology of the GKR arises largely from these climatic influences. The major geomorphological feature is the presence of discontinuous permafrost. Since the GKR is located at the boundary between scattered- and widespread- discontinuous permafrost, features associated with underlying permafrost (eg. solifluction lobes, stone stripes, polygons) are fairly common at lower elevations in areas north of Kluane Lake, but are restricted to upper alpine zones further south. However, the local distribution of permafrost still varies with site specific microclimatic conditions such as slope, aspect, and vegetative cover. Soil characteristics, such as texture and drainage, also influence the presence or absence of permafrost. Permafrost generally occurs in Cryosols, which are found in southwest Yukon in addition to Regosols and Brunisols (Environment Canada, 1987).

The hydrology of the GKR is dominated by five major drainage basins: the Yukon River drainage to the northeast, Alsek River drainage to the southeast, Gulf of Alaska drainage to Alaska panhandle in the southwest, Copper River drainage to Alaska in the north west, and White River drainage to the North. Large lakes of the region include Kluane, Kusawa, Aishihik, Sekulmun, Dezadeash, Wellesley, Kathleen, Mush, and Bates Lakes. Major drainage rivers include the White, Donjek, Duke, Kluane, Slims, Kaskawulsh, Alsek, Aishihik, Dezadeash, Nisling, and Tatshenshini Rivers.

4.2.2 BIOTIC FEATURES

Dominant abiotic features such as elevation, climate, soils, and wind exposure largely influence the nature of vegetation communities found in the GKR. Three main life zones have been identified - montane, subalpine, and alpine. The montane zone is located in valleys and on lower slopes, up to 1080 m in elevation, and is dominated by nearly continuous white spruce interspersed with marsh, fen, halophytic, shrub, and herb community types. The subalpine zone extends from 1080 to 1400 m and is dominated by tall shrubs (primarily willow, dwarf birch, and alder) with scattered white spruce specimens. From 1400 to 1600 m, the landscape is dominated by low krummholtz shrubs up to 1 m in height. Above 1600 m, the plant species present depend largely on time of snowmelt, available soil moisture, and aspect. In general, however, dominant vegetative communities consist of low-lying vascular plants, mosses and lichens. Isolated occurrences of these low-lying plants also occur on nunataks scattered throughout the icefield ranges (Environment Canada, 1987). Overall, plant diversity in the GKR is abnormally high for northern regions because its flora consists of species from the coastal region, western mountains, boreal forest, arctic tundra, and northern prairies due to its location at the confluence of these five zones (Parks Canada, 1998).

This array of vegetation supports a faunal diversity that is quite rich given the northern latitude. For instance, the GKR supports globally significant populations of large terrestrial mammals such as grizzly bears, Dall sheep, and moose. It is also important for populations of wolves, mountain goats, and caribou (Danby, 1999). This rich mammalian diversity is complimented by the presence of a high diversity of avifauna such as raptors, owls, songbirds, shorebirds, waterfowl, passerines, and upland species. In addition, aquatic resources include salmon, grayling, whitefish, sculpin, trout, burbot, pike, and longnose suckers (Environment Canada, 1987).

In total, the GKR supports two threatened species (wood bison, and peregrine falcon *anatum* subspecies), and four vulnerable species (grizzly bear, wolverine, short-eared owl, and Squanga whitefish) as defined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 1999). There is also a wide variety of plant species that are rare in Canada, disjunct, and/or endemic (Cody, 1996; Douglas *et al.*, 1981).

4.3 SOCIAL ASPECTS

This section first provides an overview of the historical and present land uses of the GKR to provide insight into the evolution of the region's economy. Then, roles of the various parties involved in regional management are discussed to demonstrate the complexity of regional management in the GKR.

4.3.1 HISTORICAL LAND USE

The GKR was first occupied by the Upper Tanana, Northern Tutchone, and Southern Tutchone Indians as early as 11,000 years before present (Coates, 1991). Historically, these groups led a nomadic, subsistence-based lifestyle dependent on fishing, trapping, and hunting. Large groups would gather during the summer and fall to fish for spawning salmon and to hunt migrating caribou. The people would then disperse into smaller family groups for the winter and spring to focus on smaller scale harvesting activities (McClellan, 1987). First direct contact with Europeans was in the latter part of the 19th century, after which the Tanana and Tutchone became more heavily involved with the fur trade, exchanging furs for western tools and guns.

Despite the presence of a successful fur trade, Yukon is known best for the Klondike Gold Rush of the late 1800's. Thousands of prospectors immigrated to Yukon in search of gold between 1897 and 1900, and booming mining towns appeared across the Territory. Since many prospectors accessed the Klondike through southwest Yukon, there was a massive influx of people to the GKR. The gold rush also led to experimental agriculture in Yukon in order to sustain the ever-increasing population (Peake and Walker, 1975). In addition, harvesting wood for transportation, mining, and domestic purposes increased during the gold rush era (NDC, 1993). Market and trophy hunting also became increasingly popular, and many big game populations, such as Dall sheep and caribou, suffered from overexploitation in the years immediately following the Klondike gold rush (McCandless, 1985). However, the economic boom ended abruptly, and most of these activities were absent from the GKR by the 1930s (McCandless, 1985; Environment Canada, 1987).

The next big economic boom in the GKR came with the construction of the Alaska Highway in 1942 due to the threat of Japanese invasion to Alaska (Environment Canada, 1987). The highway led to increased access for mineral exploration and big game sport hunting, guiding and outfitting, as well as a renewed interest in agricultural experimentation. Subsequently, a federal experimental station was established in 1944 to explore the agricultural capabilities of the GKR (Peake and Walker, 1975). Timber harvesting was also reactivated, primarily for purposes of corduroy road construction, housing, and fuelwood (NDC, 1993). Highway construction also placed additional stress on wildlife, as newcomers "shot everything in sight" (McCandless, 1985:88).

Increased concern over the potential extermination of big and small game species led to the designation of the Kluane Wildlife Sanctuary (KWS) in 1943, covering an area of 25,000 km^2 in southwest Yukon (Environment Canada, 1987). This area was supposed to be established as Kluane National Park Reserve (KNPR) with the next National Parks Act amendment. However, after World War II, mineral exploration and extraction continued throughout the GKR, and mega-scale northern developments were strongly encouraged. High resistance from the mining industry therefore delayed the establishment of KNPR, in which none of these activities would be permitted, for 30 years (Theberge, 1975). Finally, 22,000 km^2 of the KWS were designated as a National Park Reserve in 1972 (Environment Canada, 1987). It was not given full park status because land claim negotiations with the Champagne and Aishihik (CAFN) and Kluane First Nations (KFN) were still unsettled.

The presence of the National Park brought a new source of money for the local economy: tourism. Tourism expanded rapidly over the next 20 years. In particular, activities such as backcountry and frontcountry trail use, flight seeing tours, vehicle-based wildlife sightseeing, outfitting on horseback, and canoeing became increasingly popular (Hegmann, 1995; Dill *et al.*, 1997). The right to carry out subsistence harvesting on traditional territories located within park boundaries has also recently been recognized for the CAFN and KFN. Outside the park, outfitting for big game trophy hunting and sport fishing became increasingly popular.

4.3.2 PRESENT LAND USE

Many of these historical land uses are still present in the GKR today. Within KNPR, most of the aforementioned activities are increasingly popular. For instance, Hegmann (1995) estimates that rafting along the major rivers increased 16-fold in only 4 years (1989-1993).

The CAFN and KFN have the right to carry out subsistence activities on their respective traditional territories within park boundaries. A third First Nation group, the White River First Nations (WRFN), also harvests in the GKR, but their traditional territory does not overlap with the national park.

Outside park boundaries, small-scale mining are of regional economic significance. Currently, there are three major sources of aggregate and mineral potential in the GKR: (1) aggregates suitable for construction material alongside the highways, (2) minerals such as copper, nickel, molybdenum, and gypsum in the Donjek and Alsek ranges, and (3) placer (gold) mining along the Burwash and Duke River areas, upper reaches and tributaries of Jarvis Creek, and along the Tatshenshini River area (LeBarge, 1996; RCP, 1982). The mining industry will therefore continue to play an important role in the GKR.

Logging operations are also of increasing economic and environmental importance in the GKR. A widespread spruce bark beetle infestation in southwest Yukon has led to several proposals for logging in the affected areas as a form of control and to salvage valuable timber (Humphreys and Safranyik, 1993). In addition to these salvage operations, it is estimated that 28% of the forested land in Yukon is capable of producing economically valuable timber (YRR, 1993). Forestry activities in the GKR can therefore be expected to increase in the next few years.

Agriculture is another source of local economic income. Although the federal experimental farm closed down in 1968, some agricultural activity is still taking place in the GKR today. A total of 10 farms, covering 5378 ha, were reported in the GKR in 1991. The majority of these farms produce livestock (primarily horses, hogs, and poultry), animal products, field crops, and horticultural items (DRR, 1994; White and Bisset, 1993). A new study of agricultural potential is also currently underway within the CAFN traditional territory (Y. Harris, pers. comm, 1999)

Consumptive wildlife-based activities in the GKR currently include commercial, sport, subsistence, and recreational fishing, big game outfitting, subsistence hunting, and trapping. Commercial fisheries are located on Kluane and Hutshi Lakes, and depend primarily on whitefish, lake trout, and burbot, whereas sport, subsistence, and recreational fisheries use both freshwater and anadromous fish throughout the GKR (deGraff and McEwen, 1989; RCP, 1982). Big game outfitters provide a guiding service for non-resident hunters and focus on species such as Dall sheep, caribou, moose, and grizzly bears (Tompkins, 1996; DRR, 1989b). Subsistence hunting by CAFN, KFN, and WRFN also focuses on species such as moose, caribou, and sheep, and occurs on traditional territories throughout the GKR. Trapping for lynx, marten, wolverine, wolf, fox, and otter is also common throughout the GKR, although the first three are most sought after due to their high economic value (Tompkins, 1996).

Infrastructure in the GKR is limited to two major highways (Haines and Alaska) and two secondary roads leading to Aishihik and Kusawa Lakes. The five main communities are Beaver Creek, Burwash Landing, Destruction Bay, Haines Junction, and Champagne. Small villages of Canyon, Aishihik, Hutshi, Koidern, and Snag are also present. Total year-round population in the GKR, however, remains quite low at approximately 2000 individuals.

4.3.3 PRESENT LAND MANAGEMENT

Currently, the federal and territorial government as well as three First Nations bands all participate actively in the management of the GKR. The Federal government is represented by both Parks Canada and DIAND. Parks Canada's involvement is restricted to within the boundaries of KNPR, whereas DIAND administers the water, forests and minerals on most of the remaining lands, including the KWS. The Yukon Territorial Government is responsible for wildlife resources throughout the region, including the KWS, which are managed by the Department of Renewable Resources.

The signing of the Yukon First Nations Umbrella Final Agreement in 1990, and subsequent land claims negotiations, have recognized traditional territory land rights of the Champagne and Aishihik First Nations (settlement reached 1993), White River First Nation (settlement reached 1998), and Kluane First Nation (settlement pending). All three bands will therefore be fully involved in future regional management schemes.

As an outcome of the CAFN land settlement, the Alsek Renewable Resources Council, a subdivision of the Yukon Fish and Wildlife Branch was created. It allows 3 Department of Renewable Resources and 3 CAFN appointed members to comment and make recommendations on the management of renewable resources on CAFN traditional territory outside KNPR. In addition, the Kluane National Park Management Board was established to make recommendations on the development and management of KNPR. It consists of 2 CAFN members and 2 Parks Canada members. It is anticipated that once a settlement has been reached with the KFN, 2 KFN members will also join this board. Furthermore, this settlement will likely lead to the establishment of another Resources Council through the Yukon Fish and Wildlife Branch. The WRFN settlement may also lead to the development of a new territorial park in the north of KWS, around the Klutlan glacier.

4.4 HISTORY OF PARK, PLANNING AND ASSESSMENT STUDIES

Many studies carried out in the past 20 years in the GKR have proven to be quite useful for the purposes of this thesis. They can be subdivided into three broad headings: protected areas and critical habitat research, land use plans, and environmental impact assessments. Each subdivision is discussed briefly below.

4.4.1 PROTECTED AREAS AND CRITICAL HABITAT RESEARCH

There are two main veins of research related to protected areas in the GKR: research relating specifically to KNPR, and environmentally significant areas studies. In addition, several reports on critical wildlife habitats were derived from traditional ecological reports and from the Department of Renewable Resources key wildlife areas studies. Each study is briefly discussed below.

Several information sources deal specifically with KNPR, since Parks Canada requires that certain information be collected during the establishment of a national park. First, an initial resource survey identifying the most unique characteristics of the proposed park must be carried out. Then, a comprehensive bibliography on the park must be prepared. Subsequently, a Resource Description and Analysis is undertaken in order to identify, discuss, and record all abiotic, biotic, and social aspects of the park. All these studies were carried out between 1972 and 1987 for KNPR, and have provided valuable park-specific information (Environment Canada, 1987). Furthermore, many independent studies on the park have been carried out (eg. Danby, 1999; Maraj, 1999).

Another series of reports on protected areas was prepared by a group of researchers from the University of Waterloo. The goal of their study was to identify all environmentally significant areas in the Yukon Territory, and complete abiotic, biotic, and cultural resource surveys for each environmentally significant areas. Several proposed environmentally significant areas fall within the GKR, but only two were studied in great detail: Kluane North and Aishihik Lake. A biotic survey of Kluane North, and abiotic, biotic, cultural, and institutional surveys of Aishihik Lake have provided detailed information on highly significant areas, ecologically and socially, throughout the GKR (Bastedo, 1986; Hans-Bastedo, 1986; Theberge *et al.*, 1980).

Three main reports on wildlife habitat arising from the traditional ecological knowledge literature were available for the GKR. For WRFN, a resource inventory was carried out in 1998. This report documents information on historical and current moose, caribou, sheep, and goat distributions in the WRFN traditional territory. Information was also collected on waterfowl, fish, and tourism opportunities (TransNorthern Consulting, 1998). The Aishihik/Kluane caribou recovery program resulted in the documentation of caribou migration corridors, calving grounds, and general distribution patterns based on knowledge from both the KFN and CAFN. In addition, information on key moose habitat and wolf pack distribution was collected from KFN (Johnson, 1993). Finally, an independent report on key wildlife use areas recorded important areas for moose and caribou in the CAFN traditional territory. These areas included concentrations in late winter and seasonal movement corridors. Traditional moose hunting areas during summer and winter were also documented (Jingfors, 1990).

Considerable research on wildlife habitat has also been carried out by the Department of Renewable Resources Habitat Branch. A large database of critical habitats was available for most wildlife species except wide-ranging predators whose distribution depends more on availability of prey than specific habitat characteristics such as wolves, wolverines, and lynx (YTG, 1999).

4.4.2 LAND USE PLANS

Three major land use planning studies carried out in the GKR have been instrumental in the case study by providing considerable information on wildlife and cultural resources: (1) the Kluane Region Study; (2) East Kluane Planning Area; and (3) Greater Kluane Land Use Plan.

In 1973, the Kluane Region Study was initiated by YTG due to increased concern that not enough attention was being given to the need for a long-range, regional plan for the area. Its purpose was to look at land use along the Haines and Alaska Highway corridors in order to determine the "best land use" for the study area. It presented an overview of physiography, climate, land uses, biological resources and human resources along the highways (Synergy, 1974). Of particular relevance to this case study was the identification of biologically significant zones and areas with high probability of major wildlife disturbance.

The East Kluane Planning Area was first described in 1979 when a joint federal and territorial regional planning exercise was endorsed. As with the Kluane Region Study, it was instigated due to increasing concern over the seemingly random exploitation of resources and lack of consideration of the long-term potential of the East Kluane Planning Area. Baseline data were collected between 1979 and 1981, after which draft background papers were prepared and consolidated into a final report (RCP, 1982). These reports provided both federal and territorial governments with useful material on natural, historical, social and economic resources of the area. Upon its completion in 1982, however, political incentives to adopt the plan were weak, and the regional plan was never officially implemented. The information collected for the East Kluane Planning Area, however, has aided this case study in providing key wildlife habitat maps as well as land use summaries.

The next attempt at a regional plan arose with the Northern Land Use Planning program's Greater Kluane Land Use Plan of the late-1980's. There were 5 major goals associated with this regional land use plan: "(1) identify social, cultural and economic opportunities and conservation requirements and to propose a course of action to achieve them; (2) anticipate and resolve land use problems; (3) provide a forum for public involvement in the management of a region; (4) address the potential for accumulated impacts from development; and (5) provide guidance for the project review processes." (YLUPC, 1990). Although the primary outcome of the Greater Kluane Land Use Plan was a land use plan that made recommendations for land management policies and practices, a series of background reports and maps describing ecological and social considerations was also prepared. Extensive research on subsistence fishing by the CAFN was also documented as part of this land use plan (Joe, 1990). Although the plan was never implemented, it is probable that it will continue to influence future policy and land use decisions (Kuhn and Duerden, 1996). The background reports were indeed invaluable for this case study, as they provided key information on both ecological and social values in the GKR. In fact, the usefulness of these reports led to the case study taking place within the same boundaries as those established for the Greater Kluane Land Use Plan.

4.4.3 ENVIRONMENTAL IMPACT ASSESSMENTS

Several environmental impact assessments have been carried out in the GKR over the past 20 years. The five most prominent are: the Alaska highway gas pipeline (1977-79), Shakwak highway improvement (1977), KNPR cumulative effects assessment (1995), Alsek Pass project (1996), and Aishihik Lake hydro power relicensing project (1998).

The Alaska highway gas pipeline environmental impact assessment involved investigating the potential impacts of constructing a pipeline adjacent to the Alaska highway to link gas resources from Prudhoe Bay to the south. A multitude of background research reports documented information on rare plants, fish spawning, rearing, migration, and overwintering grounds, waterfowl nesting and staging grounds, raptor nesting areas, and habitat for Dall sheep, caribou, moose, elk, mule deer, grizzly bears, beaver, muskrat, and other furbearers along the Alaska highway corridor (see FPL, 1979 for individual references). Although this information was collected between 1976 and 1978, it still provides the main working base for wildlife occurrences, particularly for aquatic aspects.

The Shakwak highway improvement study evaluated the potential impacts of modifications required to portions of the Haines and Alaska Highways along the Shakwak trench. Information was collected for the occurrence of a variety of wildlife species, including sheep, goat, caribou, moose, grizzly bear, fox, game birds, raptors, waterfowl and shorebirds, salmon, whitefish, pike, burbot, suckers, grayling, and Dolly Varden. Although there was not as much new data collected as for the pipeline project, substantial information was compiled into a useful format (DPW, 1977). In addition, several rounds of public meetings and written correspondence were included in the environmental impact assessment, providing valuable insight into public values (Fisheries and Environment Canada, 1978).

In 1995, KNPR contracted G. Hegmann to carry out a cumulative environmental assessment for the park. This CEA collected a variety of information on surrounding land uses and park management practices, and compiled information on five key wildlife species (grizzly bear, golden eagle, Dall sheep, moose, and mountain goat). In addition, potential changes in tourism level were projected, and effects of development on wildlife species assessed (Hegmann, 1995).

The Alsek Pass project proposal of the mid-1990's involved the construction of a road and a day-use area overlooking the Alsek River. The initial environmental evaluation collected information on geomorphological features, rare plants, and wildlife habitat of the Alsek River valley (AXYS, 1996).

A comprehensive environmental assessment was carried out for the Aishihik Lake hydro power relicensing project in 1998. Detailed information on waterfowl, raptors, moose, aquatic furbearers, freshwater fish, and sites of cultural and archeological significance was provided for Aishihik Lake, Sekulmun Lake, and surrounding areas (North/South Consultants, 1998; Schmidt Environmental Consultants, 1998). The assessment report also included traditional ecological information on traditional food fishing areas, hunting areas, and trapping locations (Allen, 1996).

4.5 SUMMARY

This chapter presented the necessary background information on the GKR. Although each section is by no means comprehensive, a sufficient overview has been given for ecological and social aspects of the GKR. In addition, a brief history of park, planning and assessment research was also provided. The next chapter focuses on the results of the case study and discusses the implications of these findings (Figure 4.2).

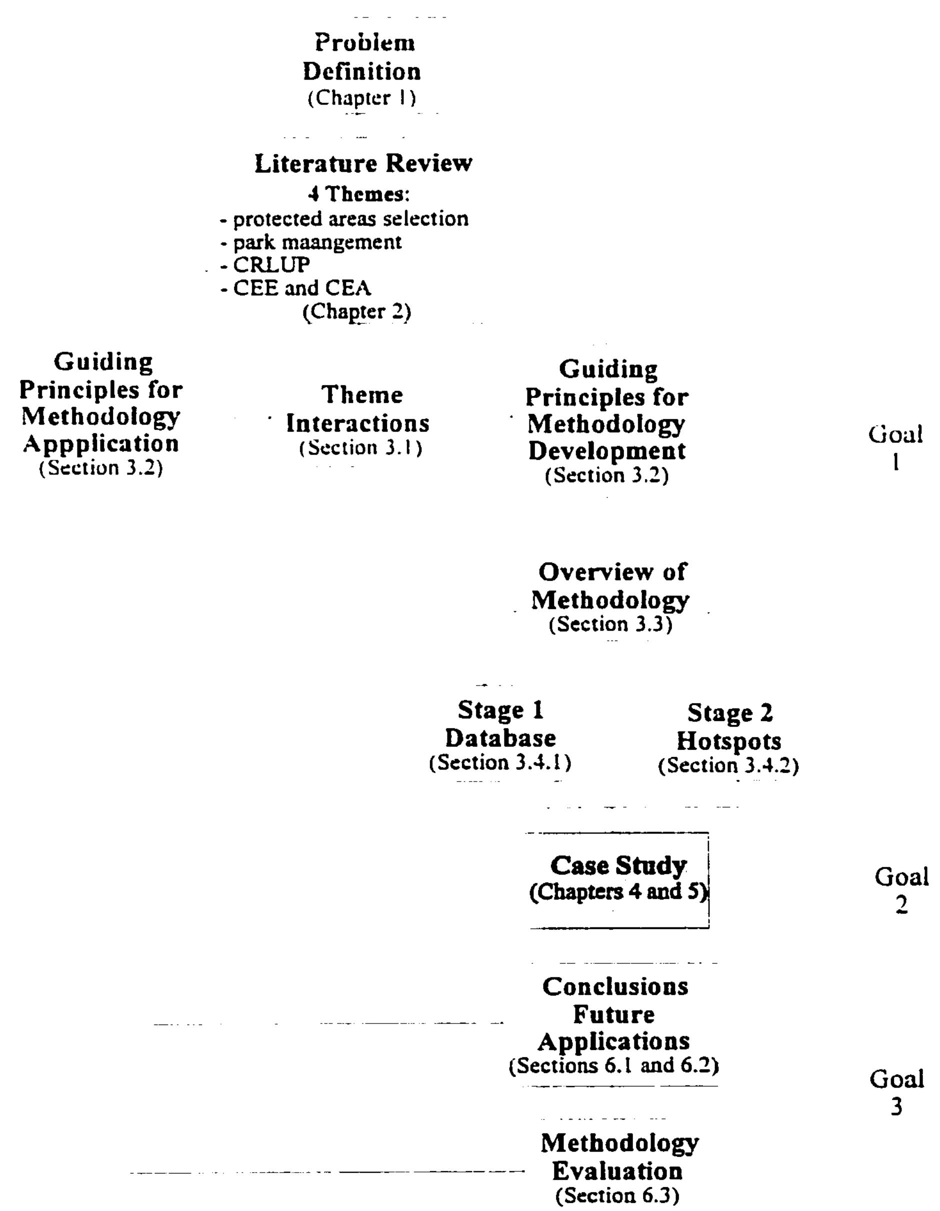


Figure 4.2 - Conceptual Map of Thesis.

Chapter 5 - Case Study Results and Discussion

Results of the case study are presented for both of the steps outlined in Chapter 3. Boundaries are described and justified in section 5.1. In section 5.2, a brief discussion of the main information sources is given, followed by a description of social and ecological values outlined in Tables 3.1 and 3.2 respectively. These results are then compiled to determine locations with the highest concentrations of values in the GKR in section 5.3. Differences in results are discussed throughout this section as the key findings are presented. Concluding remarks regarding the limitations of the data, and future research priorities are then discussed in section 5.4.

5.1 Case Study Boundaries

Before implementing the methodology, case study boundaries had to be set. The official boundary of the 'Greater Kluane Region' was defined according to the Greater Kluane Land Use Plan (see Figure 4.1). Although it is desirable to use ecologically relevant boundaries, the boundaries defined by the Greater Kluane Land Use Plan were selected for several reasons.

First, the background reports of the Greater Kluane Land Use Plan provided considerable information on both ecological and social aspects of the GKR. Second, many regional planners and managers are familiar with this area because of the Greater Kluane Land Use Plan, so the case study results will be more easily applied. Third, many wildlife species of concern are wide ranging species, which makes it even more difficult to define ecologically relevant boundaries while maintaining a reasonably sized study area. Boundaries were not extended beyond the Yukon Territorial border for reasons already discussed in section 4.1.

5.2 STAGE 1: CREATE DATABASE OF VALUES

5.2.1 SOCIAL VALUES

Once study area boundaries had been defined, the social values highlighted in Table 3.1 were investigated. The description in Section 3.3.1 recommends the use of two resources to determine social values. These are: (1) direct consultation with public, and (2) literature review on topics such as environmental impact assessments, traditional ecological knowledge, and local planning issues. Given time and budget restrictions, consultation with the public at large was not carried out for the purposes of this research. In order to compensate for this, the list of generated social values was presented to several individuals familiar with the Kluane area for commentary (Brenneman, Eklund, Elliott, Godin, Henry, and Slocombe, pers. comm., 1999). Their comments are incorporated into the following list of social values. The list of social values was therefore developed by surveying the literature and using Table 3.1 as a guideline. Main information sources and social values are presented below.

Key Information Sources and Data Collection

Literature reviews were carried out at DIAND, Parks Canada, and Yukon College libraries in Whitehorse and Haines Junction. These reviews focused on four main publication categories, namely land use planning, environmental impact assessment, traditional ecological knowledge, and protected areas research (section 4.4). An overview of the main information provided by each category is presented in Table 5.1.

Since a number of reports of varying quality were available, the most reliable and credible reports were selected by applying a series of data filters. The first filter involved examining the purpose and methods of each report to determine if the research findings would be applicable to this study. Reports that were not relevant were disregarded. All useful information from reports with pertinent scopes and sound methodologies was then recorded. Any weaknesses associated with the methodology employed were noted at this point. For instance, since data collected on fish habitats for the Alaska Highway Pipeline project were only collected at the exact locations where the proposed pipeline would cross rivers, it was noted that data were site-specific and could not be extended to the entire river.

Table 5.1 - Key Information Sources for Social Values.

Publication Category	Information Provided	Sources
Land Use Planning	- sport fisheries - cultural and heritage appreciation sites - recreation	Reports associated with the Greater Kluane Land Use Plan, East Kluane Planning Area, and the Greater Kluane Study
Environmental Impact Assessments	- fishing - wildlife viewing - aquatic furbearers	Reports associated with Alaska Highway Pipeline
Traditional Ecological Knowledge	- subsistence hunting - subsistence fishing - subsistence trapping - cultural and heritage appreciation sites	WRFN resource surveys, CAFN resource reports, caribou recovery program reports
Protected Areas	- wildlife viewing - aesthetics - education/interpretation - scientific interest - cultural and heritage appreciation sites - recreation	Parks Canada reports on KNPR, ESA research, independent research

A second filter was subsequently applied in which data collected from the different reports were compared to see how closely the information corresponded. Where several sources cited the same information, these data were entered into the database. In cases where information was only cited in one source, a third filter relating to existing information availability was applied. In cases where a number of documents were available on the particular topic but none of the other documents cited similar information, reports were disregarded. However, when only a limited number of reports were publicly available, for instance with Traditional ecological knowledge reports, it was assumed that the sources were credible unless some aspect of the report suggested inherent weaknesses or high uncertainty. Information presented in these reports was also fed into the database.

The database compiled from all information collected from these filtered reports is presented in detail in Appendix 1. However, a brief discussion of values related to consumptive wildlife based activities, non-consumptive activities, and recreational activities is included here.

Consumptive Wildlife Based Activities

For subsistence hunting, key species include moose, caribou, Dall sheep, and waterfowl (Allen, 1996; Barichello, 1996; Allen, 1994; Johnson, 1994; Peepre and Associates, 1993; TransNorthern Consulting, 1993; Jingfors, 1990). Key subsistence fish species include whitefish, lake trout, rainbow trout, arctic grayling, salmon, burbot, and northern pike (TransNorthern Consulting, 1993; Joe, 1990; FPL, 1979).

Key sport and recreation fishery species include chinook, chum, coho, and sockeye salmon, lake trout, arctic grayling, and northern pike (Peepre and Associates, 1993; deGraff and McEwen, 1989; Archer Cathro and Associates, 1988; Hancock and Marshall, 1984; Blood and Associates, 1982; FPL, 1981; Paish and Associates, 1981; FPL, 1979; DPW, 1977; FPL, 1977; NNRS, 1977; Beak, 1976; Brown *et al.*, 1976; Walker and Brown, 1974).

Furbearers of greatest economic value in Yukon include lynx, marten, wolverine, wolf, fox, otter, mink, beaver, and muskrat (Schmidt Environmental Consulting, 1998; Allen, 1996; TransNorthern Consulting, 1993; DRR, 1989; FPL, 1978; Blood and Associates, 1975). Species of primary importance to big game outfitting and recreational hunting include Dall sheep, grizzly bear, moose, caribou, black bear, and mountain goat (Read and Associates, 1990).

Once all potential values associated with consumptive wildlife-based activities were listed, primary locations for subsistence harvest, sport and recreation fishing, and recreation hunting were subsequently recorded in table format (Appendix 1). However, it is important to note that information on key locations for trapping and outfitting was limited due to trapper and outfitter privacy rights. As a result, key locations for these activities could not be included in the analysis. Further discussion of the causes and consequences of data disparities is presented in section 5.5.

Non-consumptive Activities

Species identified as most valuable for wildlife viewing include bears, Dall sheep, mountain goats, moose, raptors, waterfowl, passerines, and shorebirds (Hegmann, 1995; Peepre and Associates, 1993; DRR, 1990; Henderson, 1987; Blood and Associates, 1975; Yukon Wild, n.d.). Several key locations of undisturbed wilderness aesthetics are also identified by examining reports and surveys relating to wilderness tourism (eg. Peepre and Associates, 1993; DRR, 1990).

Sites for cultural/heritage appreciation include historic sites, prehistoric sites, and sources of raw material (DRR, 1989; Gotthardt, 1989). Little information was found on sites of educational and/or interpretive value although interpretive areas associated with the national park are outlined. Examples of sites of scientific value include International Biological Programme sites

(Beckel, 1975), Heritage Rivers (Parks Canada, 1984), Special Protection Areas (Parks Canada, 1980), and Environmentally Significant Areas (Theberge *et al.*, 1980).

Other non-consumptive land activities range from hiking and biking to nature appreciation and camping. Water based activities in the GKR include canoeing, rafting, kayaking, and motor boating, and winter activities include cross country skiing, snowmobiling, dog mushing, and ice fishing (DRR, 1990; deGraff and McEwen, 1989; DRR, 1989; FPL, 1979).

Once all known values associated with non-consumptive activities were listed, locations receiving the greatest use for each value were subsequently recorded in table format (Appendix 1).

5.2.2 ECOLOGICAL VALUES

The approach described in section 3.3.1 recommends that the literature be surveyed, knowledgeable people be interviewed, and field surveys carried out if possible to determine the values outlined in Table 3.2. In this case study, the literature was reviewed extensively, and the information collected was verified with biologists, ecologists, park wardens, and academics with experience in the GKR. No primary field research was undertaken due to limited time and the author's lack of experience with abiotic landscape features. However, the rich literature combined with personal communication with locals lead to a high level of confidence that major ecological values have been successfully recorded. Main information sources and social values are presented below.

Key Information Sources And Data Collection

Literature reviews were carried out at DIAND, Parks Canada, Yukon Renewable Resources, Canadian Wildlife Service, and Yukon College libraries in Whitehorse and Haines Junction. These reviews focused on the same four publication categories as social values - environmental impact assessments, traditional ecological knowledge, and protected areas research - with an additional source of government and independent wildlife reports. An overview of the main information provided by each category is presented in Table 5.2.

As with social values, a large volume of reports was available for review. These reports were passed through the same filters described in section 5.2.1. All information collected from the filtered reports is presented in detail in Appendix 1, and a brief discussion of abiotic and biotic values is included below.

Abiotic Features

Rare, threatened and unique geomorphological features of the GKR include river flats and deltas, icefield nunataks, thundereggs, rock glaciers, loess steppes, sand dunes and ridges, badlands canyon geomorphology, balanced periglacial environments, and glacial landforms (AXYS and Inukshuk, 1996; Hegmann, 1995; Natural Resource Conservation, 1991; Theberge and Oosenbrug, 1975).

Valuable hydrological resources include groundwater supply and recharge areas, important headwaters, waterfalls, critical fish habitat watercourses, and ice free areas for migratory waterfowl (Hegmann, 1995; Peepre and Associates, 1993; Natural Resource Conservation, 1991; Nixon, 1989; Beak, 1978; Beak, 1977; Synergy, 1974).

Table 5.2 - Key Information Sources for Ecological Values.

Publication Category	Information Provided	Sources
Land Use Planning	- hydrology - RTVE flora and fauna - hypersensitive species - key prey species - summit predators - migratory and spatially demanding species - habitat specialists	deGraff and McEwen, 1989; DRR, 1989; Nixon, 1989; Sumantik, 1989; EKPA, 1982; Synergy, 1974
Environmental Impact Assessments	- geomorphology - hydrology - RTVE flora and fauna - hypersensitive species - key prey species - summit predators - migratory and spatially demanding species - habitat specialists - highly diverse communities	Schmidt Environmental Consulting, 1998; AXYS and Inukshuk, 1996; Hegmann, 1995; Peepre and Associates, 1993; Prystupa, 1991; Aniveiler and Blood, 1981; Blood and Associates, 1979; FPL, 1979; Beak, 1978; FLP, 1978; Beak, 1977; FPL, 1977; Northern Natural Resource Services, 1977; CFS, 1972
Traditional Ecological Knowledge	- RTVE flora and fauna - summit predators	Allen, 1996; Barichello, 1996; Johnson, 1994; TransNorthern Consulting, 1993; Jingfors, 1990
Protected Areas	- geomorphology - hydrology - RTVE flora and fauna - hypersensitive species - key prey species - summit predators	Danby, 1999; Natural Resource Conservation, 1991; Gauthier *et al.*, 1985; Gauthier and Theberge, 1983; Parks Canada, 1980; Theberge and Oosenbrug, 1975; Krebs and Wingate, 1974
Wildlife Reports	- RTVE flora and fauna - key prey species - summit predators - migratory and spatially demanding species - habitat specialists - highly diverse communities	Ward and Larsen, 1995; deGraff, 1992; Larsen and Ward, 1991; DRR, 1990; Slough and Ward, 1987; Hayes and Bayer, 1986; Slough and Smits, 1985 Dennington, 1985; Mossop and Dennington, 1984; Slough and Jessup, 1984; Larsen, 1981; CWS, 1979; Mossop, 1976

Once all potential abiotic values were outlined, primary locations for geomorphological and hydrological features were subsequently recorded in table format (Appendix 1). However, it is important to note that the amount of data available for these abiotic landscape features was quite limited, so several other sites of potentially high abiotic significance may not be recorded in the database. Further discussion of the causes and consequences of data disparities is presented in section 5.5.

Biotic Features

A number of rare, endangered, threatened, vulnerable, or unique floral and faunal species are located within the GKR. Vulnerable species include grizzly bears, wolverines, and Squanga whitefish. Wood bison, a threatened species, was recently reintroduced to the area (COSEWIC, 1999). Other species at risk include mule deer and elk. Unique species in the GKR include Dall sheep, moose subspecies, and endemic populations of Kokanee salmon and rainbow trout. Mountain goats are near the north of their range in the GKR, and thus deserve special consideration as well (Danby, 1999; Schmidt, 1996; Hegmann, 1995; Peepre and Associates, 1993; Johnson, 1994; DRR, 1989; Sumantik, 1989; Gauthier *et al.*, 1985)

Several valuable bird species were also identified, such as trumpeter swans, peregrine falcon, gyrfalcon, bald eagle, golden eagle, osprey, short-eared owl, great gray owl, and wandering tattler. There are many nationally rare, regionally rare, disjunct, and endemic plants present in the GKR (Cody,1996; Environment Canada, 1987; Douglas *et al.*, 1981).

There are also a number of hypersensitive species identified in the GKR. These include caribou, grizzly bear, beaver, wolverine, raptors, and sharp-tailed grouse (Schmidt Environmental

Consulting, 1998; DRR, 1989; EKPA, 1982; Aniveiler and Blood, 1981; FPL, 1978; Synergy, 1974). Key prey species include snowshoe hares, lemmings, squirrels, pikas, shrews and voles, muskrats, and upland game birds (Schmidt Environmental Consulting, 1998; DRR, 1989; Slough and Jessup, 1984; FPL, 1979; Blood and Associates, 1975; Krebs and Wingate, 1974; Synergy, 1974), while the main summit predators are the wolves (Allen, 1996; Hegmann, 1995; Johnson, 1994; Hayes and Bayer 1986; Parks Canada, 1980).

Migratory species such as waterfowl and shorebirds are also considered ecologically valuable in the GKR (DRR, 1989; Nixon, 1989; Dennington, 1985; EKPA, 1982; Aniveiler and Blood, 1981; CWS, 1979; Mossop, 1976; Synergy, 1974), as are spatially demanding species including caribou, grizzly bears, and wolverines (DRR, 1989). Habitat specialists include mountain goats, lynx, and pine marten (DRR, 1989; Slough and Ward, 1987; Slough and Smits, 1985; FPL, 1979; Blood and Associates, 1975). Finally, a number of regionally uncommon or rare vegetation communities and highly diverse communities can also be identified throughout the study area (deGraff, 1992; CWS, 1979; CFS, 1972).

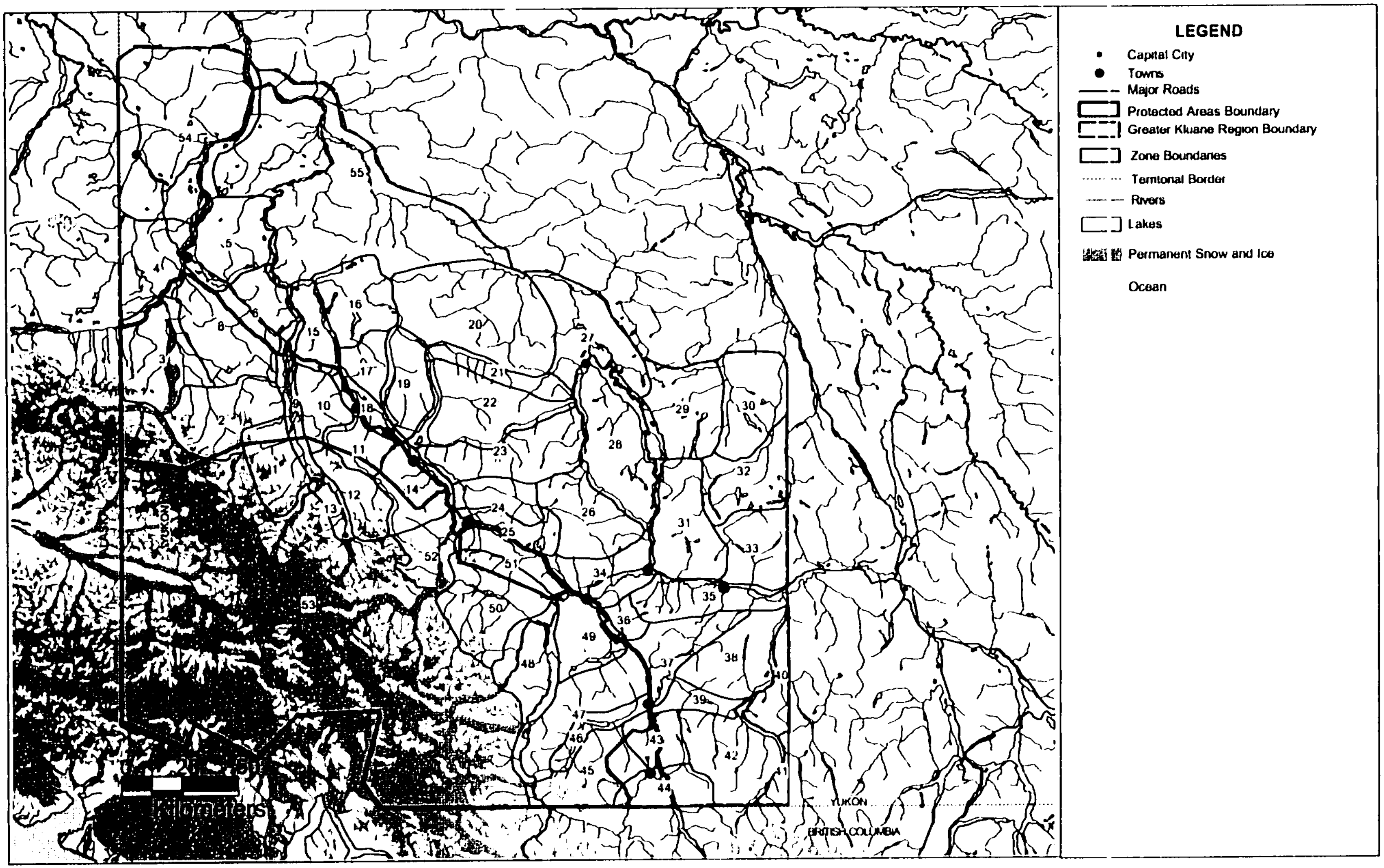
Once all potential biotic values were listed, primary locations for these values were subsequently recorded in table format (Appendix 1). However, it is important to note that data on small mammals (key prey species) and wolverines (hypersensitive, vulnerable, spatially demanding) were limited. As a result, key locations for these species are not included in the analysis. Further discussion of the causes and consequences of data disparities is presented in section 5.5.

5.3 STAGE 2: IDENTIFY VALUE HOTSPOTS

The second stage of the recommended methodology involves the selection of the most valuable areas in the region by identifying areas with high concentrations of social and ecological values, or value hotspots. This was to be accomplished by subdividing the region into subzones and tallying the amount of values in each zone using Table 3.6.

First, the GKR was subdivided into smaller zones. Given a study area size of approximately 60,000 km^2, a total of 55 zones with a median area of 767 km^2 were drawn following the approach outlined in section 3.4.2. Boundaries were drawn around physiographical features such as valleys and mountains that encompassed units of critical wildlife habitat (Map 5.1). For instance, zone 13 was drawn to encompass riparian grizzly bear habitat, whereas boundaries to zone 45 were drawn to encompass mountain goat habitat in the hills but to exclude the riparian moose habitat in the Mush-Bates Valley. Details on zone boundaries, rationale, and the values present in each zone are outlined in Appendix 2. It is important to note that zone boundaries are approximate and were drawn for discussion purposes only. A detailed analysis has not been carried out on these boundaries so they must not be considered definitive.

After subdividing the study area, a matrix organized like Table 3.6 was compiled and is presented in Appendix 3. The 55 zones were listed in the first column, and the values present at each location recorded as 1 if present, 0 if absent. This case study has therefore not used a weighted approach discussed in 3.4.2, as there were neither the time nor the resources to facilitate the extensive consultation that would be required to devise a suitable weighting system. The implications of this decision are discussed in more detail in Chapter 6. The number of social values, ecological values, and total values present in each zone was then summed and recorded.



Map 5.1 - Zones in the Greater Kluane Region

Zone area was also determined using MapInfo GIS, and the number of total values per area, social values per area, and ecological values per area were calculated. This database, presented in Appendix 4, was subsequently used to carry out six analyses. The first three analyses used the raw data and looked at the spatial distribution of total values, social values, and ecological values. The values calculated per area were then used in the last three analyses, to determine the effects of area and to see whether the results when corrected by area were comparable with the results using the raw data. Results from each of these six analyses are presented below in the following order: total values, social values, ecological values, total values per area, social values per area, and finally ecological values per area.

Total Values Per Zone

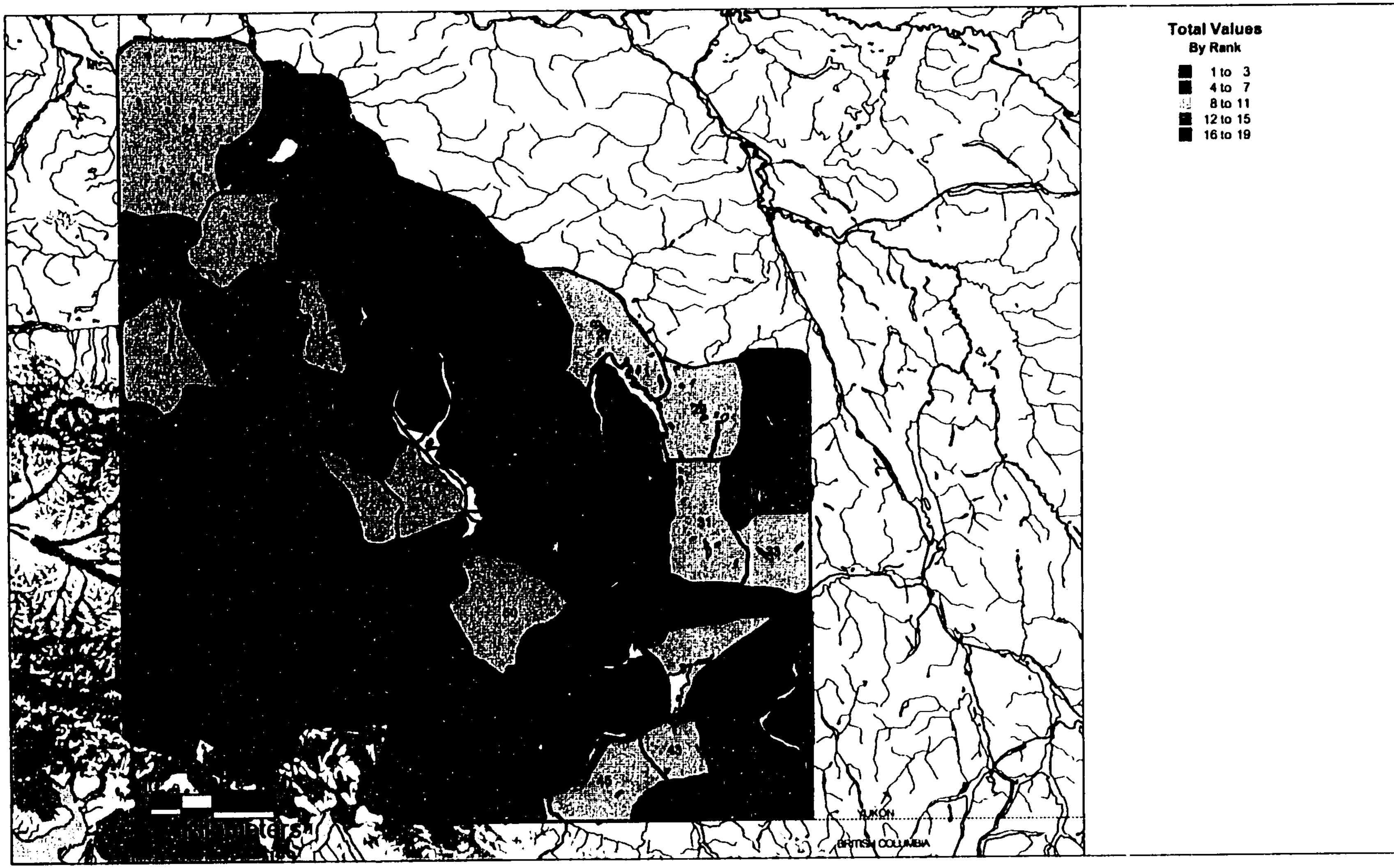
Once the number of values per zone had been tallied, zones with the highest concentration of values were determined by ranking zones in order of decreasing number of total values per zone. If two or more zones contained the same number of values, they were all given the same rank. Because of this, there was only a total of 19 ranks in this analysis. These 19 ranks were subsequently divided into five intervals, with ranks 1 to 3 representing the top 20% (19-21 values), 4 to 7 the >20% - 40% (15-18 values), 8 to 11 the >40% - 60% (11-14 values), 12 to 15 the >60% - 80% (7-10 values), and 16 to 19 the >80% - 100% (3-6 values). This classification was carried out to simplify comparative analysis throughout this discussion, as rank percentages can be calculated for each of the analyses. It also provides a classification system for mapping purposes, since five categories provide a sufficient overview of the values distribution without providing too much detail so as to make the maps difficult to interpret.

Table 5.3 lists details for the zones falling within the top 40% when ranked by total values, but details on the ranking of all 55 zones are provided in Appendix 4 (Table A4.1). Of these top 40%, five (49, 47, 52, 48, and 46) are located wholly within KNPR, and three (44, 51, and 11) are at least partially within the KWS.

Table 5.3 - Value Hotspots, Ranked by Total Values per Zone.

Rank	Zone	Name	Total Values	Social Values	Ecological Values
1	49	Kathleen Lakes	21	15	6
2	44	Tatshenshini/Dalton Post	20	14	6
3	47	Lowell Lake/Goatherd Mt.	19	15	4
3	52	Slims Valley	19	11	8
3	51	Hungry Lakes	19	14	5
4	48	Alsek-Kaskawulsh Confluence	18	13	5
5	24	Jarvis River	17	8	9
5	28	Aishihik and Sekulmun Lakes	17	11	6
5	18	Kluane River	17	9	8
5	34	Pine Lake	17	11	6
6	25	Kloo Lake	16	7	9
6	11	Burwash Uplands	16	8	8
6	35	Dezadeash River, Canyon to Champagne	16	7	9
7	46	Mush-Bates Lakes	15	9	6
7	38	Jo-Jo and North Kusawa Lakes	15	9	6

Results from this analysis are also presented in Map 5.2. Several patterns can be detected from this map. First, many high ranking zones are found within KNPR, including 3 of the 5 zones in the top 20%. This suggests that the park contains a diversity of social and ecological values, largely within the southern half. Second, there are a considerable amount of zones within the top 40% that lie adjacent to park boundaries, such as zones 11, 18, 24, 25, 34, and 44. T hird, many of the highest ranking zones are concentrated along the highway corridor. This pattern may arise because the Haines and Alaska Highways are the only two main roads in the area and many social values - such as fishing, boating, hunting, biking, education and camping - are based from



Map 5.2 - Spatial Distribution of Social and Ecological Values

these access corridors. Although some social values involve more remote settings, such as backpacking, mountaineering and experiencing wilderness, the majority would be expected to be in closer association with road access. The GKR's physiography and resulting wildlife ranges may also contribute to this concentration along the highway corridors, as the front ranges of the St. Elias Mountains and the Shakwak Trench are known for their high biological diversity relative to other subarctic regions, especially when compared to the inhospitable icefield ranges to the southwest. Finally, the roadside concentration may simply be a reflection of a greater availability of data along the highway corridor due to ease of access for research purposes.

In order to determine whether the results were affected by grouping the social and ecological values into one grand total, values were also ranked in order of decreasing number of social values per zone and in order of decreasing number of ecological values per zone. Again, zones with the same number of values were given equal ranks, and the total number of ranks were divided into five intervals. For social values, there were a total of 16 ranks, with ranks 1 to 3 representing the top 20% (13-15 values), 4 to 6 the >20% - 40% (10-12 values), 7 to 9 the >40% - 60% (7-9 values), 10 to 12 the >60% - 80% (4-6 values), and 13 to 16 the >80% - 100% (0-3 values). For ecological values, there were a total of 8 ranks, with rank 1 representing the top 20% (9 values), 2 and 3 the >20% - 40% (7-8 values), 4 the >40% - 60% (6 values), 5 and 6 the >60% - 80% (4-5 values), and 7 and 8 the >80% - 100% (2-3 values).

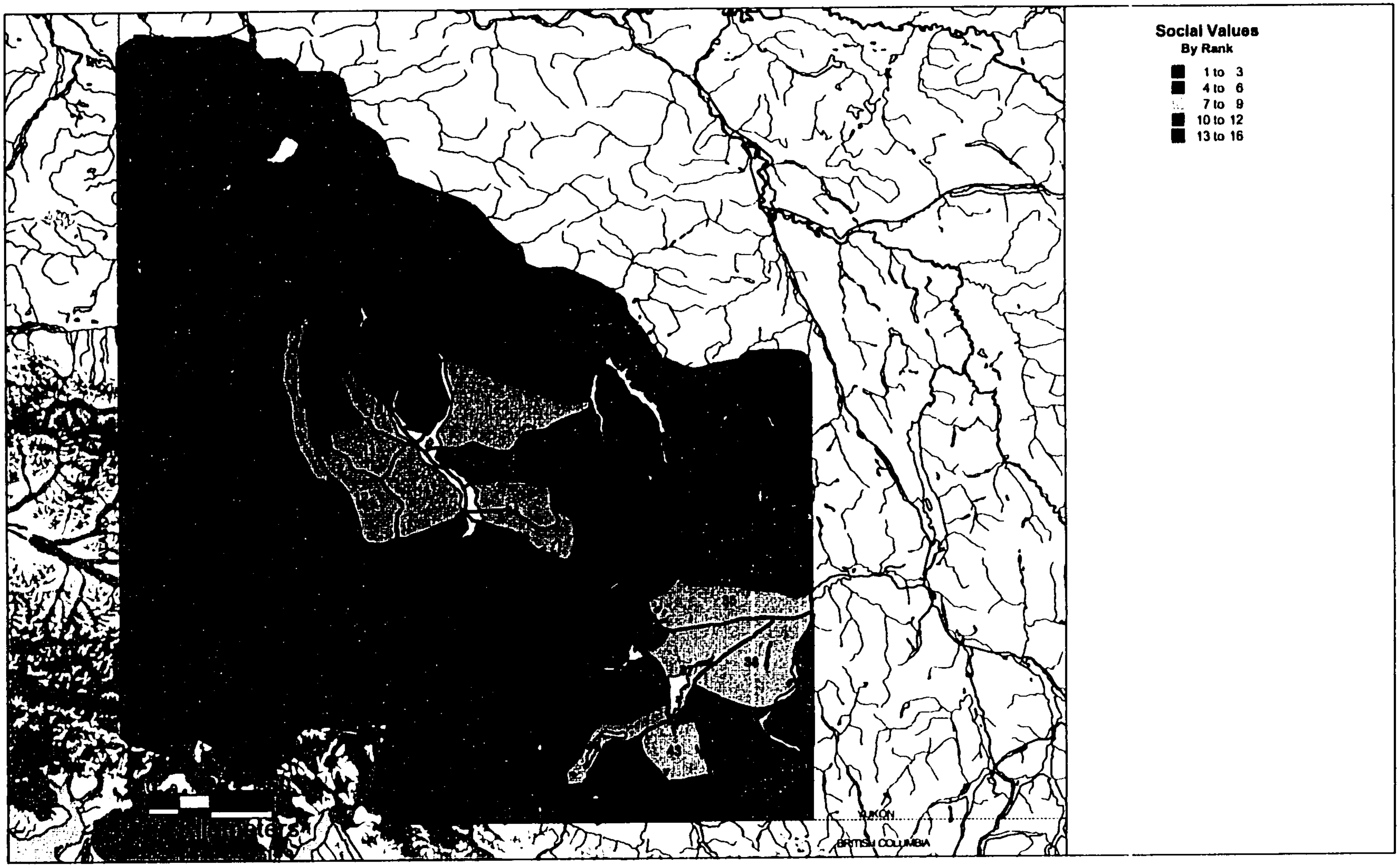
Social Values Per Zone

The zones falling within the top 40% when ranked by social values are listed in Table 5.4, and details on the ranking of all 55 zones are provided in Appendix 4 (Table A4.2). Of these top 40%, six (47, 49, 48, 45, 52, and 50) are located within KNPR, and two (44 and 51) are at least partially within the KWS. In addition, only two of the zones listed in the top 40% when ranked by social values are not found on the list of the top 40% when ranked by total values (zones 45 and 50). Neither of these zones are included in Table 5.3 because they both have fewer ecological values, giving them a total values rank of 14, just below the top 40% cut off. Likewise, several zones listed in the top 40% when ranked by total values are not included in top 40% when ranked by social values, namely zones 24, 18, 25, 11, 35, 46, and 38. However, all of these zones have between 7 and 9 social values and would thus fall in the next category of top 60% when ranked by social values, suggesting that the differences between these zones and the ones listed in both analyses are slight.

Table 5.4 - Value Hotspots, Ranked by Social Values per Zone.

Rank	Zone	Name	Total Values	Social Values	Ecological Values
1	47	Goatherd Mountain	19	15	4
1	49	Kathleen Lake	21	15	6
2	44	Tatshenshini River	20	14	6
2	51	Hungry Lakes	19	14	5
3	48	Alsek/Dusty/Kaskawulsh	18	13	5
4	45	Onion Lake	14	12	2
5	28	Aishihik Lake/Sekulmun Lake	17	11	6
5	34	Pine Lake	17	11	6
5	52	Slims River	19	11	8
6	50	Mt. Archibald/Vulcan Mt.	14	10	4

Results for ranking by social values are also presented in Map 5.3. There are many similarities between this map and Map 5.2. Although many zones have shifted up or down one category, only zone 15 falls in a considerably lower category (top 100 %) when ranked by social values as opposed to total values (top 60%). This likely arises because there is a large amount of ecological values in this zone, but few social values. When ranked by social values, the highest concentration of the top 40% of the ranks is still located in the southern part of KNPR, with a few other hotspots located adjacent to park boundaries and along highway corridors. Overall,



Map 5.3 - Spatial Distribution of Social Values

then, there is considerable overlap between the zones with the highest ranking social values and highest ranking total values.

Ecological Values Per Zone

The zones falling within the top 40% when ranked by ecological values are listed in Table 5.5, and details on the ranking of all 55 zones are provided in Appendix 4 (Table A4.3). Of these top 40%, only one (zone 52) is located within KNPR, and one (zone 11) is within the KWS. It is extremely important to note here that this does not mean that the park does not provide critical habitat for the species it supports. Rather, zones within the park ranked low in terms of concentrated ecological values due to the lack of extensive wetlands such as those found in zones 35, 5, 18, 54, and 27 which contain numerous ecological values such as beaver, muskrat, waterfowl, and a diversity of fish species. The lack of fish diversity in the park's lakes also contributes to the lower ranking, as does the fact that it lies outside the range of some species such as the bison, mule deer and elk of zones 27, 35, and 33. Thus, although the park consistently provides critical habitat for the species which fall within its boundaries such as grizzly bear, Dall sheep, mountain goat and moose, the actual value of these habitats is not reflected here since no weighting system was applied for reasons discussed above. Again, implications of this decision are discussed in Chapter 6.

When compared to the rankings of total values in Table 5.3, we see that six of the fourteen zones listed in the top 40% when ranked by ecological values are also found on the list of the top 40% when ranked by total values (zones 24, 25, 35, 11, 18, and 52). The eight remaining zones that are only listed when ranked by ecological values are not listed when ranked by total values because of their low amount of social values, putting them in the top 60% (zones 15, 54, 27, 31, and 33) and top 80% (zones 4 and 19) categories when ranked by total values. Likewise, several zones in the top 40% when ranked by total values (Table 5.3) are not included when ranked by ecological values (Table 5.5), namely zones 49, 44, 47, 51, 48, 28, 34, and 46. This arises due to the lower concentration of ecological values in these zones, particularly in zones 47, 51, and 48 which are only found in the top 80% when ranked by ecological values for the reasons outlined above when discussing ecological values within KNPR.

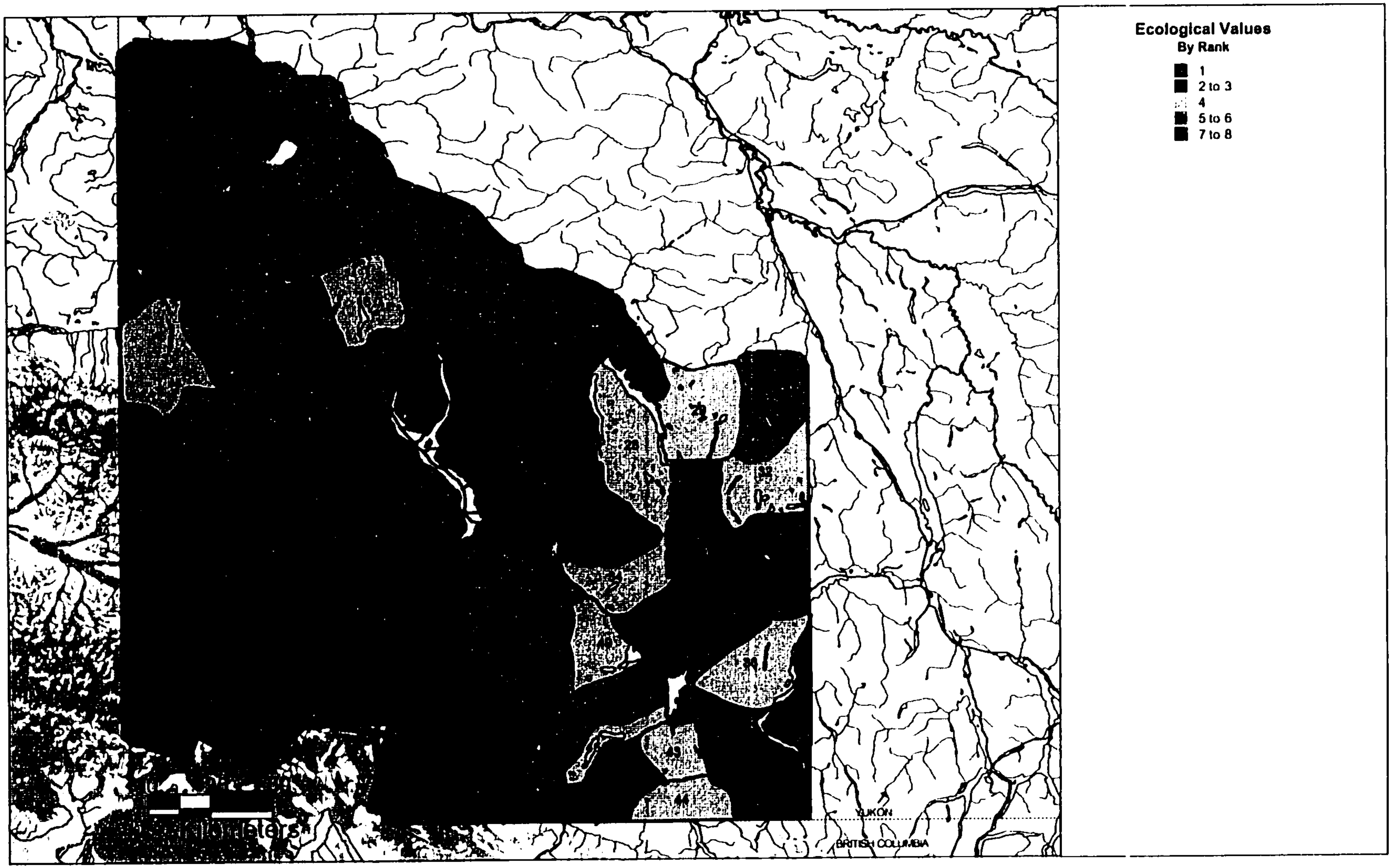
It is also interesting to note that only one zone listed in the top 40% when ranked by total values (zone 52) is listed in the top 40% both when ranked by social values and when ranked by ecological values. This suggests that there is little or no relationship between social and ecological values. Plotting social values versus ecological values confirms this to be true (Figure 5.1). This is an important point to recognize, as it reinforces the need to consider both social and ecological values, since zones of high social importance may not be so ecologically speaking, and vice versa.

Table 5.5 - Value Hotspots, Ranked by Ecological Values per Zone.

Rank	Zone	Name	Total Values	Social Values	Ecological Values
1	24	Jarvis River	17	8	9
1	25	Kloo Lake	16	7	9
1	35	Dezadeash River	16	7	9
2	5	Pickhandle Lakes	13	5	8
2	11	Burwash Uplands	16	8	8
2	15	Donjek/Kluane Confluence	11	3	8
2	18	Kluane River	17	9	8
2	52	Slims River	19	11	8
2	54	White River/Snag	14	6	8
3	4	Tchawsahmon Lake	10	3	7
3	19	Brooks Arm Plateau	10	3	7
3	27	Stevens Lake	13	6	7
3	31	Moraine Lake	12	5	7
3	33	Taye Lake	12	5	7

Figure 5.1 - Scatterplot of Social Values Versus Ecological Values

Results for ranking by ecological values are also presented in Map 5.4. When compared to the total values map, several differences can be noted. First, several zones (4, 19, 44, 45, 47, 48, 49, and 51) have shifted up or down more than one category when mapped by ecological value ranks. For instance, both zones 4 and 19 fall in the top 80% category when ranked by total values, but rise to fall within the top 40% when ranked by ecological values. This suggests that these zones contain concentrated ecological values but that they do not contain many social values. Indeed, they are both in the lowest category when ranked by social values (Map 5.3). Conversely, zones 47 and 51 only rank in the top 80% when ranked by ecological values, whereas they are found within the top 20% when ranked by total values and by social values. These differences are not surprising given the lack of a relationship between social and ecological values displayed in Figure 5.1.



Map 5.4 - Spatial Distribution of Ecological Values

Overall, then, the concentration of values in the southern part of KNPR (ie. zones 45 through 51) can be largely attributed to the presence of numerous social values, whereas the higher rankings of zones near the north end of the park (ie. zones 11, 18, 24, and 25) arise largely due to a concentration of ecological values. Only one zone - number 52 - contains a concentration of both social and ecological values. It appears as though grouping social and ecological values together to carry out the analysis does not affect the results substantially, as a core group of zones emerges as having high concentrations of both social and ecological values, whether ranked independently or together. Notably, zone 52 is found within the top 40% in all three analyses. In addition, zones 28, 34, 44, 47, 48, 49, and 51 are all within the top 40% in both the total and social analyses, whereas zones 11, 18, 24, 25, and 35 are within the top 40% in both the total and ecological analyses.

The data so far have been analyzed in an unmodified form. Although this approach has provided a good overview of the data, it has not taken the possible effect of area into consideration. Therefore, the data were also analyzed when ranked based on values per area per zone.

Total Values Per Area Per Zone

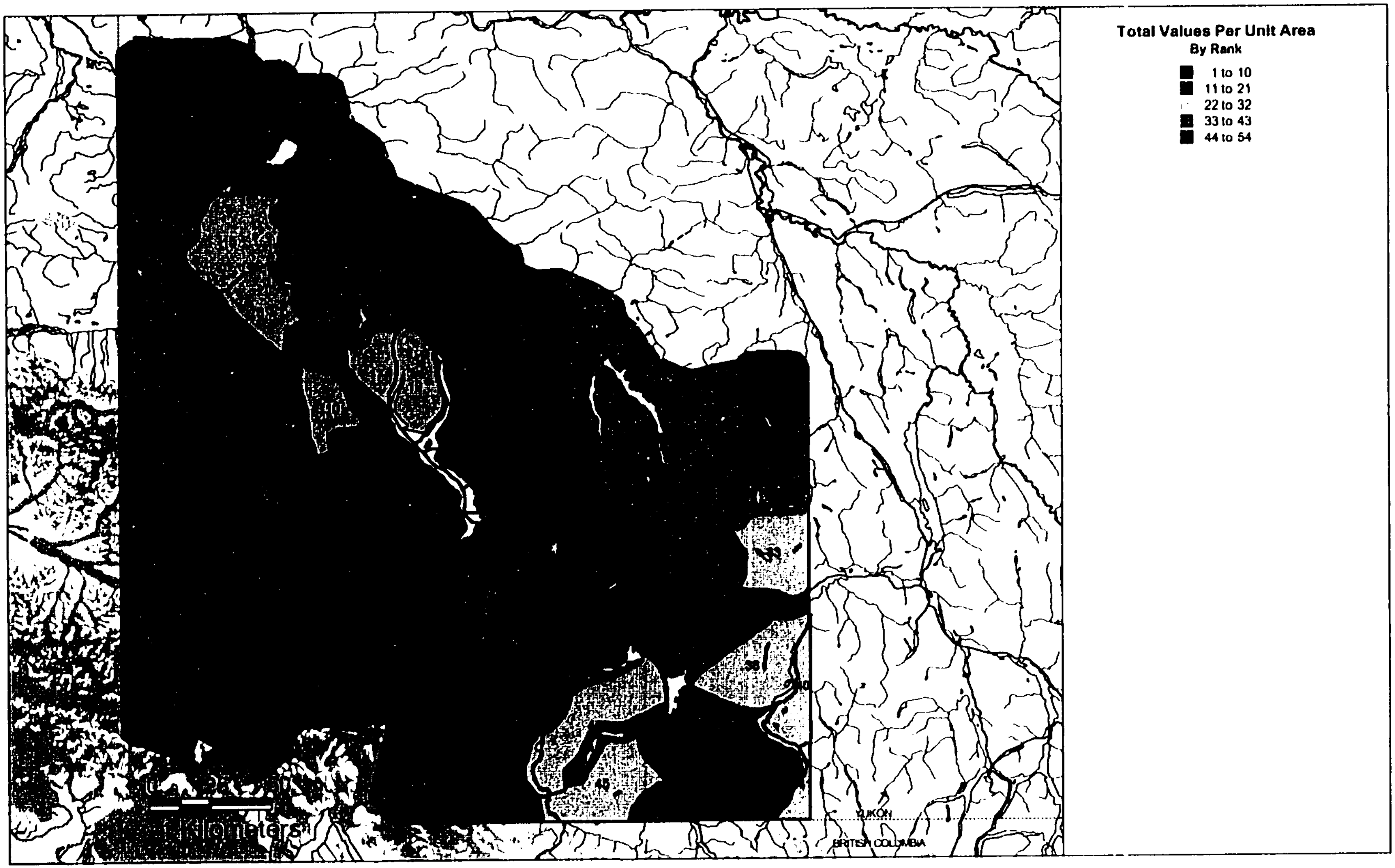
First, data were ranked by the total number of values per area per zone. Since no two zones contained exactly the same number of values per area, there was a total of 54 ranks. These 54 ranks were subsequently divided into five intervals, with ranks 1 to 10 representing the top 20%, 11 to 21 the >20% - 40%, 22 to 32 the >40% - 60%, 33 to 43 the >60% - 80%, and 44 to 54 the >80% - 100%.

Table 5.6 lists details for the zones falling within the top 40% when ranked by total values per area per zone, and details on the ranking of all 55 zones are provided in Appendix 4 (Table A4.4). Of these top 40%, six (46, 13, 52, 49, 12, and 48) are located wholly within KNPR, and six (11, 51, 44, 43, 9, and 14) are at least partially within the KWS. The list of the top 40% when ranked by total values per area contains twelve of the fifteen zones originally ranked by total values in Table 5.3. Only zones 47, 28, and 38 from Table 5.3 are not included in Table 5.6, mostly due to their larger areas of 1143km^2, 1393km^2, and 977km^2 respectively.

Table 5.6 – Value Hotspots, Ranked by Total Values per Area per Zone.

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Values per Area
1	18	Kluane River	17	9	8	287	0.05923
2	25	Kloo Lake	16	7	9	368	0.04348
3	46	Mush-Bates Lakes	15	9	6	360	0.04167
4	11	Burwash Uplands	16	8	8	389	0.04113
5	13	South Donjek River Valley	9	6	3	220	0.04091
6	36	Rainbow Lakes	9	6	3	223	0.04036
7	51	Hungry Lakes	19	14	5	473	0.04017
8	24	Jarvis River	17	8	9	457	0.0372
9	44	Tatshenshini/Dalton Post	20	14	6	562	0.03559
10	52	Slims Valley	19	11	8	568	0.03345
11	49	Kathleen Lakes	21	15	6	655	0.03206
12	39	Frederick Lake	9	4	5	301	0.02990
13	43	Klukshu Lake	14	8	6	476	0.02941
14	34	Pine Lake	17	11	6	692	0.02457
15	12	Bighorn Creek	13	8	5	536	0.02425
16	9	North Donjek Valley	10	7	3	428	0.02336
17	15	Donjek-Kluane River Confluence	11	3	8	500	0.02200
18	48	Alsek-Kaskawulsh Confluence	18	13	5	844	0.02133
19	35	Dezadeash River, Canyon to Champagne	16	7	9	827	0.01935
20	37	Dezadeash and Sixmile Lakes	14	9	5	736	0.01902
21	14	Congdon Creek	13	9	4	738	0.01762

Results from this analysis are also presented in Map 5.5. When compared to the map of total values (Map 5.2), the major differences arise in the zones that either have small areas (eg. zones



Map 5.5 - Spatial Distribution of Social and Ecological Values Per Unit Area

13 and 36) or large areas (eg. zones 28 and 54). The distribution of zones within the top 40% also differs slightly, as the higher ranking zones of the total values per area analysis are more evenly distributed along the highway corridor as opposed to the concentration in the southern part of KNPR observed in the total values analysis. Despite these slight differences, however, a total of twelve zones are listed in the top 40% both when ranked by total values and when ranked by total values per area (zones 11, 18, 24, 25, 34, 35, 44, 46, 48, 49, 51, and 52), indicating that there is a considerable amount of overlap between the two analyses.

As with the above analysis of total values per zone, values were also ranked in order of decreasing number of social values per area and decreasing number of ecological values per area. These data were used to determine if and how the results vary when corrected by area, and to determine the effect of grouping the social and ecological values per area into one grand total. Again, since no two zones contained exactly the same number of social values per area or ecological values per area, there were a total of 54 ranks in each analysis. These 54 ranks were subsequently divided into five intervals, with ranks 1 to 10 representing the top 20%, 11 to 21 the >20% - 40%, 22 to 32 the >40% - 60%, 33 to 43 the >60% - 80%, and 44 to 54 the >80% - 100% for both social value per area and ecological values per area.

Social Values Per Area Per Zone

The zones falling within the top 40% when ranked by social values per area are listed in Table 5.7, and details on the ranking of all 55 zones can be found in Appendix 4 (Table A4.5). Of these top 40%, eight (zones 13, 46, 49, 52, 48, 12, 45 and 47) are located wholly within KNPR, and six (zones 51, 44, 11, 43, 9, and 14) are at least partially within the KWS. Only zones 45 and 47 - both located within KNPR - are not found in the top 40% when ranked by total values per area. This likely arises because there is a large amount of water recreation along the Alsek River in these zones, but given their sizes (910km^2 and 1143km^2 respectively) the ecological values are slightly less concentrated. They are both found in the top 60% when ranked by total values per area, suggesting that the difference is not substantial. Likewise, although zones 15 and 35 are both in the top 40% when ranked by total values per area, they do not appear in the top 40% when ranked by social values per area. For zone 15, this is not surprising as it is not easily accessible, so social values are expected to be somewhat lower. However, zone 35 is located alongside the Alaska highway. The fact that it is not in the top 40% of social values per area may be more a reflection of the presence of a lower concentration of social values in zone 35 relative to numerous other zones around KNPR with relatively high concentrations of social values per area. Since both of these zones are found in the top 60% when ranked by social values per area, the difference between ranking by total values per area and by social values per area can be considered minimal.

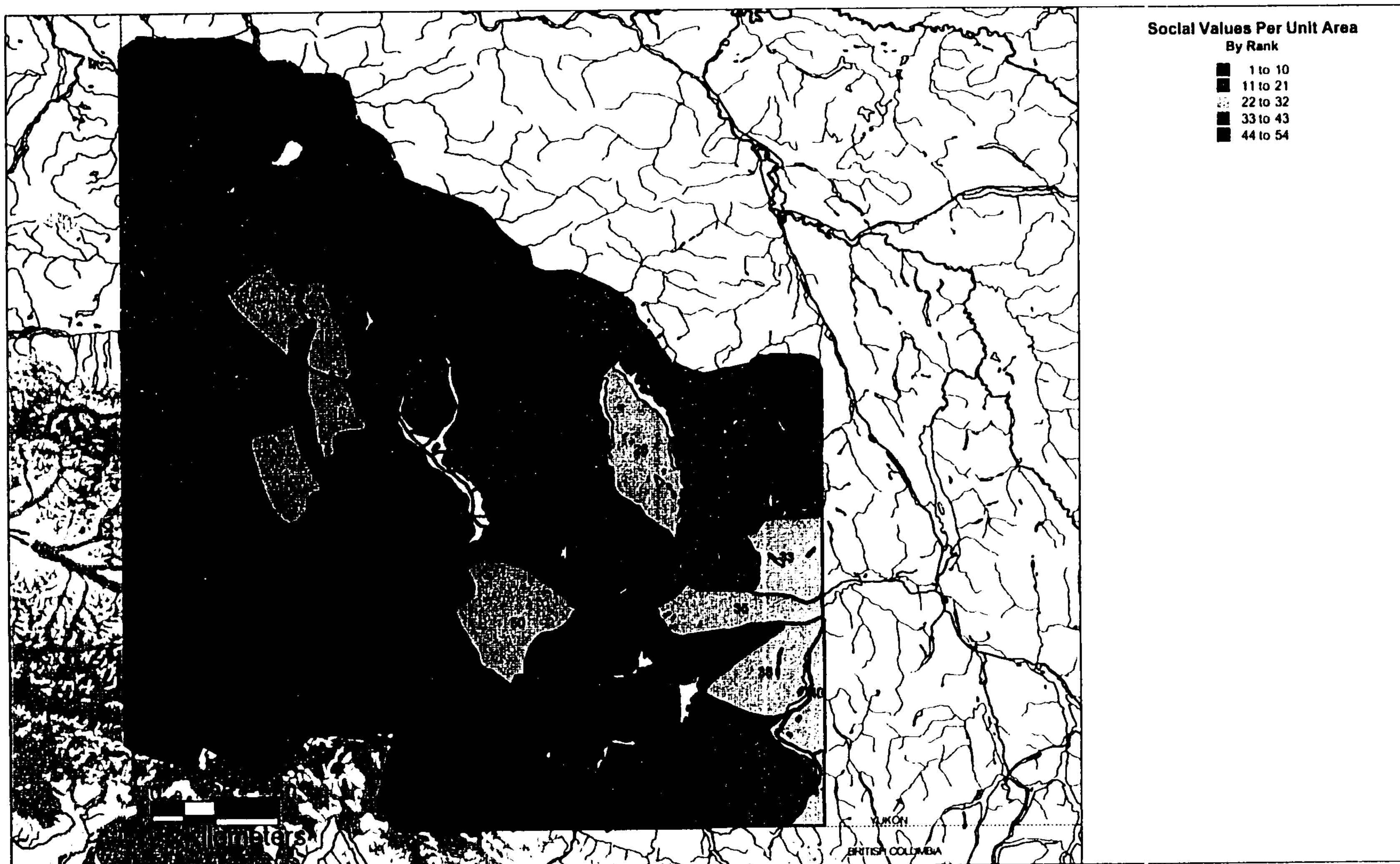
When compared to the results of the analysis ranked by social values, we see that the list of the top 40% when ranked by social values per area contains eight of the ten zones originally ranked by social values in Table 5.4. Only two zones in the top 40% of the social values analysis - zones 28 and 50 - are not listed in the top 40% of the social values per area analysis, mostly due to their large areas of 1393km^2, and 1319km^2 respectively.

Table 5.7 - Value Hotspots, Ranked by Social Values per Area per Zone.

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Social Values per Area
1	18	Kluane River	17	9	8	287	0.0314
2	51	Hungry Lakes	19	14	5	473	0.0296
3	13	South Donjek River Valley	9	6	3	220	0.02727
4	36	Rainbow Lakes	9	6	3	223	0.02691
5	46	Mush-Bates Lakes	15	9	6	360	0.025
6	44	Tatshenshini/Dalton Post	20	14	6	562	0.02491
7	49	Kathleen Lakes	21	15	6	655	0.0229
8	11	Burwash Uplands	16	8	8	389	0.02057
9	52	Slims Valley	19	11	8	568	0.01937
10	25	Kloo Lake	16	7	9	368	0.01902
11	24	Jarvis River	17	8	9	457	0.01751
12	43	Klukshu Lake	14	8	6	476	0.01681
13	9	North Donjek Valley	10	7	3	428	0.01636
14	34	Pine Lake	17	11	6	692	0.0159
15	48	Alsek-Kaskawulsh Confluence	18	13	5	844	0.0154
16	12	Bighorn Creek	13	8	5	536	0.01493
17	39	Frederick Lake	9	4	5	301	0.01329
18	45	Onion Lake	14	12	2	910	0.01319
19	47	Lowell Lake/Goatherd Mt.	19	15	4	1143	0.01312
20	37	Dezadeash and Sixmile Lakes	14	9	5	736	0.0122
21	14	Congdon Creek	13	9	4	738	0.01672

Results from the social values per area analysis are also presented in Map 5.6. When compared to the map of total values per area (Map 5.5), there is very little difference. Only one zone - zone 17 - has shifted up or down more than one category, moving from the top 60% when ranked by total values per area down to the top 100% when ranked by social values per area. This occurs because the zone contains few social values per area but a number of ecological values per area.

When compared to the spatial distribution of values when ranked by social values (Map 5.3), several key differences are noticed. The main difference is that most zones with an area under 500km^2 have shifted from the lower ranks of top 60% - top 100% when ranked by social values up to the top 20% - top 60% when ranked by social values per area (eg. zones 13, 34, 10, 11, 15,



Map 5.6 - Spatial Distribution of Social Values Per Unit Area

18, 24, 25, 39, 41, and 46). This is not altogether unexpected, as the whole point of dividing by area was to allow the smaller zones to be comparable to the larger ones. Despite these slight differences, a total of eight zones are listed in the top 40% both when ranked by social values and when ranked by social values per area (zones 34, 44, 45, 47, 48, 49, 51, and 52), indicating that although there will be inevitable differences when correcting for area, the core group of social value hotspots remains unchanged.

Ecological Values Per Area Per Zone

The zones falling within the top 40% when ranked by ecological values per area are listed in Table 5.8, and details on the ranking of all 55 zones can be found in Appendix 4 (Table A4.6). Of these top 40%, five (zones 46, 52, 13, 12 and 49) are located within park boundaries, and five (zones 11, 43, 44, 51 and 10) are at least partially located in the KWS. Five of the zones falling within the top 40% when ranked by ecological values per area (zones 41, 17, 19, 33 and 10) were not listed in the original list of total values per area due to the low concentration of social values present in each. By comparison, zones 34, 9, 48, 37, and 14 were listed in the top 40% when ranked by total values per area but were not among the top 40% when ranked by ecological values per area. These zones fall outside of habitat ranges for several species, resulting in a lower ecological concentration than areas where more wildlife ranges overlap. However, it is important to note that the habitats located within these zones may still be quite valuable for the species located within those zones. For instance, the confluence of the Alsek and Kaskawulsh Rivers in zone 48 may be critical for grizzly bears, but since this zone does not maintain as wide of a range of ecological values as, say, zone 18, zone 48 did not appear in the top 40%.

When compared to the results of the analysis ranked by ecological values, we see that the list of the top 40% when ranked by ecological values per area contains nine of the fourteen zones originally in the top 40% when ranked by ecological values in Table 5.5. In addition, zones 5, 54, 4, 27, and 31 from the top 40% of the ecological values analysis are not included in the top 40% of the ecological values per area analysis, mostly due to their larger areas of 983km^2, 3147km^2, 866km^2, 1140km^2, and 1143km^2 respectively.

It is also interesting to note that there are considerably more zones that are found in the top 40% of both the social values per area analysis and the ecological values per area analysis as opposed to the little amount of overlap between high ranking zones in the social values and ecological values analyses. Recall that when not corrected by area, only one zone (number 52) was listed in the top 40% of both social values and ecological values. However, when corrected for area, fourteen zones (11, 12, 13, 18, 24, 25, 36, 39, 43, 44, 46, 49, 51, and 52) are listed in the top 40% of both social values per area and ecological values per area. To examine this relationship, social values per area were plotted against ecological values per area. Figure 5.2 shows that there is indeed some correlation between social and ecological values when corrected for area. This correlation likely arises from the fact that when corrected by area, the zones with larger areas generally tend to have a smaller number of values per area and vice versa. Two exceptions are larger zones with an abnormally high concentration of social (eg. zones 47 and 45) or ecological values (eg. zones 5 and 35), and smaller zones with an abnormally low concentration of social (eg. zones 41 and 17) or ecological values (eg. zones 1 and 40). Note that the outlier that ranks high in both social values per area and ecological values per area is zone 18, Kluane River, which ranks first in all three area-corrected analyses.

Table 5.8 - Value Hotspots, Ranked by Ecological Values per Area per Zone.

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Ecological Values per Area
1	18	Kluane River	17	9	8	287	0.02787
2	25	Kloo Lake	16	7	9	368	0.02446
3	11	Burwash Uplands	16	8	8	389	0.02057
4	24	Jarvis River	17	8	9	457	0.01969
5	46	Mush-Bates Lakes	15	9	6	360	0.01667
6	39	Frederick Lake	9	4	5	301	0.01661
7	15	Donjek-Kluane River Confluence	11	3	8	500	0.016
8	52	Slims Valley	19	11	8	568	0.01408
9	13	South Donjek River Valley	9	6	3	220	0.01364
10	36	Rainbow Lakes	9	6	3	223	0.01345
11	43	Klukshu Lake	14	8	6	476	0.01261
12	41	South Takhini River	3	1	2	179	0.01117
13	17	Little Creek/Outlet Hill	5	1	4	361	0.01108
14	35	Dezadeash River, Canyon to Champagne	16	7	9	827	0.01088
15	44	Tatshenshini/Dalton Post	20	14	6	562	0.01068
16	51	Hungry Lakes	19	14	5	473	0.01057
17	19	Brooks Arm Plateau	10	3	7	663	0.01056
18	12	Bighorn Creek	13	8	5	536	0.0093
19	49	Kathleen Lakes	21	15	6	655	0.0092
20	33	Taye Lake	12	5	7	793	0.0088
21	10	Quill Creek	7	3	4	456	0.00877

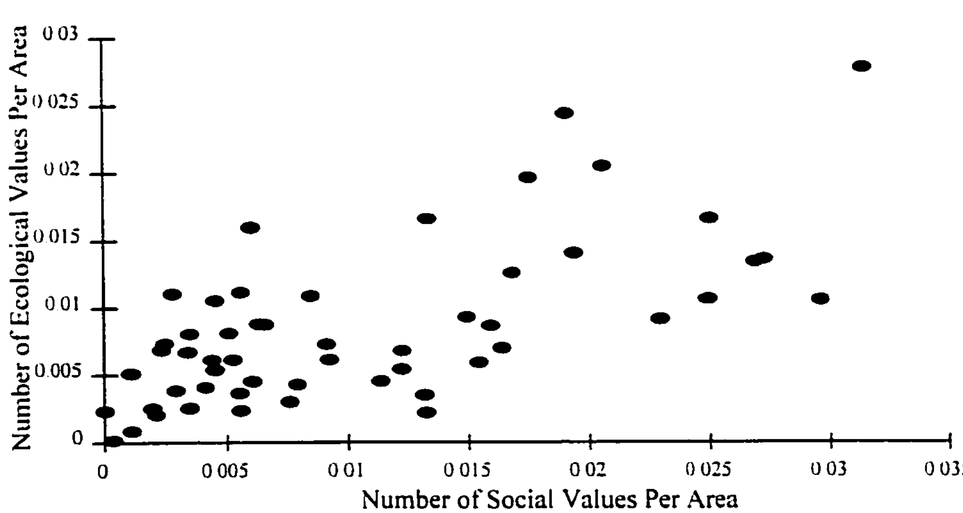


Figure 5.2 - Scatterplot of Social Values Per Area Versus Ecological Values Per Area.

Results from the ecological values per area analysis are also presented in Map 5.7. When compared to the map of total values per area (Map 5.5), there are only a few differences. Only four zones (14, 45, 47, and 48) shifted up or down more than one category, moving from the top 60% when ranked by total values per area down to the top 100% when ranked by ecological values per area. This likely occurs because the zones have a high number of social values per area - all are within the top 40% when ranked by social values per area - but a lower concentration of ecological values per area.

When compared to the spatial distribution of values when ranked by ecological values, many differences are detectable. The main difference is that most zones with an area under 550km^2 have shifted from the lower ranks of top 60% - top 100% when ranked by ecological values up to the top 20% - top 60% when ranked by ecological values per area (ie. zones 9, 10, 12, 13, 17, 21, 36, 39, 41, 46, and 51). A few large zones with areas greater than 1000km^2 also decreased from ranking within the top 40% when ranked by ecological values to only ranking within the top 80% when ranked by ecological values per area (zones 31 and 54). Again, these differences were expected as the intent of correcting by area was to make smaller and larger zones more comparable. Despite these differences, it is important to note that nine zones are listed in the top 40% both when ranked by ecological values and when ranked by ecological values per area (zones 11, 15, 18, 19, 24, 25, 33, 35, and 52). This indicates that although there will be inevitable differences when correcting for area, the core group of ecological value hotspots remains largely unchanged.

Overall, grouping social values per area and ecological values per area together to carry out the analysis does not affect the results substantially, as a core group of zones emerges as having

Map 5.7 - Spatial Distribution of Ecological Values Per Unit Area

high concentrations of both social and ecological values. Notably, zone 18 is ranked as number one in all three analyses. In addition, zones 11, 12, 13, 18, 24, 25, 36, 39, 43, 44, 46, 49, 51, and 52 are all within the top 40% in all three analyses.

Summary of Findings

Six different tables and maps have been analyzed and discussed throughout this section. The distribution of the total values in the GKR were tabulated and mapped first (Table 5.3, Map 5.2). Then, social values and ecological values were analyzed independently in order to determine whether grouping the two into one total value had any major affect on the results (Tables 5.4 and 5.5, Maps 5.3 and 5.4). Interestingly, there was little overlap between zones with high ranking social values and zones with high ranking ecological values, reinforcing the need to consider both social and ecological values in any analysis (Figure 5.1). Only one zone - zone 52 - contained a considerable concentration of both social and ecological values. Despite these differences, a core group of zones emerged as having high concentrations of both social and ecological values, whether ranked independently or together (social values in zones 28, 34, 44, 47, 48, 49, and 51; ecological values in zones 11, 18, 24, 25, and 35).

The last three analyses considered how these results changed when the number of values per zone was corrected for area (Tables 5.6, 5.7, and 5.8; Maps 5.5, 5.6, and 5.7). There was very little difference when comparing the zones in the top 40% when ranked by total values and when ranked by total values per area, as a total of twelve zones were listed in the top 40% in both analyses (zones 11, 18, 24, 25, 34, 35, 44, 46, 48, 49, 51 and 52). Similarly, there were only slight differences when comparing the top 40% when ranked by social values and when ranked by social values per area, as zones with smaller areas generally ranked higher once corrected for area. A total of eight of the high-ranking zones (ie. top 40%) when ranked by social values were also in the top 40% when ranked by social values per area, (zones 34, 44, 45, 47, 48, 49, 51, and 52). When comparing the top ranking zones when ranked by ecological values and when ranked by ecological values per area, most of the differences arose due to the smaller zones increasing in rank and larger zones decreasing in rank due to the area correction. However, a total of nine zones were listed in the top 40% when ranked by both ecological values and ecological values per area (zones 11, 15, 18, 19, 24, 25, 33, 35, and 52). Overall, this indicates that although there will be inevitable differences when correcting for area, a core group of value hotspots remains unchanged for total, social, and ecological values.

The three analyses that were corrected by area were also compared with one another to determine whether grouping social and ecological values together had any effect. As with the analysis on the uncorrected data, there was little difference when comparing the spatial distribution when ranked by total values per area, social values per area, and ecological values per area. There was, however, more overlap between social and ecological values when corrected by area (Figure 5.2). This is because zones with larger areas generally tend to have a smaller number of values per area, with the exception of large zones with an abnormally high concentration of values social and smaller zones with an abnormally low concentration of values. Nevertheless, a core group of zones found within the top 40% of all three analyses emerged, as in the other analyses (zones 11, 12, 13, 18, 24, 25, 36, 39, 43, 44, 46, 49, 51, and 52).

When comparing the core zones that emerged from all six analyses, it is interesting to note that zone 52 fell within the top 40% of all six analyses, while zones 11, 18, 24, 25, 44, 49, and 51 fell within the top 40% of five of the six analyses, and zones 34, 35, 46, and 48 fell within the top

40% of four of the six analyses. Regardless of the slight differences arising from grouping social and ecological values together, or the changes observed when corrected by area, the results from all analyses suggest that these twelve zones are undoubtedly value hotspots.

Given these findings, the next section discusses some weaknesses inherent in the data and suggests some future priorities for research within the GKR.

5.4 CONCLUDING REMARKS

Although this exercise provides an overview of the spatial distribution of values on the GKR, the analysis is only as strong as the data available. The next section therefore discusses the weaknesses inherent in the data and how these weaknesses may have affected the results. Some general conclusions are then drawn from the case study findings.

Data Weaknesses

Several key weaknesses in the data need to be pointed out. Social values will be discussed first, followed by ecological values and general data disparities. First, it is important to note that information on subsistence harvesting is not always readily available for public use due to sensitivities associated with traditional ecological knowledge. Moreover, it should be noted that information for CAFN is considerably more accessible than information for KFN and WRFN, so data available for subsistence harvest in the northern portions of the study area are limited.

Very little information is also available for primary trapping areas and key guiding/outfitting areas due to the privacy rights of trappers and outfitters. This data gap has probably caused some areas of key significance to trappers and outfitters to be omitted from the final maps. This is less problematic for outfitters, as it is reasonable to assume that key outfitting areas overlap considerably with key wildlife areas. However, it is a weakness that must be considered for trapping values, since little information is available on specific habitats of key furbearing species, such as lynx, marten, wolves, and wolverines.

One main reason for this lack of information on critical habitats of these predatory furbearers is that the presence of prey is often more important than specific habitat requirements. Since many of these key prey species are widely distributed, it is extremely difficult to select key habitat locations for both prey and predators. Thus, some less obvious key habitats, such as denning sites for ground squirrel colonies, have likely been omitted from the ecological values database.

Data on significant geomorphological and hydrological sites are also lacking. In addition, exact locations of rare plant species are not yet available, so rare plants have been left out of the analysis.

It is also important to note that data are considerably more concentrated around roads. This is obviously due to the high costs associated with carrying out field surveys in remote locations. Consequently, this may have caused some values present in the more remote zones to be overlooked.

Another potential weakness in the data arises since some of the information was collected up to twenty years ago, and there was no way to verify whether the current status is the same without carrying out extensive field surveys. It is therefore necessary to assume that any major data flaws would have been detected in discussions with individuals familiar with the study area.

These data disparities have influenced this study in two ways. First, several categories of social and ecological values were omitted from the analysis because there was simply not enough information available. These include outfitting and trapping areas, wolverine, rare plants, key prey species (except muskrat), passerines and shorebirds. Second, the database represents values that are well documented more accurately than values where information is sparse, such as abiotic features and subsistence harvest by KFN and WRFN. The database developed must be therefore be considered as a starting point, with more information being added as the data become available.

Future Research Priorities

Based on these data disparities, several areas for future research are recommended. First, some future research needs to be directed towards gathering more data on the spatial distribution of small mammals that act as key prey species for the larger predators in the GKR. Knowing the regional distribution of these prey species, in years with high and low population densities, will provide the needed information on large predators such as wolverines, lynx, and wolves. A major study on small mammal community dynamics in the Kluane area has just been completed and will likely help to address this area for research once the results have been published (Krebs *et al.*, in press).

More detailed research also needs to be carried out on rare plants, as the GKR contains multiple nationally rare and/or endemic plant species. Although the general location of these plants has been described, more site-specific information would be useful.

More research into aquatic ecology both within the park's oligotrophic lakes and in the more diverse lakes outside park boundaries is also required. This area of research has been recognized as critical by several park staff (Brenneman and Elliot, pers. comm, 1999).

General Conclusions

The above analyses explored three main questions: (1) how are value hotspots distributed throughout the GKR, (2) what is the effect of grouping social and ecological values into one total, and (3) what is the effect of area and should it be corrected. Some general conclusions can be drawn for each of these questions.

With respect to the distribution of values, the tables and maps presented above repeatedly showed zones 52, 51, 49, 44, 24, 25, 18, 11, 48, 46, 35 and 34 ranking within the top 40% of most analyses. This implies that these zones are undoubtedly value hotspots and need to be given special consideration in future planning exercises and when exploring questions surrounding cumulative environmental effects. It is interesting to note that of these hotspots, four are fully protected within KNPR. Three others receive a moderate amount of protection in the KWS, while the remaining five are located outside the borders of parks and protected areas.

Two sets of analyses were carried out - one on the raw data, one on area-corrected data. In all analyses, there were few major differences in the resulting zones ranking in the top 40% when social and ecological values were grouped together in one total as opposed to being analyzed independently. This indicates that future exercises could analyze social and ecological values independently or together, depending on the desired level of detail. However, the lack of relationship between social and ecological values in the uncorrected data also suggests that both social and ecological values must be considered in any case study, as one cannot be assumed to overlap with or include the other. An interesting future option would be to give each zone two ranks, one for social values and one for ecological values.

When comparing the analyses that used the raw data with those that used area-corrected values, many differences were noted, particularly with smaller zones ranking substantially higher. One potential problem with this is that although it allows zones with smaller areas to be more comparable with those with larger areas, there may be too strong of a bias towards the smaller zones which may only have a few values, causing some of the average to large sized zones with a substantial concentration of values to go undetected. For instance, zone 41 has a small area and only contains two ecological values (goat and sheep), yet it appears within the top 40% when ranked by ecological values per area. Conversely, zone 31 contains a diversity of ecological values (deer, waterfowl, raptors, grouse, grizzly bear and sheep) yet it only ranks in the top 80% when ranked by ecological values per area due to the medium zone area. For this reason, it is recommended that in future applications the zone area be kept as constant as possible when determining the initial zone boundaries, and that all analyses be performed on the raw data. This would avoid the difficulties associated with correcting for data by completely removing the need for any correction.

The implications of this case study are discussed in Chapter 6, along with an overview of potential applications of the methodology, an evaluation of the methodology, and some concluding remarks (Figure 5.3).

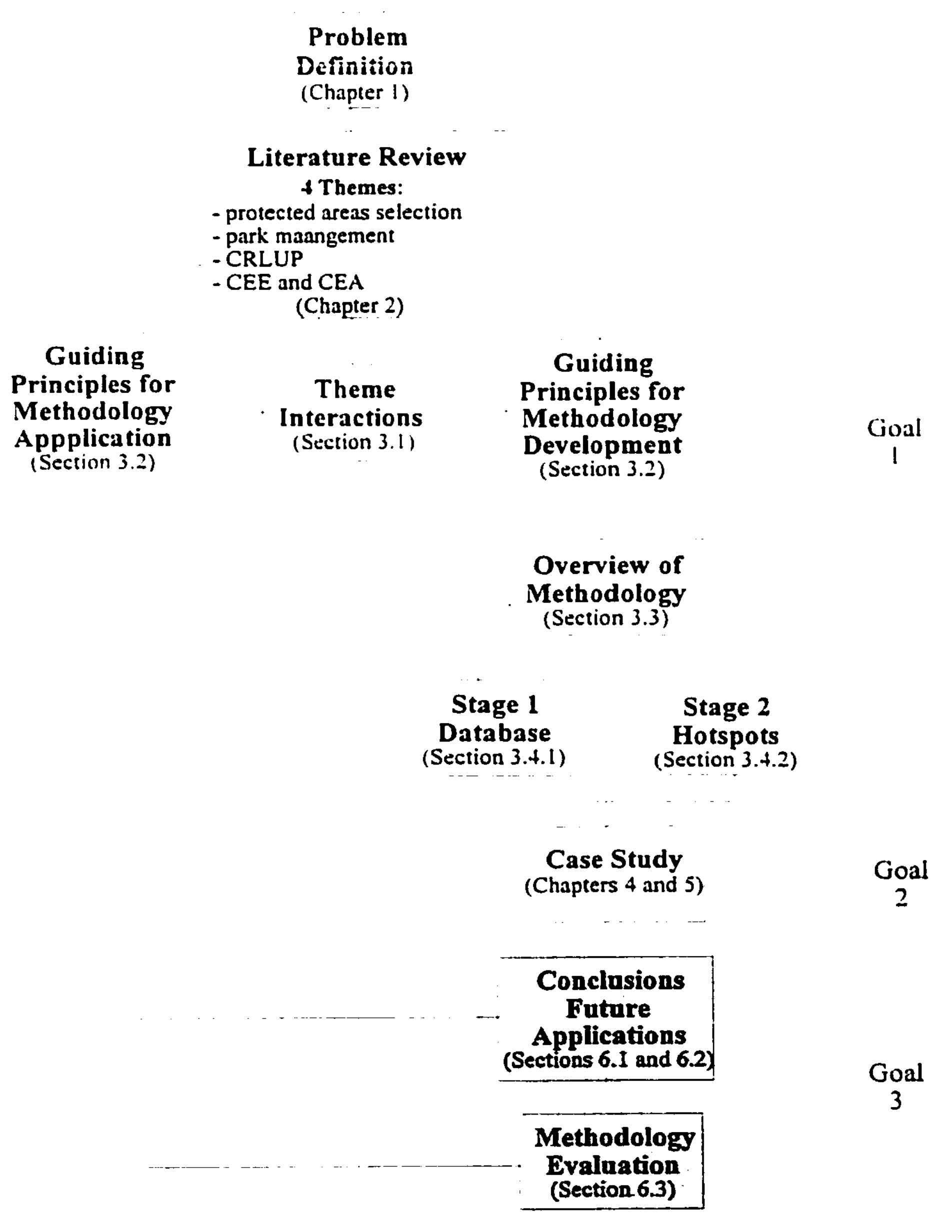


Figure 5.3 - Conceptual Map of Thesis

CHAPTER 6 - CONCLUSIONS

In the previous chapters, the literature on protected areas selection, northern national park management, comprehensive regional land use planning, and cumulative environmental effects and assessment was reviewed. This literature then served as the basis for a series of principles that guided the development of the proposed methodology. The methodology involves compiling a database of social and ecological values and determining areas with the highest concentrations of these values. To test the methodology, a case study was carried out in the Greater Kluane Region of southwest Yukon. Results show that twelve zones in the GKR are undoubtedly value hotspots and need to be given special consideration in future planning exercises and when exploring questions surrounding cumulative environmental effects. Notably, only four of these zones are fully protected within KNPR.

In this chapter, the question "What Next?" is explored through a discussion of potential future applications of the methodology (section 6.1). Implications of the case study findings are also discussed (section 6.2). Conclusions on the utility of the methodology are then drawn by evaluating how well the methodology and its potential applications are aligned with the guiding principles outlined in Boxes 3.1 and 3.2 (section 6.3). This is followed by a discussion on research contributions (section 6.4) and potential areas for future research (section 6.5). Finally, thesis goals and objectives are reviewed (section 6.6) and some concluding remarks presented (section 6.7).

6.1 POTENTIAL FUTURE APPLICATIONS

The proposed methodology consists of two products: a database of values and a spatial overview of concentrations of social/ecological values. These products may be applied in both planning exercises and project-specific CEAs to help minimize CEEs in and around northern national parks.

Regional Planning Applications

For planning purposes, development thresholds and limits of acceptable change could be determined as part of a vision for a region, with more restricted commercial access to value hotspots. These thresholds and limits of acceptable change may then be used in conjunction with the values database and project-specific CEAs to evaluate the acceptability of any proposed project, only allowing a project to proceed if impacts (project-specific AND cumulative) do not exceed pre-specified thresholds and limits of acceptable change. Therefore, as more and more projects are developed in a region, it will become increasingly difficult to develop in the most valuable areas as the amount of activity approaches the predetermined cap on development. As such, a proactive management stance is being taken to inhibit more development than an area can sustain, so that social and ecological values are not compromised.

Indeed, some work has already been started on thresholds in Yukon (AXYS, 1999) and the value of proactive planning for minimizing CEEs is becoming more and more recognized (Mueller, pers. comm. 1999). In addition, with the upcoming structural changes to environmental assessments throughout the Yukon Territory with the advent of the new Development Assessment Process, now would be an ideal time to highlight the need to view development activities at broader space and time scales and to have a planning regime in place to limit CEEs.

Consider the following hypothetical example based on the results of the case study. If the results presented in Chapter 5 encourage KNPR to develop a regional plan to proactively minimize CEEs, the onus would fall on Parks Canada to initiate the planning process. This could perhaps be carried out in association with either a management plan review or an ecological integrity statement update, as both of these processes require a focus beyond park boundaries and consideration of CEEs. Past, present and future land uses could then be mapped, noting the major impacts - both positive and negative, socioeconomic and ecological - associated with each, as well as the potential for the interaction and accumulation of these impacts. Keeping the highest priority areas outlined in Chapter 5 in mind, Parks Canada would then consult the public regarding limits of acceptable change in these areas given past, present and future uses and the positive and negative implications of various projects and alternatives. Some professional input on wildlife thresholds would also be useful at this stage.

Information on limits of acceptable change, wildlife thresholds, development impacts and potential accumulations could then be compiled to determine how much more development can be permitted in each zone. Ideally, fewer future developments would be permitted in areas of highest value such as zones 52, 51, 49, 44, 25, 24, 18 and 11. The suitability or desirability of future proposed projects and activities could then be evaluated using these thresholds. For instance, zone 11 (Burwash Uplands) already sustains a considerable amount of past, present and potential mining sites. The same area also provides critical caribou calving grounds, habitat for grizzly bears and raptors, and contains unique geomorphological features. By placing a cap on future developments beyond which will cause unacceptable changes, the ecological integrity of the park and surrounding regions will be maintained. Social values associated with the zone - such as hiking, wilderness experience, and nature appreciation - will also be preserved. Of course, some degree of monitoring would be required to ensure that proper development limits were established and that development impacts are not interacting to cause CEEs. Although a considerable amount of time and energy is required to carry out this planning process, taking a proactive stance will help to save time and financial resources in the future.

Cumulative Effects Assessment Applications

The proposed methodology may also be used for project-specific CEAs, as all known elements of ecological and social value are already outlined. This initial comprehensive look at values will ensure that *all* values are plainly visible from the start of the assessment. It is important to note that the values database and/or areas with the highest concentration of values can not act in place of VECs/VSCs. Rather, specific VECs/VSCs should be selected from the database or valued areas based on their susceptibility to the project under review. This way, all proposed developments for a region start with the same values that must be considered, acting almost as a checklist of values. However, it is crucial that the values database be updated regularly as more data becomes available in order that it remains a reliable overview of values in the study area.

Although the methodology has been designed with northern parks in mind, it could be applied in virtually any situation where CEEs have not yet become problematic. Efforts are then directed towards proactively planning to limit the potential for CEEs before excessive degradation occurs. In regions where CEEs are already prevalent, however, efforts may be more effective if directed towards mitigating the existing CEEs.

6.2 CASE STUDY IMPLICATIONS

Case study results indicate that several key areas can be considered as "value hotspots" throughout the GKR. Only a third of these zones are located within the boundaries of KNPR, yet there are many interactions between the zones within the park and those falling outside park boundaries. For instance, the grizzly bears in the Slims River Valley (zone 52) likely make use of the habitat found on the east side of Kluane Lake in zones 24 and 25. For social values, the hiking and biking occurring in zone 49 is likely linked to the proximity of education, camping, and nature appreciation in zone 34. Given that values within the park are linked to those outside the park, the results of the case study reinforce the need to manage KNPR in a regional context if ecological integrity and the associated social and ecological values are to be maintained. One way to accomplish this would be for Parks Canada to initiate a proactive regional planning approach such as that listed above. This would involve working with adjacent land owners, the Yukon Territorial Government, and local Aboriginal groups to determine a long-term vision for the region and set development thresholds or limits of acceptable change for the most valuable zones. These development limits may then be used to evaluate the acceptability of proposed projects, so as to not allow development to exceed the predetermined thresholds. Hosting regular meetings and initiating a monitoring program to track the effectiveness of the development thresholds or limits of acceptable change will help to achieve this goal.

By effectively implementing development caps, a proactive stance on CEEs will be taken by limiting development in the most valuable areas before environmental impacts accumulate and have significant negative effects. In addition to minimizing CEEs, this approach would provide better protection for all wildlife and contribute to the general long-term sustainability of the GKR. Indeed, some park staff have already recognized the need for the park to take a proactive approach to protect ecological integrity in order to avoid a situation where rectification is necessary (Elliot, pers. comm. 1999). Taking such a proactive planning approach will also allow national parks to meet the challenge of determining "... how to manage the increasing flow of development requests as a way of limiting cumulative effects" put forth by the Panel on the Ecological Integrity of Canada's National Parks (Parks Canada, 2000:12.17).

It is very important to note here that zones with the most concentrated values may not be the most valuable for a particular species of concern. For instance, some critical areas for grizzly bears are not located within the zones with most concentrated values. Thus, when setting development thresholds while undertaking a regional planning exercise, it will be necessary to take species of particular concern into special consideration. One possible way to address this drawback would be to devise a weighting system to be implemented when tallying total zone values, as discussed in section 3.4.2. For instance, grizzly bear habitat could be given a score of 10 while mountain biking trails a score of 1. This way, zones with critical grizzly habitats would almost always have a high number of total values. This approach was not taken in the case study presented in this thesis because weighting for relative significance would require considerable input from both the public as well as regional biologists to come to an agreement on a suitable weighting system for the study area. In addition, it was felt that weighting was not required given the exploratory nature of this study, although it would be interesting to see the results of a future weighted case study of the methodology.

As far as data availability, it can be concluded that although there are enough data to carry out an analysis on values in the GKR, there are inevitable weaknesses associated with this data, as discussed in section 5.4. This highlights the need for more basic inventorying, continued monitoring, and regular updating of the values database in order to strengthen any future applications of the methodology in the GKR.

6.3 METHODOLOGY EVALUATION

Two sets of guiding principles are presented in Chapter 3. To evaluate the effectiveness of the proposed methodology, it is useful to compare how well the methodology and its implementation potentials meet the guidelines outlined in Boxes 3.1 and 3.2.

Recall that the five principles guiding methodology development require that the methodology:

i. Provide a manner to select areas where achieving the proper balance between environment and development is of greatest importance;

ii. Incorporate social and ecological values of the study area;

iii. Take account of the recommended ecological integrity monitoring measures;

iv. Work at a regional scale; and

v. Assimilate information within study area boundaries .

All of these requirements have been met in the methodology developed in Chapter 3. Stage 1 involves assimilating information to identify social and ecological values at a regional scale, as specified by principles 2, 4 and 5. Principle 3 is also satisfied in Stage 1 since the recommended ecological integrity monitoring measures have been incorporated into the list of social and ecological values listed in the literature on protected areas selection, park management, and VECs/VSCs presented in Tables 3.1 and 3.2. Stage 2 involves determining zones with the highest concentrations of social and ecological values, thereby providing a manner to select areas where achieving the proper balance between environment and development is of greatest importance as stated in principle 1.

A set of guiding principles was also derived for the potential applications of the methodology. A summary of these sixteen principles and notes on how well the methodology addresses these principles are presented in Table 6.1. In general, the methodology and its associated applications discussed in section 6.1 allow a long-term, proactive regional perspective to be taken on past, present and future development activities. This is accomplished through setting clear goals, integrating social, economic and environmental aspects, and identifying land use thresholds to link environmental assessments and regional planning under government leadership. Other guidelines - such as flexibility, time constraints, stakeholder roles, and continuity over time - could not be evaluated at this time as they will vary considerably based on the specific conditions surrounding each case application.

Overall, the proposed methodology and its associated applications in proactive land use planning, setting development thresholds, and CEAs satisfy almost all of the guiding principles derived from the literature review. This suggests that the methodology will be quite useful in working towards a proactive planning approach to limiting cumulative environmental effects in and around northern national parks. The main drawback of the methodology is its reliance on existing data, causing weak data to give weak results. The only way to address this drawback would be to initiate more basic inventorying and to establish monitoring programs.

Table 6.1 - Evaluation of Proposed Methodology Applications

Guiding Principle	Applicable with Methodology?	Justification
1. Take a regional perspective on threats.	Yes.	The methodology provides an overview of values and, when incorporated into regional CEAs, will help determine impacts of regional stressors.
2. Maintain a proactive stance on environmental impacts and integrate environmental assessment more fully with park planning.	Yes.	Incorporating the methodology into regional planning allows a proactive stance to be taken on CEEs. In addition, devising a land use plan with development thresholds and subsequently using these thresholds to evaluate project acceptability will help make a stronger link between planning and EIA in parks.
3. Focus on long-term human impacts.	Yes.	Long-term impacts are addressed when a land use plan with development thresholds is devised and applied to limit development in areas with concentrated values.
4. Establish clearly defined goals.	Yes.	Development of a land use plan, thresholds, and limits of acceptable change are all guided by a collective long-term vision for the study area.
5. Integrate social, economic and environmental components.	Yes.	Social and ecological values are directly incorporated into the methodology. These values are then integrated with economic aspects when the methodology is applied in land use planning and/or CEAs.
6. Maintain flexibility	Maybe.	The methodology itself is highly flexible and easy to update. However, when applying the methodology in land use planning and CEAs flexibility will vary on a case-by-case basis and is therefore hard to evaluate at this point.
7. Focus on key issues and most promising solutions.	Maybe.	The methodology focuses on areas where an accumulation of environmental effects would result in the degradation of multiple social and ecological values. The extent to which key issues and most promising solutions are considered beyond this point is difficult to evaluate at this time, as it would vary on a case-by-case basis.

Guiding Principle	Applicable with Methodology?	Justification
8. Clearly define stakeholder roles.	No.	This principle may only be addressed on a case-by-case basis, as how well stakeholder roles are defined would vary considerably among the different potential applications of the methodology. The methodology does, however, help to highlight the key stakeholder groups which need to be involved.
9. Achieve continuity over time.	No.	Whether or not the methodology and its associated applications (eg. land use plan, thresholds, CEAs) are maintained over the long term is entirely dependent on who is applying the methodology and how it is being applied.
10. Work with realistic time restrictions.	Maybe.	It is certainly possible to develop the methodology and apply it in a reasonable time frame. However, how well this is implemented may only be evaluated on case-by-case basis.
11. Anticipate future developments before they arise.	Yes.	When integrated into land use planning and regional CEAs, the methodology will help take a proactive stance by putting a cap development before projects and associated impacts arise.
12. Work towards a better understanding of past, present and future human impacts.	Yes.	The methodology may be integrated into CEAs to examine past, present and future impacts on social and ecological values of the study area.
13. Be proactive and planning-based.	Yes.	Application of the methodology into a planning framework where development thresholds are specified will help take a proactive stance on development impacts.
14. Have government leadership.	Yes.	It is recommended that a government agency, such as Parks Canada in this case, be the initiator of the various methodology applications, so long as some degree of continuity over time may be ensured.
15. Identify land use objectives and thresholds.	Yes.	The establishment of development thresholds and limits of acceptable change are integral to the planning application of the proposed methodology.
16. Link planning with environmental assessments.	Yes.	The proposed methodology may be applied directly in CEAs, as discussed in section 6.1, and may link EA with planning through establishing development thresholds.

6.4 RESEARCH CONTRIBUTIONS

In this thesis, a proposed methodology for determining areas of concern for regional cumulative impact assessment with applications in regional planning and CEA has been developed. A pilot application of this methodology was also carried out in the Greater Kluane Region of southwest Yukon. Although there are certainly other existing methods for dealing with planning issues and CEAs around parks, the research presented in this thesis is unique both in its focus on future applications with planning for cumulative effects, and in its treatment of social and ecological values.

For instance, the ABC resource survey method was designed in the mid 1980's with the primary purpose of identifying environmentally significant areas in Yukon, although the concept is generally applicable to all park and reserve planning in other "unaltered areas" (Bastedo, 1986). The methodology proposed in this thesis has some similarities with this resource survey, mostly with respect to the integration of abiotic, biotic, and cultural data, the encouragement of taking a proactive planning stance, and the incorporation of structural and functional attributes. Both approaches also have planning applications, but the planning foci are quite different. Planning applications of the ABC approach mostly involve establishing park and reserve boundaries, whereas the planning focus of methodology in this thesis involves setting development thresholds to limit CEEs in and around existing parks and reserves. The spatial scale of the individual case studies in the ABC approach is also quite localized, and hence data can be collected in great detail through field surveys and satellite images. Conversely, the methodology proposed in this thesis works over considerably larger distances, using more generalized data found in the existing literature. In the same way, abiotic, biotic and cultural significance were determined through a detailed procedure in the ABC method, whereas the methodology proposed in this thesis took a more general approach by focusing on the spatial distribution of social and ecological values.

This treatment of values is another unique aspect of the proposed methodology. As was discussed in section 6.1, the methodology results in a large database of values which can act as the basis for selecting the VECs/VSCs most susceptible to development impacts when carrying out CEAs in or around the park.

6.5 FUTURE RESEARCH

A few areas of potential future research may be identified. First, more research is required on how to determine, set, and enforce development thresholds and limits of acceptable change, as these concepts are central to effective proactive planning. For instance, if inappropriate thresholds are set and environmental impacts arise in spite of the thresholds, the opportunity for proactive planning is lost and management is forced to take a potentially more costly reactive approach. Thresholds and limits of acceptable change are also important when dealing with CEEs, as setting and enforcing land use limits before future proposals arise will help keep spatial and temporal overlaps to a minimum. Using development thresholds and limits of acceptable change will also help achieve a better integration of environmental assessments and planning exercises.

More research also needs to be carried out on regional CEAs. In particular, a stronger link needs to be made between regional planning and CEAs so that impacts of planned projects will be considered in a regional perspective. CEAs also need to be better integrated into regional visions or objectives so that proposed developments will only be allowed to proceed if their goals are aligned with the regional vision. Indeed, these were both weaknesses associated with the CEA frameworks reviewed in Chapter 2.

6.6 THESIS GOALS AND OBJECTIVES REVISITED

Recall that three main goals were established for this thesis: (1) develop a methodology to be used for proactive planning to minimize cumulative environmental effects in and around northern national parks; (2) test the method through a case study; and (3) discuss some potential applications of the methodology in regional planning exercises and cumulative effects assessments.

Throughout the course of this thesis, a methodology was successfully developed based on an extensive literature review of the four thesis themes (goal 1, objective i). The methodology was then tested in the Greater Kluane Region, resulting in the identification of social and ecological values, and the creation of a series of summary maps and tables (goal 2, objectives i and ii). The potential application of the methodology in regional land use planning exercises and cumulative effects assessments was then discussed, followed by a discussion of the implications of the case study (goal 3, objectives i, ii and iii). The methodology was then evaluated based on a series of guiding principles derived from the literature review (goal 1, objective ii and goal 3, objective iv). All thesis goals and objectives established in Chapter 1 have therefore been successfully met.

6.7 CONCLUDING REMARKS

Both the Panel on the Ecological Integrity of Canada's National Parks and the 1997 State of the Parks Report have acknowledge that the ecological integrity of Canada's national parks is becoming increasingly at risk due to cumulative environmental effects (PEICNP, 2000; Parks

Canada, 1998). However, northern parks are currently at an exciting stage where CEEs, although impending, have not yet had major impacts.

Northern parks are therefore at a divide where managers have two options. They may choose to address environmental impacts as they arise and risk overlooking individually minor but collectively significant effects. These effects will ultimately lead to the inevitable degradation of ecological integrity in both the park and surrounding areas. Alternatively, managers may choose to be proactive by implementing regional plans which focus on setting development thresholds to limit commercial development of areas of greatest social and ecological value. This will provide better protection of the matrix to which park ecological integrity is intricately linked, thereby ensuring that Canada's northern parks will continue to protect pieces of Canada's natural heritage for future generations.

APPENDIX 1 - SOCIAL AND ECOLOGICAL VALUES OF THE GREATER KLUANE REGION

Table A1.1 - Social Values

Social Values	Key Locations	Sources
Subsistence Moose Harvest	- Haines and Alaska highway corridors, Dezadeash Lake area, Kloo Lake-Silver City area, E and NE of Aishihik Lake, Hutshi Lake, Takhanne River, Klukshu River - Tchawsahmon Lake valley near White River; Nisling River valley; Harzbutgite Peak area, Creek Valley N of Snag Creek, E of Snag Creek. towards White River, White River S of Snag - mountains NW of village, across Sekulmun River on mountains to S, N of Aishihik Lake, Sekulmun River wetlands, N end of Sekulmun Lake, W of Aishihik Lake, along road between Dze and 27-Mile campground and in mountains, cow moose in creek area between 27-Mile Campground and Chemi Village, good summer cow/calf habitat along Aishihik River	- Jingfors 1990 - TransNorthern Consulting, 1993 - Allen, 1996
Caribou Subsistence Harvest	- Chisana herd around Wellesley Lake in winter and E of Snag and on pond 1 km N of Dry Creek; 40-mile herd on Ladue River S to Yukon River; Klaza herd NW along Dawson Range to Coffee Creek and Mount Cockfield and headwaters of Nisling River (including Klotassin Creek and Klaza River). Traditional knowledge maps also show along Snag Creek. - mountains NW of village, across Sekulmun River on mountains to S, N of Aishihik Lake, Sekulmun River wetlands, N end of Sekulmun Lake, E of Aishihik Lake near mountains in Long Lake area, during migration across Aishihik Lake to grazing grounds near Long Lake in spring, and N and W between Soldiers Bay and 55-Mile to rutting grounds in fall	- TransNorthern Consulting, 1993 - Allen, 1996
Dall Sheep Subsistence Harvest	- Dawson Range near Mount MacLennan, Nutzotin Mountains on ridges on either side of Tchawsahmon Lakes.	- TransNorthern Consulting, 1993

Waterfowl Subsistence Harvest	- bay and lagoon adjacent to Aishihik Village, Stevens, Polecat, Steamboat, Popular, 50-Mile, Duck and Martens Lakes, Soldiers Bay, 2 small bays at Miles 48 and 60, along ponds and lakes on both sides of road, Hopkins and Lacelle Lake, Aishihik Lake, near 27-mile Campground, along 27-mile creek and pond area, Otter Lake, in front of Chemi Village, along creek between 27-mile Campground and Chemi Village, Otter Pond, Aishihik River from road	- Allen, 1996
Whitefish Subsistence Harvest	- spawn: Snag creek and highway, Donjek River and highway, Halfbreed Creek between Duke River and highway; winter: Beaver Creek and highway, White River near Koidern Mountain, White River at lower canyon, Koidern River near highway and Grafe Creek, Swede Johnson Creek and highway, Brooks Arm, Christmas Bay; spawn and winter: N Wellesley Lake, Pickhandle Lake complex, Longs Creek and Koidern River, Wolf Creek and Koidern River, Tchawsahmon Lake, Lake Creek area, Toshingermann Lakes, S tip of Tincup Lake, Kluane Lake N of Jacquot Island - large native whitefish net fishing at N Dezadeash Lake every spring; also harvested from Klukshu Lake; cyest-free at Polecat and Stevens Lakes - Enger Lakes, Kluane Lake - spawn in E Aishihik River or Giltana Creek, N end of AishihikLake (along NW shore halfway between Aishihik Village and Coronation Point, the W shore, S of Sekulmun River, in Sekulmun River at lake outlet, Albert Creek, Dze to S of Aishihik Lake, Tusho Creek, and the E shore); fall/early winter near N endof Seklumun River complex	- TransNorthern Consulting, 1993 - Joe, 1990 - FPL, 1979 - North/South Consultants, 1998
Lake trout Subsistence Harvest	- spawn: Halfbreed Creek Between Duke River & highway; winter: Koidern River near highway and Grafe Creek, Christmas Bay; spawn and winter: Wolf creek & Koidern River, Tchawsahmon Lake, Toshingermann Lakes, S tip of Tincup Lake, Kluane Lake N of Jacquot Island - Klukshu Lake - migrate between Aishihik and Sekulmun Lakes; spawn in both lakes particularly at N shore of Aishihik Lake (E of Coronation Pt), Soldiers Bay and Tusho Cr	- TransNorthern Consulting , 1993 - Joe, 1990 - North/South Consultants, 1998
	- Klukshu Lake	- Joe, 1990

Rainbow trout Subsistence Harvest		
Arctic grayling Subsistence Harvest	- Winter at Snag Creek and Alaska highway, Quill Creek and highway, Burwash Creek and highway; spawn at Beaver Creek and Alaska Highway, Sanpere Creek near White River, White River at lower canyon, Donjek River and highway; spawn and winter at N Wellesley Lake, White River near Koidern Mountain, Pickhandle Lake complex, Longs Creek and Koidern River, Wolf Creek and Koidern River, Tchawsahmon Lake, Koidern River near highway and Grafe Creek, Lake Creek area, S tip of Tincup Lake, Swede Johnson Creek and highway, Brooks Arm, Kluane Lake N of Jacquot Island, Christmas Bay. - Enger lakes, Swede Johnson Creek, Kluane Lake - spawn in E Aishihik River or Giltana Creek, important area in upper Sekulmun River, Tsusho Creek, 60-mile Creek, and other creeks; migrate from Sekulmun Lake to Sekulmun River	- TransNorthern Consulting, 1993 - FPL, 1979 - North/South Consultants, 1998
Salmon Subsistence Harvest	- Chum: spawning at Yukon River between Ballrat Creek and Britania Creek, Wellesley Creek (E of Lake), Nisling River South of Donjek River branch, White River at lower canyon, Donjek River and highway, Duke River near Squirrel Creek; spawn and winter at White River near Koidern Mountain, Koidern River near highway and Grafe Creek, S tip of Tincup Lake, Swede Johnson Creek & highway, Quill Creek and highway, Burwash Creek and highway, Brooks Arm, Kluane Lake N of Jacquot Island, Christmas Bay; Chinook spawn: Donjek River and highway ; winter: White River at lower canyon, Brooks Arm; spawn and overwinter at White River near Koidern Mountain; - Kloo Lake class 1 salmonid spawning area; Klukshu also good spawning and habitat; Tatshenshini system - Swede Johnson creek (chum and chinook), Kluane Lake (Chum)	- TransNorthern Consulting, 1993 - Joe, 1990 - FPL, 1979
Burbot Subsistence Harvest	- spawn: Donjek River and highway; winter: White River at lower canyon, Brooks Arm ; spawn and winter: Pickhandle Lake complex, Koidern River near highway and Grafe Creek, Kluane Lake N of Jacquot Island - Klukshu Lake	- TransNorthern Consulting, 1993 - Joe, 1990 - North/South

	- N half of Aishihik Lake and Sekulmun River	Consultants, 1998
Northern Pike Subsistence Harvest	- winter: Koidern River near highway and Grafe Creek, Brooks Arm, Christmas Bay ; spawn and winter: Pickhandle Lake complex, Lake Creek area, Toshingermann Lakes, Kluane Lake N of Jacquot Island - Enger Lakes, Kluane L - Spawn in Sekulmun River and ponds, ponds and wetlands in Tsusho Creek area, margin in front of Aishihik village and near mouth of Sekulmun River and N end; nursery at Sekulmun River wetlands, shallow bays, creek mouths of N end, Soldiers Bay and Tusho wetlands	- TransNorthern Consulting, 1993 - FPL, 1979 - North/South Consultants, 1998
General food fishing lakes and rivers	- Dezadeash, Six-mile, Frederick, Aishihik, Sekulmun, Canyon, Moraine, Pine, Kloo, Braeburn, Long, Hutshi, Klukshu, Kloo, Kusawa, Jo-Jo,and Taye Lakes, Aishihik, Dezadeash, Jarvis, and Takhini Rivers - Indian Fook Fishery on Kluane, Kloo, Pine, Dezadeash (limited), and Klukshu Lakes, Kluane and Klukshu Rivers, and Swede Johnson Creek - Teslin, Tagish, Little Atlin, Aishihik, Dezadeash, Kluane Lakes for Whitefish and Lake Trout; Alsek and Yukon River drainages for salmon - camps at N of Aishihik Lake, along Sekulmun River and Lake(N end), on Stephens Lake and adjoining lakes; main camps used are 60-mile (soldiers bay), 48-mile, Dze, and camps along Sekulmun River; ice fish in bay and along N shore of Aishihik Lake near Village, at N of lake, mouth of Sekulmun River and along NE shore of Sekulmun Lake, at N of Sekulmun Lake and at mouth of Albert Creek	- Joe, 1990 - Reid Crowthers & Partners, 1982 - Tompkins, 1996 - Allen, 1996
Lynx Subsistence Harvest	- White River near Mount Baker, E of Wellesley Lake, Onion Creek, - Aishihik Village area and Sekulmun River wetlands, Soldiers Bay to Big Tree Creek, Dze to 27-Mi Campground, River/creek area between 27-Mi campground and Chemi Village site, Sekulmun Lake	- TransNorthern Consulting, 1993 - Allen, 1996
Marten Subsistence Harvest	- White River near Mount Baker	- TransNorthern Consulting, 1993

Wolverine Subsistence Harvest	- Aishihik Village area and Sekulmun River wetlands, Soldiers Bay to Big Tree Creek, Dze to 27-Mi Campground, River/creek area between 27-Mi campground and Chemi Village site, Sekulmun Lake	- Allen, 1996
Wolf Subsistence Harvest	- Aishihik Village area amd Sekulmun River wetlands, Soldiers Bay to Big Tree Creek, Dze to 27-Mi Campground, River/creek area between 27-Mi campground and Chemi Village site, Sekulmun Lake	- Allen, 1996
Fox Subsistence Harvest	- Wellesley Lake (S), Onion Creek, - loess deposits of Slims and Donjek - Aishihik Village area and Sekulmun River wetlands, Soldiers Bay to Big Tree Creek, Dze to 27-Mi Campground, River/creek area between 27-Mi campground and Chemi Village site, Sekulmun Lake	- TransNorthern Consulting, 1993 - Blood and Associates, 1975 - Allen, 1996
Otter, mink. beaver, and muskrat harvest	- N and S Wellesley Lake, Onion Creek, - otter in salmon-bearing streams - Dezadeash wetlands, Alder creek valley, Mush-Bates area, Alsek - Mendenhall River from near Champagne to Takhini River, Enger Lakes, Pickhandle Lakes - N end of Otter Lake, 27 mile creek, and creek between Aishihik and Otter Lake - muskrat and beaver at Sekulmun River wetlands, Polecat Lakes, Otter Lake (S) and Pond, along Aishihik River and wetlands, at ponds at S of Sekulmun Lake; muskrat from turnoff to 27-mile campground to Giltana Lake and up swamps to 30 mile on Aishihik Road, river/creek area between 27-mi campground and Chemi Village, Otter Lake (S) and Pond; beavers along Aishihik Road (Lacella and Hopkins Lakes), Giltana Lake, and up to 30-Mi on Aishihik Road.; otter Soldiers Bay to Big Tree Creek, N end of Otter Lake to 27-Mi creek and the creek between Aishihik Lake and Otter Lake (highly productive Otter habitat), Otter Lake and creek, Aishihik River and wetlands.	- TransNorthern Consulting, 1993 - DRR, 1989 - Blood and Associates, 1975 - FPL, 1978 - Schmidt Environmental Consulting, 1998 - Allen, 1996

Chinook Salmon Sport Fishing Areas and General Habitat	- migrate Donjek River south of highway; spawn Takhini River near Kusawa Lake, Takhanne River; spawn and rear Tatshenshini River, Village Creek, Blanchard River; spawn, rear and winter Klukshu Lake and River - Klukshu, Blanchard and Takhanne Rivers for migration and spawning; also in Koidern River, Tincup Creek, Takhini and Nordenskiold drainages; Dalton Post - Takhini River, Tatchun Creek, Tatshenshini River and tributaries - migrate at lower White River to Kluane River and lower Donjek, and up Takhini River; high spawning potential at Koidern; spawn at Kluane River outlet, Tincup creek, Kusawa Lake outlet to Takhini River and near confluence with Yukon River - spawning at Nisling River, Tincup Creek and Kluane River - spawn at Tatshenshini headwaters, upper Tatshenshini, Klukshu, Blanchard, Takhanne, Lowfog, Goat and Village Creek drainages, Onion, Klukshu, Neskataheen and Blanchard Lakes - winter Mendenhall River, Takhini River; migrate Takhini River; spawn Takhini, Grafe Creek - spawning in Klukshu River and Lake, at confluence of Tatshenshini and Takhanne, and along Takhanne River; in Village Creek and Nesketaheen Lake and Blanchard River - spawning, rearing and migration at White River and highway, Donjek River and highway, Klukshu River, overwinter at Klukshu Lake	- EKPA, 1982 - deGraff and McEwen, 1989 - Howard Paish & Associates, 1981 - FPL, 1977 - FWGP, 1984 - Peepre & Assoc. , 1993 - FPL, 1981 - Hancock and Marshall, 1984 - DPW, 1977
Chum Salmon Sport Fishing Areas and General Habitat	- migrate Donjek River south of highway; spawn Kluane River from lake outlet to Swede Johnson Creek, Central Kluane Lake, - Donjek River, White River, Kluane River, Swede Johnson Creek, Duke Creek, Burwash Creek, Kluane Lake, Christmas and Cultus Creeks, Nissling River, Koidern River - spawn in White River, Koidern River, Donjek River, and Duke River - migrate up White/Donjek to Kluane River, Koidern River; spawn in Kluane Lake (at Slims mouth, Christmas Bay, Burwash Lake, SW shore from Destruction Bay to outlet, near NE shore between Long Point and Cultus Creek), Koidern River (downstream of Edith and Lake Creek), White River (at Miles Creek), Duke River mouth, and Kluane River (at lake outlet and Swede Johnson creek and Quill creek).	- EKPA, 1982 - deGraff and McEwen, 1989 - Beak, 1976 - FPL, 1977 - Peepre and Assoc., 1993 - FPL, 1979 - FPL, 1981 - Hancock and Marshall, 1984 - Archer, Cathro & Assoc.,

	- spawn at Tatshenshini headwaters, upper Tatshenshini, Klukshu, Blanchard, Takhanne, Lowfog, Goat and Village Creek drainages, Onion, Klukshu, Neskataheen and Blanchard lakes - migrate White, Koidern, Donjek, Kluane Rivers, Kluane Lake; spawn Koidern River (2km downstream of 3rd pipeline crossing), Kluane River (at Swede Johnson and Quill Creek and Burwash Creek and Duke River confluence) - migrate White, Koidern, and Kluane Rivers; spawn Koidern River, Swede Johnson Creeik, Quill Creek, Burwash Creek, Duke River - Taku River - spawning areas identified along Kluane River at Swede Johnson mouth, on E shore just N of Swede-Johnson Creek, on W shore along highway section between Swede-Johnson Creek and Quill Creek, on E bank N of Quill Creek, and on W bank between Quill Creek and Burwash Flats - spawning, rearing and migration at White River and highway, Koidern River at highway, Donjek River and highway; spawning at Kluane River near Quill Creek, Duke River near Brooks Arm,	1988 - DPW, 1977
Coho Salmon Sport Fishing Areas and General Habitat	- spawn, rear and winter Klukshu Lake and River; spawn and rear Tatshenshini River - Dalton Post - Klukshu River and Lake, Takhanne River (up to falls), Taku River, Village Creek and Neskataheen Lake - spawning, rearing and migration at Klukshu River, overwinter at Klukshu Lake,	- EKPA, 1982 - deGraff and McEwen, 1989 - Hancock and Marshall, 1984 - DPW, 1977
Sockeye Salmon Sport Fishing Areas and General Habitat	- spawn, rear and winter Klukshu Lake and River; spawn and rear Tatshenshini River; migration, spawn and rear Nesketaheen Lake, Village Creek - spawning in Tatshenshini, Blanchard, Takhanne, and Klukshu Rivers, Nesketaheen Lake; Dalton Post - spawn at Tatshenshini headwaters, upper Tatshenshini, Klukshu, Blanchard, Takhanne, Lowfog, Goat and Village Creek drainages, Onion, Klukshu, Neskataheen and Blanchard Lakes - Klukshu River and Lake, Taku River, Blanchard River, spawning on Takhanne River up to falls and along NE shore of Nesketaheen Lake and where Kane Creek and Village Creek split.	- EKPA, 1982 - deGraff and McEwen, 1989 - Peepre & Assoc., 1993 - Hancock and Marshall, 1984 - DPW, 1977

	- spawning, rearing and migration at Klukshu River, overwinter at Klukshu Lake	
Lake Trout Sport Fishing Areas and General Habitat	- spawn central, SW and S Kluane Lake, Pine Lake, Kathleen River, Dezadeash Lake, - Wellesley Lake - summer at Kluane Lake, Slims River, Takhini River, Louise Lake; fall at Kluane Lake, Louise Lake; spawn in Kluane Lake on S shore between Burwash Landing and Christmas Bay, near Slims delta and island, and near Congdon Creek, Long Point and between Long Point and Cultus Creek; also at mouth of Halfbred Creek and SE lake near Slims River - but no spawning. - scarce at upper Aishihik River major flow areas - Onion, Neskataheen, Stella, Pringle, Klukshu and Blanchard Lakes - winter Kluane Lake, Takhini River; spawn Halfbreed Creek, Kluane Lake - Harrison Lake, 37-Mile Lake, Rose Lake, Jo-Jo Creek and Lake, Takhini Lake	- EKPA, 1982 - Howard Paish & Associates, 1981 - FPL, 1977 - Peepre & Associates, 1993 - FPL, 1979 - FPL, 1981 - Brown *et al.*, 1976
Arctic Grayling Sport Fishing Areas and General Habitat	- spawn, rear and winter Christmas Creek, Jarvis River near Kloo Lake - Jarvis Creek spring run - spawning at Koidern River, Beaver Creek, Edith Creek, Donjek River, Lake Creek, Jarvis River, Marshall Creek, Aishihik River; migrate Swede Johnson Creek, Fox Creek, White River, Koidern River, Donjek River, Takhini River Creek, Fox Creek, White River, Koidern River, Donjek River, Takhini River - Migration at Unnamed creek at Mile 37.8; spawn and rear at Swede Johnson Creek - spawning at inflow of Canyon Pool and lower area of Giltana Creek and upper Aishihik River, and above Otter Falls; migrate through Upper Aishihik River; rearing at Canyon Pond, Giltana Creek and adjacent ponds. - migrate in Beaver and Jarvis Creeks (extensive), Unnamed Creek at km 60.5, Koidern River, Donjek River, Swede Johnson Creek, Yukon River, White River, (moderate); spawning extensive in Beaver Creek, Koidern River (below proposed crossing), Jarvis River, moderate in Unnamed creek (60.5), Koidern River (at and above crossing), Donjek River (above crossing), marshall creek (at and below crossing); overwinter in White, Koidern, Donjek, Duke and Kluane Rivers. - winter in Mirror Creek, Snag Creek, White River, Koidern River, Donjek River, Duke River, Kluane Lake, Jarvis River, Marshall Creek, Aishihik River, Mendenhall River, Takhini River; migrate up Beaver Creek, Unnamed Creeks at	- EKPA, 1982 - Howard Paish & Associates, 1981 - Northern Nat. Res. Services, 1977 - Beak, 1977 - Walker & Brown, 1974 - FPL, 1979 - FPL, 1981 - Brown *et al.*, 1976 - DPW, 1977

	60.97, 81.36, and 380.93 kms, Koidern River, Donjek River, Jarvis River, Marshall Creek; spawn in Beaver Creek, Enger Creek, Unnamed Creeks at 60.97,81.36, and 380.93 kms, Koidern River, Donjek River, Jarvis River, Marshall Creek - Kusawa Lake, Takhini River, Harrison Lake, 37-mile Lake, Primrose River and Lake, Rose Lake, Jo-Jo Creek and Lake, and Takhini Lake - spawning and rearing at Beaver Creek/Alaska Highway junction, Koidern River near highway; spawning, rearing, overwinter and migration at White River and highway, Donjek River and highway; rearing and migration at Kluane River near Swede-Johnson Creek and Quill Creek, Christmas Creek and highway, and at Dezadeash River near Haines Junction.	
Northern Pike Sport Fishing Areas and General Habitat	- weedy areas of E side of Canyon Pond and lowermost 50 feet of Giltana Ceek - Kusawa Lake, Taye Lake, Kluane, Aishihik, Dezadeash, Klukshu, Kusawa, and Pine Lakes, Dezadeash, Kathleen, Koidern, and Jarvis Rivers, Wellesley and Frederick Lakes	- Walker and Brown, 1974 - Brown *et al.*, 1976
General Sport Fishing Areas	- Swede Johnson, Marshall, Pine, Halfbreed (limited), and Christmas Creeks, Kluane and Dezadeash Rivers (limited), Jarvis, Klukshu, Tatshenshini, Blanchard, Takhanne, Kathleen, Aishihik, and Takhini Rivers, Kathleen, Moraine, Frederick, Klukshu, Stella, Dezadeash, and Pine Lakes	- EKPA, 1982
Big game outfitting	** No location-specific data available **	
Wildlife Viewing and Photography	- Tatshenshini River, Dalton Post (bear, salmon), Million Dollar Falls, Klukshu Lake (salmon), Stony Creek (elk), Alsek Pass, Mount Decoeli, Telluride Creek, Pickhandle Lakes (migratory birds), Dezadeash River, Burwash Uplands, Duke River, Wellgreen/Nickel Creek, Kluane River, Talbot Arm - BIRDS: Mush-Bates, Alder creek wetland, Dezadeash area, Alsek River shorelines, Bullion Plateau, Obsertvation Mountain, lower canyons of Duke (raptors), Donjek valley (raptors), and Burwash Uplands (shorebirds) - spawning fish at Klukshu/Takhanne River, grizzly at Takhanne, Blanchard and Klukshu Rivers, birds in Shakwak valley - Pickhandle Lakes (waterfowl, furbearers), Donjek River, Kluane and Klukshu	- DRR, 1990 - Blood and Associates, 1975 - Peepre & Assoc., 1993 - Henderson, 1987 - Crane Management - Yukon Wild, 1995

	Rivers (bear), Koidern Mountain (sheep, goats to S), Kluane River at Highway 1 (eagle, salmon, wolverine), Kluane Lake North (waterfowl), Kathleen Lake and Kusasa Lake (wolf), Burwash Uplands (woodland caribou), Sheep Mountain (sheep), Strong Creek (elk), Haines Road, Dezadeash River - prime viewing of spring bears at Slims/Alsek valleys and Donjek River and Kluane River, Dall sheep at Sheep Mountain, waterfowl at Koidern, raptors along river corridor - Pine Lake Campground (black bear), Alsek River (grizzly, sheep, goats), Dalton Post (grizzly), Kluane River overlook (grizzly, moose), Kusawa Lake campground (grizzly, sheep), Tatshenshini (grizzly), Sheep Mountain (sheep), Dezadeash Lake Trail (moose, waterfowl, shorebirds), Aishihik Lake Campground (raptors, waterfowl, shorebirds, wood bison), Pickhandle Lakes (raptors, muskrat), Sulpuhur Lake (raptors, waterfowl, shorebirds), Takhini River valley (raptors, elk, mule deer), Kathleen River (waterfowl, shorebirds), Klukshu wetland overlook (waterfowl, shorebirds).	
Aesthetics of large tracts of undisturbed wilderness	- Burwash Uplands, Duke River, Jo-Jo Lake, Telluride creek, - Alsek range, Wolverine Creek area	- DRR, 1990 - Peepre and Assoc., 1993
Cultural/heritage appreciation sites	- Klukshu Lake, Silver City, Dalton Post, Aishihik Falls/Canyon Creek, Outpost Mountain, Airdrop/Hoodoo mountains - HISTORIC SITES at: Aishihik Village, Bear Creek, Beloud Post, Bullion City, Burwash Landing, Canyon, Canyon City, Champagne, Cultus creek, Dalton Post/Neskatahin, Destruction Bay, Dezadeash River outlet, Donjek city, Dry creek, Duke meadows, Dutch Harbour, Hutshi Lakes, Isaac Creek, Kloo Lake, Kluane/Silver City, Klukshu River, Quill Creek, Lynx City, Mendenhall Landing, Lake Creek, Snag, Steamboat Landing, Enger Lakes, and Wellesley Lake; PREHISTORIC SITES at Kluane Lake outlet, Gladstone Creek mouth, Cultus Creek mouth, Christmas Bay, N end of Aishihik and Sekulmun Lakes, S end of Aishihik and Sekulmun Lake, Otter Falls, Canyon, Taye Lake, Champagne, Middle Ibex River drainage, N end of Kusawa Lake, Kusawa Lake at narrows above Primrose River and W shore just E of Frederick Lake; RAW MATERIAL SOURCES at Klestan Creek, Tatamagouche Creek, Mush Lake, Airdrop Lake, and	- DRR, 1990 - Gotthardt, 1989 - Greer, 1998

	Kaskawulsh/Dusty River. - Aishihik River/Canyon/ Alaska highway area, Otter Falls/Canyon Lake/Aishihk River, Aishihik River/Canyon Lake/Aishihik Road, Chemi Narrows/Aishihik Campground/ Hopkins Lake/ Aishihik Road, S end of Aishihik Lake/Chemi Narrows, S end of Sekulmun Lake, Aishihik Road/ E of Aishihik Lake, middle of Aishihik Lake, middle of Aishihik Lake/Lister Creek, middle of Sekulmun Lake/Isaac Creek, N Aishihik Lake/Soldiers Bay, N end Aishihik Lake/Aishihik Village/ Aishihik airport, N end Sekulmun Lake/Tahgah River/AishihikVillage **N end Aishihik Lake and Chemi Narrows area; key sites in Yukon Archeological Research include: Airdrop Lake, Kusawa Bluff at N Kusawa Lake, Annie Lake, Taye Lake, Otter Falls, Canyon, Chemi, Gladstone, Little Arm, and around Snag	
Sites of Scientific Value	- International Biological Programme sites at Sheep Mountain/Mount Wallace, Mount Archibald/Decoeli, Koidern River area, Klutlan glacier area, Lowell glacier, Kaskawulsh glacier, Aishihik Lake - Heritage Rivers: Alsek and Tatshenshini - Special Preservation Areas at Airdrop/Hoodoo Mountian, Steel Creek, Mount Hoge/Donjek valley, Duke River headwaters, Slims River delta, Alsek valley, Shaft Creek, Fraser Creek fen, Goatherd Mountain, Lower Alsek valley, Logan Nunatak, Bullion Creek dunes, Sheep Mountain (loess-steppes), Sockeye Lake and River, and Bates Lake Island - Environmentally Significant Areas at Kusawa Lake, Primrose River, Dalton Post, Mount Cairnes, Aishihik Lake, Kluane North, and Nisling River.	- Beckel, 1975 - Parks Canada, 1984 - Parks Canada, 1980 - Theberge *et al.*, 1982
Sites of educational and/or interpretive value	- Kathleen River (canoe instruction)	- DRR, 1990
Canoeing rivers/lakes	- Tatshenshini River, Quill Creek, Dezadeash River, Rainbow Lakes, Takhini River, Jarvis Creek, Kluane Lake, Kathleen River	- DRR, 1990
Kayaking and rafting rivers/lakes	- Tatshenshini River, Quill Creek, Takhanne River, Jarvis creek, Primrose River, Primrose River	- DRR, 1990

Motor boating lakes	- Dalton Post, Dezadeash Lake, Rainbow Lakes, Kusawa Lake, Pine Lake, Kluane Lake, Aishihik Lake	- DRR, 1990
Hiking trails	- Haines Road, Dezadeash Lake, Dalton Post, Million Dollar Falls, Kusawa Lake, Pine Lake, Takhini River, Aishihik Lake road, Paint Mountain, Mount Decoeli, Silver City, Telluride Creek, Silver creek/Outpost Mountain, Burwash Uplands, Archibald Mountain, Ruby Range	- DRR, 1990
Horseback riding	- Koidern River, Dalton Trail	- DRR, 1990
Biking trails/roads	- Aishihik Lake road, Old Alaska Highway, E side of Kluane Lake (Ruby Ranges), Telluride Creek,	- DRR, 1990
Mountaineering	- Telluride Creek, Mount Hoge, Mount Cairnes, Mount Logan, Mount St- Elias	- DRR, 1990
Nature appreciation sites	- Champagne (giant esker), Million Dollar Falls (waterfall viewing), Otter Falls (waterfall viewing), Aishihik Falls/Canyon Creek (waterfall viewing)	- DRR, 1990
Fishing rivers/lakes	- Haines Road, Dezadeash Lake and River, Dalton Post, Million Dollar Falls, Klukshu Lake, Tatshenshini River, Pringle and Stella Lakes, Takhanne River, Rainbow Lakes, Kusawa Lake, Pine Lake, Takhini River, Moraine Lake, Mendenhall and Marshall Creeks, Aishihik Lake, Enger Lakes, Hungry Lake, E side of Kluane Lake (Ruby Ranges), Kluane Lake, Kluane River, Mystery Lake, Pickhandle Lakes, Koidern River, Kathleen River bridge, Jarvis Creek, Hungry Lake - remote fishing at DogPack, Frederick, Jo-Jo, Long, Nesketaheen, Sekulmun, Wellesley, Six-mile, Teepee, Tincup, Tchawsahmon, Toshingermann, and Stevens Lakes - Enger Lakes, Kluane Lake, Christmas Creek, Jarvis River, Pine Lake, Marshall Creek, Dezadeash River, Mendenhall River, Takhini River	- DRR, 1990 - deGraff and McEwen, 1989 - FPL, 1979
Hunting corridors	- Dezadeash Lake (bear), Dezadeash River, Takhanne River (spring bears, fall moose), Thirty-seven mile creek, Moraine Lake, Paint Mountain, Enger Lakes (duck), E side of Kluane Lake (Ruby Ranges), Kluane River, Mystery Lake,	- DRR, 1990

	Pickhandle Lakes, Snag Road (grouse), Granite Lake road, Taye Lake, Aishihik Lake Road, Sekulmun Lake, July and McKinley Creeks, Kloo Lake, Garnet Creek, Duke River flats, Koidern River	
Camping sites	- Million Dollar Falls*, Pine Lake*, Mendenhall and Marshall Creeks, Aishihik Lake road, Enger Lakes, Silver City, E side of Kluane Lake (Ruby Ranges), Takhini River, Haines Road, Dezadeash Lake*, Dalton Post, Tatshenshini River, Kusawa Lake, Takhini River, Kluane Lake, Aishihik Falls/Canyon Creek, Jarvis Creek, Horseshoe bay/Dutch Harbor, Congdon Creek*, Lake creek*, Snag Junction, - * = most popular; Informal nights at Dalton Post, Klukshu village, Kathleen Riverbridge, Donjek River bridge, Kluane Lake pulloffs	- DRR, 1990 - DRR, 1989b
XC ski trails	- Dezadeash Lake, Mount Decoeli, Old Alaska Highway, Silver creek/Outpost mountain, Kluane Lake, Burwash Uplands, Duke River, Telluride creek, Klutlan glacier	- DRR, 1990
Snowmobiling and dog mushing routes	- Haines Road, Dezadeash Lake, Mount Decoeli, Old Alaska Highway, Silver Creek/Outpost Mountain, Kluane Lake, Burwash Uplands, Duke River, Telluride Creek, Klutlan glacier,	- DRR, 1990
Ice fishing lakes	- Kloo, Kluane, Pine, Rainbow and Wellesley Lakes - Tchawsahmon Lake	- DRR, 1990 - deGraff and McEwen, 1989

Table A1.2 - Ecological Values

Ecological Values		Key Locations	Sources
Rare, endangered, unique geo-morphology	Loess steppes	- Sheep Mountain/Mount Wallace, Kaskawulsh glacier	- Hegmann, 1995
	Sand dunes	- Bullion creek, Neoglacial Lake Alsek	- Hegmann, 1995

	Badlands	- Burwash Uplands	- Theberge & Oosenbrug, 1975
	Canyons		
	Other	- Slims River delta, icefield nunataks - thundereggs of Archibald Creek, - Kaskawulsh River flats, rock glaciers	- Hegmann, 1995 - Axys and Inukshuk, 1996 - Natural Resource Consservation, 1991
Hydrology features	Groundwater	- White River and Koidern River confluence	- Northern Natural Resource Services, 1977
	Headwaters	- Klukwan River and Chilkat River (salmon & eagles) - Duke River headwaters (rare plants) - Upper Tatshenshini River (key water recreation access point)	- Synergy, 1974 - Hegmann, 1995; Sachmidt, 1996 DRR, 1989b
	Waterfalls	- waterfall resources at upper and lower canyons on Tatshenshini River, and Million Dollar Falls; upper Tatshenshini River and tributaries have region/territorial significant salmon habitat	- Peepre and Associates, 1993
	Critical for Fish Habitat	- Fish overwintering in White, Koidern, Donjek, Duke, Kluane Rivers, Snag, Wolf and Swede Johnson Creeks due to underground source or open area - Fish overwintering potential at Stonehouse Creek, Clear Creek, Goat Creek, Takhanne River, Kwatini Creek, Unnamed creeks at 201.1km, 213.6km, 217.9km, 218.8km - Upper Tatshenshini River and tributaries have region/territorial significant salmon habitat - critical fish habitat in Koidern, Takhini, White, and Kluane Rivers	- Beak, 1977 - Olmsted *et al.*, 1979 - Peepre & Assoc., 1993 - Beak, 1978
	Ice-free areas	- North Kluane Lake/ Brooks Arm	- Nixon, 1989
	General	- Alsek River, Slims River delta - Kaskawulsh River	- Hegmann, 1995 - Natural Resource Conservation, 1991

Kokanee Salmon (endemic)	- winter Rainbow Lake; spawn and rear Kathleen River; spawn Frederick Lake - Kathleen and Sockeye Lakes	- EKPA, 1982 - Hegmann, 1995
Squanga Whitefish (vulnerable)	- Vulnerable in Yukon Territory - Dezadeash Lake	- Schmidt, 1996 - deGraff and McEwen, 1989
Rainbow Trout (endemic)	- winter Rainbow L; spawn and rear Kathleen River	- EKPA, 1982; Schmidt, 1996
Grizzly Bear (vulnerable)	- critical summer range from Dalton Post S to BC border; major spring use along Donjek River near highway and along White River flood plain; high densities along Alsek River, - Dalton Post, Champagne, Kathleen River, Alsek River, Kloo Lake, Slims River, Kluane Lake and River, Klukshu Lake, Tatshenshini River - Kaskawulsh-Dezadeash-Alsek River valley, Dalton Post, Donjek River valley, Mount Hoge, Mush-Bates Lakes, Slims River valley, Sockeye Lake - Donjek River valley, Kluane River from Tincup lake to Kluane Lake, along W side of Kluane Lake, Slims River Valley/delta, Christmas Bay E and S to Kloo Lake, Kathleen and Sockeye Lakes, Alsek River N of Jarvis, Haines and Alaska highway corridor from Rainbow Lakes to Aishihik Road, Champagne N to Moraine Lake, south Dezadeash Lake S to BC border and SW past Dalton Post along Tatshenshini River. - Similar to Sumantik, plus: White River S of Kluane Wildlife Sanctuary boundary, Donjek River and Kluane River N of Kluane Wildlife Sanctuary boundary - Alsek, Donjek, and Slims Rivers - highest grizzly harvest (79-81) in GMZ 7-01, 7-06, 7-09, and 7-13; also high in 5-20, 6-09, 7-07, and 7-22., - Alsek, Kaskawulsh, Jarvis, Slims, Duke, Donjek, Generc, and White Rivers for summer feeding; denning on Auriol Range and Mount Archibald to E and W of Dezadeash River	- Synergy, 1974 - DRR, 1989 - Hegmann, 1995 - Sumantik, 1989 - Danby, 1999 - Blood and Associates, 1975 - EKPA, 1982 - FPL, 1979
Wolverine (vulnerable)	No Data	
Wood Bison (threatened)	- Nisling River valley, N of Aishihik Lake	- DRR, 1989

Caribou (unique)	- Kluane First Nation traditional knowledge: Migration from Burwash Uplands near Quill Creek across Kluane River near Glacier Creek to Brooks Arm and Talbot Arm and Ruby Range; calving: Burwash Uplands, head of Duke River, head of Burwash Creek, Quill Creek, Iron Creek, Kluane River, Tincup Lake, Brooks Arm, Brooks Arm plateau, Nisling area, Ruby Range area, Talbot Arm, Sekulmun Lake, and Albert Creek; Champagne and Aishihik First Nation traditional knowledge: NW to SW of Aishihik Lake, and E of Aishihik Lake starting N of Village; calving: Gladstone Creek headwaters /Dry Pass - traditional knowledge: winter range: E of Aishihik village, between Cultus Creek and Aishihik Lake; summer range: SE Aishihik Village, E of Aishihik Lake, E of Silver City - traditional knowledge: Nisling Mountains from Dwarf Birch Creek to Nisling River, Stevens Lake, Isaac and Gladstone Creeks, and Talbot Arm; Ruby Ranges from S side of Isaac Creek down to headwaters of Marshall Creek, W along Kluane Hills and N to Gladstone Creek valley. - Special sub-species of Osborne caribou in Burwash Uplands, Wolverine Plateau and Teepee Lake areas - Fourty-mile caribou herd winter at Ladue and N Ladue River; Chisana caribou herd winter at big boundary creek and St. Clare Creek, rut at St. Clare Creek; Burwash caribou herd winter at Brooks Arm Plateau and Burwash Uplands, migrate across Shakwak trench near Quill Creek; Aishihik caribou herd winter in Ruby Ranges, N and S of Gladstone and Isaac Creeks, and in Kluane Hills - see map - Duke and Donjek River areas - critical areas outlined in detail on KNPR map - Burwash Uplands in summer, then to Donjek valley, Generc and White Rivers OR across highway between Quill Creek and Halfbred Creek to Brooks Arm/Talbot Arm; range just E of Silver City between Cultus Creek and Jarvis River to Kloo Lake - calving on Uplands mostly between Burwash and Glacier creeks - post calving range directly E of Christmas Bay and NW of Mount Bark; rutting primarily directly E of Talbot Arm; smaller herds at Brooks Arm Plateau, N Nisling range, Dawson range and Kirkland Creek area - most rutting and early wintering at St Clare Creek/Wolverine Plateau of Uplands;	- Johnson, 1994 - Jingfors, 1990 - Allen, 1994 - Synergy, 1974 - DRR, 1989 - Danby, 1999 - Blood and Associates, 1975 - Parks Canada, 1980 - FPL, 1979 - Gauthier *et al*, 1985 - Larsen, 1981 - Gauthier and Theberge, 1983

	most wintering around Boundary Creek to W of Generc Creek; most calving also in St Clare Creek/Wolverine Plateau region	
Mountain Goat (North of range)	- Auriol Range, Archibald Mountain, Donjek River valley, Mount Hoge, Goatherd mountain, Sheep Mountain, Vulcan Mountain - range throughout much of the southern Kluane Ranges, with concentrations near Kathleen Lake, Goatherd Mountain, Tatshenshini River valley, and in Ruby Ranges to the W of Kusawa Lake - Mush-Bates and Alsek corridors - critical areas outlined in detail on KNPR map - ranges outlined in maps - main range: Fisher Glacier range, Alsek range, Mush Creek range (wintering along Mush Creek, Silver Creek and near Onion Lake), Klukshu range, Goatherd range (high density here, critical S aspects along creeks N of Goatherd Mountain), and Victoria Creek range - main range in Tatshenshini River area: from Neskataheen W to Onion Lake/Bridge River area, Mount Beaton area, Neskataheen Lake N in Kluane Ranges to Klukshu River, E of Klukshu River to Takhanne River and Klukshu Lake, E of Tahkanne River S to BC border; kidding, rutting and feeding in Kluane, Alsek and coastal mountain ranges - Goatherd Mountain area, from toe of Lowell glacier N along Alsek River to near Campsite Lake; also some NE of Cottonwood Cr near Kathleen Lake and at E of Mush Lake	- Hegmann, 1995 - Danby, 1999 - Blood and Associates, 1975 - Parks Canada, 1980 - EKPA, 1982 - Hoefs, 1973 - Peepre & Assoc., 1993 - Parks Canada goat surveys
Dall Sheep (unique)	- High concentration in game sanctuary, Nutcotin Mountains; low concentration in Nisling & Dawson Ranges - Dalton Post to BC border, around Dezadeash Lake, close to Kluane Lake; winter around Christmas Bay; movement between Decolei and Auriol area across Alsek River; salt licks near N Kusawa Lake, and W Kusawa Lake - highest concentrations in Ruby Ranges N of Kluane Lake, Kluane Ranges S of Koidern and W of Burwash, and the Coastal mountains S of Champagne and W of Kusawa Lake - Sheep Mountain, Auriol Range, Archibald Mountain, Burwash Uplands, Donjek River valley, Mount Hoge, Vulcan Mountain	- TransNorthern Consulting, 1993 - Synergy, 1974 - DRR, 1989 - Hegmann, 1995 - Danby, 1999 - Blood and Associates, 1975 - Parks Canada, 1980

- all throughout Kluane ranges and Ruby ranges, particularly in Donjek River valley, Wellesley Lake, Sheep Mountain, Vulcan mountain, and Mount Decoeli areas
- high concentration in Slims, Duke and Donjek corridors
- critical areas outlined in detail on KNPR map
- ranges outlined in maps
- main range: Fisher Glacier range, Alsek range, Klukshu range, Goatherd range (high density here, critical S aspects along creeks N of Goatherd Mountain), and Victoria creek range
- in Tatshenshini River area, NE of Neskataheen Lake, along bluffs E of Klukshu River and Takhanne River, bluffs along Blanchard River (S), and around pass creek; winter range at mouth of Takhanne River and on steep S and E facing slopes between Klukshu and Takhanne River valleys; lambing on slopes S of Pass Creek, E of junction of Blanchard-Tatshenshini Rivers, S slopes where Takhanne River meets Tatshenshini, and N of Nesketaheen Lake on W facing slopes overlooking Klukshu River; breeding on E facing slopes above Tatshenshini/Blanchard junction
- around Tchawsahmon Lake, E of White River to W of Donjek River (S of highway), S of Wolf Cr and W of Donjek River on N of highway, E of Donjek River to W of Kluane River N of highway
- Wellgreen initial environmental evaluation showed: lambing sites, rutting areas, and wintering areas around Wellgreen, to Burwash Creek S of highway, E of Duke River
- E of Donjek River and W of Duke River S of highway, E of Duke River near Squirrel and Ptarmigan Creek to Sheep mountain / Bullion Creek, E of Slims River to Jarvis River and Kaskawulsh River; E of Jarvis River to Quill Creek, E of Rainbow Lake, around Granite Lake to Dezadeash River near Champagne, E of Marshall Creek to Aishihik River, E of Cracker Creek to Taye Lake and Mendenhall River, and E of Mendenhall N of Dezadeash and W of Stony Cr/37 mile
- lambing in Cultus Bay area: ridges N and S of Tharsen Bay, ridges up Cultus Creek, head of Printers Creek; sheep observed all the way across a ridge extending parallel to Printers Creek; mineral lick at base of Cutlus Bay
- lambing range on SE slopes of Killermun Lake; summer on ridge tops and W and N slopes; mineral licks N of lambing; calving from Shutdunmun Lake to N Killermun L
- Miles Ridge from Sanpete Creek to White River, Donjek River to Duke River across Burwash Uplands, Congdon Creek area, Sheep Mountain area

- EKPA, 1982
- Hoefs, 1973
- Peepre & Assoc. , 1993
- FPL, 1979
- Prystupa, 1991
- FPL, 1979
- Beak, 1977
- Frid, 1995
- FPL, 1978
- Carey at al., 1989
- Parks Canada Sheep Mountain. sheep surveys
- Parks Canada Donjek range sheep surveys
- Joe, 1988
- Bjorn, 1990

	- along Donjek Riverbetween Hoge Creek and Steele Creek, lambing areas between Donjek River and Nickel Creek, NW of Burwash Creek across ridge to Nickel Creek, and S of Quill Creek - on ridges and creek beds to N and S of Congdon Creek, in creek beds running E to Kluane Lake N of Willicroft Creek, uppermost reaches of Williscroft Creek, between Sugden Pup and Sheep Creek, N and S of Fortyeight Pup, and on plateau S of Williscroft Creek - similar places as Carey *et al.* near Donjek River valley; also found on E side of Kluane River N of highway and in Brooks Valley N of Brooks Arm - E of Sheep Creek, across Sheep Mountain/Mount Wallace N to Congdon Creek, along Bullion Creek, and along Vulcan Creek, to Vulcan Mountain, Cache Creek, and S ridge of Mount Cairnes - along Donjek River N and S of Donjek glacier toe (ie from Steele Creek, to Bighorn Creek, back to Mount Hoge and Wallace Mountain)	
Moose Subspecies (unique)	- traditional knowledge: mid-winter: Dezadeash, Klukshu and Takhanne River lowlands, Kloo Lake, Foothills of Ruby Ranges; late winter range: SW Haines Junction, Alsek River-Kathleen Lake area, Mush Lake-Dezadeash Lake area; Calving grounds: Teslin burn, Koidern area - traditional knowledge: late winter: same as above, plus Mush Lake south to Dalton Post, Dezadeash Lake south to Neskatahin and SE to Kusawa Lake, Mendenhall River to Kusawa Lake, Hutshi Lake area, NE and SW of Aishihik, Isaac Creek, Cultus Creek to Kloo Lake and Aishihik Lake, NE of Aishihik Lake, and Dezadeash River between Canyon & Haines Junction; AERIAL SURVEY late winter: Aishihik River valley from Canyon to lake, Dezadeash River to Champagne and near Steamboat landing, and an extensive range from Aishihik NW along Nisling River valley to Lynx City. - traditional knowledge: Gladstone Creek, Little Arm Creek, and Lakes on N side of Kluane Lake, between Burwash & White River and Koidern, Nisling, Grayling Creek and Mile 1124, Kloo Lake, McKelly Lake, Dry Pass, around Bear Creek and Christmas Creek - traditional knowledge: Nisling River lowlands, Nju Dalala on MacKintosh Creek, Albert/Isaac creek valleys, Bear Lake area - traditional knowledge: winter at Tatshenshini, Klukshu, Parton, and Takhanne Rivers	- Barichello, 1996 - Jingfors, 1990 - Johnson, 1994 - Allen, 1994 - Peepre & Associates, 1993 - Theberge & Oosenbrug, 1975 - Synergy, 1974 - Hegmann, 1995 - KNPR, 1996 - Danby, 1999 - Parks Canada, 1980 - EKPA, 1982 - Peepre & Assoc. , 1993 - FPL, 1979

and Village Creek; late winter at intersection of 3 valleys just E of Klukshu Lake around Frederick Creek; also E facing slope adjacent to Klukshu River, from Klukshu Lake S to Takhanne/Tatshenshini junction. - winter at Burwash Uplands - high winter densities along Alder Creek, good winter habitat north of Dezadeash Lake, summer at Dezadeash River near Haines Junction, good winter habitat between Burwash Landing and Donjek River crossing; dense moose in summer at Pickhandle wetlands; range along W of highway around Haines Junction; good range from Mush-Bates Lake across to Dezadeash Lake up to Champagne; road crossing near Champagne - Mush-Bates Lakes and Alder creek wetlands, Dalton Post, Dezadeash flats, Donjek River valley, Duke River valley, Sockeye Lake - Fall/early winter range along Alaska Highway corridor from Kluane Lake (S) to Dalton Post, around Sockeye Lake and River, along Alsek River valley on W and NE. around Mush Lakes/Shorty Creek area, E and SE of Bates Lake, around Saint Elias Lake up river to Mush Lake, SE corner of KNPR; Late winter range around Haines Junction (Dezadeash River flats), E side of Alsek River towards Sockeye Lake, and from Mush Lake E to Dalton Post and S to Klukshu Lake - winter concentration at: along Dezadeash River from Champagne-Haines Junction, S from Dezadeash River to Dezadeash Lake, and from Dezadeash River N towards Sekulmun Lake, W of Kusawa Lake to Dezadeash Lake, E of Kusawa Lake in scattered patches towards Ibex valley, Klukshu/Dalton Post area, SE of Kluane Lake around Kloo Lake area, NE of Aishihik Lake, directly E of Aishihik Lake near Hutshi Lake, W from Aishihik Lake concentration towards Wellesley Lake and Donjek River valley, NW of Kluane Lake along Kluane Wildlife Sanctuary boundary until White River and across Burwash Uplands, Talbot Arm, Brooks Arm, Koidern area, and directly W of Wellesley Lake - critical areas outlined in detail on KNPR map - highest densities in GMZ 7-03, 7-02, 7-07; menium densities in 5-38, 5-41, 5-47, 7-01, 5-47, 7-04, 7-06, 7-08, 7-22, and 7-14 - range in Klukshu River valley, S of Klukshu Lake - summer at Beaver Creek muskeg area; year round Pickhandle Lakes; fall and early winter at NE Auriol Range, Ruby Range near Emery Creek, subalpine of Kluane Range from Outpost-Archibald Mountain; winter at Edith and Lynx Creek headwaters,	- Larsen and Ward, 1991 - FPL, 1978 - Parks Canada Auriol Range moose surveys - Parks Canada Duke River moose surveys - Parks Canada moose calf surveys - Ward and Larsen, 1995 - Ward and Larsen, 1995 - Schmidt Environmental Consulting, 1998

	Burwash and Duke River valleys, Kluane River between Swede-Johnson creek and Donjek River, and burn between Destruction Bay and Kluane Lake, Boese Bay, Kloo Lake, NE along Jarvis River to Cultus Creek, Dezadeash wetlands - major moose concentration near Mount Bratnober, Granite Lake and N of Frederick L; In Aishihik Lake area, only patch of high density found N of Hutshi Lakes and S of Shaneibaw Mountain; in Haines Junction region, highest densities around Rainbow Lakes, Granite Lake, E and W of Mount Bratnober, and SW of Jo-Jo Lake - Dezadeash River between Canyon and Champagne, around Haines Junction, NW Kloo Lake, Silver City, near Halfbreed Creek, Donjek River near highway, and E of Mendenhall River near highway. - Alsek River S to Mush-Bates Lakes shows concentrations along Haines Road between Auriol Trail and Kathleen Lake, and a few from Kathleen Lake to Mush-Bates Lakes; also concentrated S, NW (Alsek valley) and SW (Cottonwood Creek to Shaft Creek/Mush-Bates Lakes area) of Sockeye Lake, and N of Alder Creek - moose observed along Ptarmigan Creek Valley near Duke River, along Duke to N of Ptarmigan Creek and S to near Bullion Creek,, along Halfbreed Creek, Grizzly Creek Bighorn Creek near confluence with Donjek River - calves observed throughout Dezadeash wetlands between Haines Junciton N to near Bear Creek - In Aishihik S, highest moose concentrations found around Long Lake and between Morraine Lake and Taye Lake - around Onion L: most dense near Kluane River just SE of Wellesley Lake, and SE of junction of Onion Creek and Nisling River - NW of Aishihik Village and in mountains S of Sekulmun River, both sides of Sekulmun Lake, W shore of Aishihik Lake between Soldiers Bay and Tusho Creek, Wetlands along river-creek areas from 27-mile to Chemi Village, Aishihik River floodplain in summer	
Mule Deer (uncommon)	- NE of Kusawa Lake - Burn sites in S Aishihik Lake, Canyon, Champagne, Takhini River valley, Kusawa Lake outlet and near Kluane Lake - mostly Takhini River burn, also Kluane Lake and Haines Junction	- Synergy, 1974 - DRR, 1989 - FPL, 1979

Elk (reintroduced)	- introduced NE of Kusawa Lake; road crossing W of Champagne; - concentrated in Takhini Valley and Hutshi Lake/Nordenskiold area (core range S of Hutshi Lake to Vowles Mountain.) - summer range throughout Takhini River valley between where Takhini River crosses AK highway W to Kusawa Road; most important summer range immediately beside Takhini River and tributaries including Stony Creek and Ibex River, and along 37-mile Cr; core winter range N of Takhini River extending from 37-mile Creek To Kusawa Road; most calving in eastern portion of range around Ibex River	- Synergy, 1974 - DRR, 1989 - DRR, 1990
Trumpeter Swan (at risk elsewhere)	- nesting at Wellesley Lake(E), W & N of Fish Lake, E of Aishihik Lake, E of Wolf Lake, lower end of Lake Creek, and NW of Snag; spring and fall staging on Kluane Lake and Wellesley Lake - Dezadeash flats and Fraser Creek fen - summer at Pickhandle, Koidern and Donjek Rivers and Rose Lake; staging at Wellesley Lake, Kluane Lake outlet, Dezadeash Lake outlet, Taye Lake, Hutshi Lake, Aishihik Lake, and the Upper Nordenskiold River - concentrations at Kluane Lake N, Takhini River	- Nixon, 1989 - Hegmann, 1995 - Mossop & Dennington, 1984 -FPL, 1977(p27)
Peregrine Falcon (threatened)	- Burwash Uplands - large rivers of Yukon river basin (ie. Donjek, White) support low density - Mount Hoge, Donjek River Valley - observed at Duke River delta, near sheep Mountain., Haines Junction	- Theberge & Oosenbrug, 1975 - DRR, 1989 - Hegmann, 1995 - FPL, 1979
Gyrfalcon (unique)	- moderate density in Coast mountains, maybe Ruby Ranges - nesting N Of Enger Lakess - observed near Burwash, Cultus Bay, Slims River delta - sited near mountains just S of Cultus Bay	- DRR, 1989 - EKPA, 1982 - FPL, 1979 - Beak, 1977
Bald Eagle (unique)	- Dalton Post-BC border - Ruby Ranges (lowlands) - nesting at confluence of Kluane River and Quill Creek, Brooks Arm, Christmas Creek near Sulphur Lakes, NE of Sulphur Lakes, Rainbow Lakes, Dezadeash Lake (W and S), Klukshu Lake, Frederick Lake, Dezadeash River N of Dezadeash Lake, and Takhini	- Synergy, 1974 - DRR, 1989 - EKPA, 1982 - Aniveiler and Blood, 1981

	River N of Kusawa Lake - nests at Lake Creek, SE shore Enger Lakes, S side Koidern River E of Grafe Creek, Koidern wetlands SE of Pickhandle Lakes, wetlands S of Koidern lodge, S bank of Sanpete Creek N of Horsecamp Hill, S band of Kluane River at Burwash Creek Outlet, Peninsula on N side of Kluane River outlet, Jarvis River near entry at N of Kloo Lake - Cultus Bay - Snag Creek near highway, beaver Creek near highway, Dukes Ridge just E of White R, Koidern Creek near Duke R, Pickhandle complex, Koidern River on both sides of highway, Donjek River S of highway, Kluane River N of highway, Duke River N and E of Burwash Lake, around Burwash Landing and Destruction Bay, Kloo Lake area, Pine Lake, Mendenhall River just W of confluence with Takhini - Aishihik Lake area: Tusho Creek and Soldiers Bay segments, Sekulmum River area and N end of lake	- Beak, 1977 - FPL, 1978 - Schmidt Environmental Consulting, 1998
Golden Eagle (unique)	- Burwash Uplands - Dalton Post-BC border - Highest density in Coast mountains near Southern Lakes - Slims River Valley, Donjek River valley, Mount Hoge, Duke River valley, Sheep Mountain - Nesting along W Kluane Lake N across Burwash Uplands to Donjek River valley, and E of Kluane Lake across to S of Canyon Lake, N of Taye Lake and to the Mendenhall River, and in area S of Dezadeash River between Haines Junction and Champagne - Particularly common in Sheep Mountain area - Nests found at S band Kluane River at mouth of Quill Creek, W canyon wall of Duke R, cliffs above slope at Cultus Bay on Kluane Lake, mountain side facing N end of Sulphur Lakes, Kluane hills mountain cliff NW of Haydn Lake creek, outcrops on mountain NE of MacIntosh lodge, mountain face on W side of cable car track on Pine Lake, NW Pine Lake, W of Aishihik River, Mount Canyon east of Aishihik River, low ridges E of Cracker Creek, cliffs on E of Quill Creek, Mine Road, Upper Burwash Creek (NW side) near Tatamagouche Creek, N canyon wall near middle Squirrel Creek, cliff above head of Squirrel Creek, W bank of upper Halfbreed Creek, head of W branch of creek W of Bocks Brook, Bocks Brook area, N side of W branch of Nines Creek, E fork creek E of Nines Creek, W side of Congdon Creek, canyon SE of	- Theberge & Oosenbrug, 1975 - Synergy, 1974 - DRR, 1989 - Hegmann, 1995 - EKPA, 1982 - FPL, 1979 - Aniveiler and Blood, 1981 - Beak, 1977

	Congdon Creek, Williscroft Canyon, creek on Sheep Mountain, SE Sheep Mountain just N of Slims delta crossing, and Sheep Mountain S of Slims River bridge - IN KLUANE L: N and S of Tharsen Bay on ridge systems, S of Cultus Bay on Ridges, and E of Cultus Creek on hill ridge	
Osprey (unique)	- few in Ruby Ranges, none in Coast mountains - observed at Koidern River, Kathleen Lake, Wolf Lake, Nisutlin River, but relatively rare in GKR - Enger Lakes	- DRR, 1989 - FPL, 1979 - FPL, 1978
Short-eared owl (vulnerable)	- Burwash Uplands	- Theberge & Oosenbrug, 1975
Beaver (hyper-sensitive)	- in area between Donjek River and Burwash Uplands, common along Dezadeash River - Mendenhall River, Little River, and Klusha creek drainages; Takhini burn - along Dezadeash River between Champagne and Canyon S of highway - Sekulmun River habitats, N of Aishihik Lake, ponds creeks and bays S and E of Aishihik Village/Sekulmun River, Soldiers Bay-Tusho Creek, Dze to 27-mile camp, 27-mile to Chemi Village, Otter Lake, Aishihik River valley	- Synergy, 1974 - DRR, 1989 - FPL, 1978 - Schmidt Environmental Consulting, 1998
Sharp-tailed grouse (hyper-sensitive)	- Takhini River, Canyon, Haines Junction, N Aishihik Lake, Nisling River, Duke Meadows, Donjek burn, Koidern, Dry Creek, Snag, Beaver Creek, Scottie Creek - Duke River near highway, Kluane Lake between Burwash and Destruction Bay, just S of Donjek River highway crossing, W of Pine Lake, Canyon, and Aishihik Road at Alaska highway	- DRR, 1989 - EKPA, 1982
Small Mammals (key prey species)	- lemmings at Alsek and Mush-Bates (bog); pikas at Observation and Goatherd Mountians; tundra vole in Duke and Donjek Valleys, singing vole at Bullion Plateau - Shrews and voles along Dezadeash River valley marshes between Bear Creek and old Dezadeash Road	- Blood and Associates, 1975 - Krebs and Wingate, 1974
Muskrat (key prey species)	- in area between Donjek River and Burwash Uplands, common along Dezadeash River, Christmas Bay - Taye Lake, Scottie Creek, Pickhandle Lakes, Kloo Lake, Jarvis River, Hutshi Lake (N) - Pickhandle Lakes, Kloo Lake, Jarvis River, Hutshi Lake(N), Taye Lake, Nisling	- Synergy, 1974 - DRR, 1989 - Slough and Jessup, 1984 - FPL, 1979

	River, Mendenhall River, Nitsulin River, Nordenskiold River, Scottie Creek, Mist Lake, McQuestern Lake - most productive at Pickhandle Lakes, sloughs near Donjek River, Enger Lakes, Kloo Lake area and Mendenhall River area - Enger Lakes, Pickhandle Lakes, from Koidern River SE to Swede Johnson Creek along highway corridor - Sekulmun River and Village lagoon, Stevens Lake, 5-mile Lake, Polecat Lake, Poplar Lake N or Aishihik Lake, Bear Lake S of Sekulumn Lake, Soldiers Bay to Tsusho Creek, Aishihik Lake between Big Fish Heart Island and 27-Mi campground, Lacelle Lake, Hopkins Lake, Giltana Lake up to 30-mile on Aishihik Road, a bay on E side of Aishihik Lake across from Big Fish Heart Island, Creek/river area from 27-mile campground to Chemi Village, Otter Pond at south end of Otter/Canyon Lake, Aishihik River and associated wetlands	- FPL, 1978 - Schmidt Environmental Consulting, 1998
Wolves (summit predators)	- Nisling River, Redtail Lake, Onion Creek, Tincup Lake, Brooks Arm, Generc River, Teepee Lake, head of Donjek River, White River, Kluane River, Dry Pass, Aishihik area - wintering at Burwash Uplands - good range north of Dezadeash Lake to around Kathleen Lake, prevalent near Kloo Lake; year-round use near Mount Decoeli; possible denning near south of Kluane Lake, near Sockeye Lake - Mount Hoge/Donjek Valley - loess deposits of Slims and Donjek, Alsek and bush-Bates, Donjek, Duke and Slims River valleys - critical areas outlined in detail on KNPR map - home ranges of several packs:jo-Jo Lake, E of Kusawa Lake to Primrose River and Rose Lake, E of Primrose River/Rose Lake to Alligator Lake, Ark Creek (W of S Kusawa L.) south to BC; individual packs recorded along Kathleen River, Rainbow Lakes, E Dezadeash Lake, Dezadeash River, S Howard Lake, W Jo-Jo Lake, W Ark Creek, W Rose Lake, NE Takhu Lake, Rose Creek, NE Primrose River, and W Arbell Creek	- Johnson, 1994 - Theberge & Oosenbrug, 1975 - Synergy, 1974 - Hegmann, 1995 - Blood and Associates, 1975 - Parks Canada, 1980 - Hayes and Baer, 1986
Waterfowl and Shorebirds (Migratory)	- staging around Dezadeash Lake; major staging area at mouth of Slims River; nesting from Donjek River to Burwash Uplands, Pickhandle wetlands area; staging at Kluane	- Synergy, 1974 - Nixon, 1989

Lake outlet, S Kluane Lake; nesting at Christmas Bay.

- migration up Shakwak trench; SPRING STAGING at N end of Kluane Lake, at mouth of Kluane River outflow and Brooks Arm, S Kluane Lake, N Dezadeash and Six-Mile Lake, Dezadeash River, Rainbow Lake, Kloo Lake; BREEDING at wetland complexes and Sulphur Lakes, Otter Falls, Moose Lake, Wellesley Lake, Borthwick Lake potholes. MOULTING on small lakes between Pickhandle Lakes and Burwash Landing and immediately N of Aishihik Lake; FALL STAGING at Kloo Lake, Pickhandle wetlands, Jarvis River wetlands, Kluane Lake, Wellesley Lake, N Kluane Lake, E of Aishihik Lake, Dezadeash Lake outlet, and Taye Lake
- Kluane Lake outlet (national significance); Dezadeash outlet, Taye Lake, Kloo Lake/Jarvis River wetlands, Pickhandle complex (regional significance); Burwash Lake, Donjek River wetlands, Dry Creek, Giltana Lake (N), Hokins Lake (N of), Hutshi Lake, Kloo Lake(SW of), Kluane River wetlands, Lake Creek Wetlands, Polecat, Five Mile and Martens Lake, Redtail and Moose Lake, Sanpete wetlands, Scottie Creek flats, Snag basin, Enger Lakes, Swede Johnson wetlands, Wellesley Lake and wetlands, and Wolf Lake
- Taye Lake, Dezadeash Lake outlet, Kloo-Enger Lakes, Kluane Lake outlet, Brooks Arm, Kluane River, Burwash Lake, Lake Creek complex, Pickhandle Lakes, Aishihik Lake outlet in winter open water channel from Canyon Pond to Canyon Lake, Hutshi Lake, Wellesley Lake
- staging at: Tincup, Sulphur, Sekulmun, lower Aishihik, Canyon, Taye, Pine, Kathleen, Sockeye, Mush-Bates, Dezadeash, Jo-Jo, and Kusawa Lakes; breeding at Kluane River near Brooks Arm, Slims River delta, Enger Lakes, Taye Lake, and Dezadeash River just NW of Dezadeash Lake;
- breeding at Jarvis River, Duke River, Quill Creek; staging at N half of Enger Lakes, Pine Lake, and Kluane Lake shoreline from Christmas Bay-Cultus Bay, and Congdon Creek to Lewis Creek
- major staging at Kluane Lake, moderate at Dezadeash Lake, Aishihik Lake (between Canyon Lake and Aishihik Lake), Kusawa Lake outlet and narrows, Kathleen Lake, Tincup Lake, Wellesley Lake, Sekulmun Lake, Canyon Lake outlet, Taye Lake, and Six-Mile Lake

- DRR, 1989
- Dennington, 1985
- EKPA, 1982
- Aniveiler and Blood, 1981
- Mossop, 1976
- CWS, 1979
- Blood and Associates, 1979
- Schmidt Environmental Consulting, 1998

	- breeding broods highest at Beaver Creek-White River, Edith Creek-Donjek River, and Donjek River-Christmas Creek; highest combined count from Donjek River to Marshall Creek; greatest species species diversity between Beaver Creek and Edith Creek - high use of Enger Lakes, across from Horsecamp Hill half way between White River and Sanpete Creek, W portion of Lake Creek, and near where Kluane River leaves highway; - in Aishihik Lake area, found in small lakes and ponds N of Aishihik Lake including Stevens, Polecat, Steamboat, Poplar, 5-mile, Duck and Martens Lakes, bays at 48 and 50 Mile near Tsusho Creek as well as ponds on both sides of road, river and creek area between 27-mile campground and Chemi Village site N of Big Fish Heart Island and 27 mile campground, Otter Pond at S end of Canyon/Otter Lake, wetlands near Aishihik Lake downstream of Otter Lake, N end of Seklumun L; SPRING STAGING at Sekulmun River complex (between Sekulmun Lake and Aishihik Lake), shorelines of Soldiers Bay, Tsusho Creek Complex and shoreline of 2 bays to the N, Canyon Pond, and Otter Pond on E Aishihik River; MOULTING at same areas, plus southernmost tip of Aishihik Lake, Canyon Lake; FALL STAGING same as spring plus shorelines of S Aishihik Lake	
Lynx (habitat specialists)	- Mush-Bates area - most important areas include Beaver Creek-Donjek River, Duke Meadow-Destruction Bay, Kloo Lake region, tributary valleys of Dezadeash and Takhini Rivers	- Blood and Associates, 1975 - FPL, 1979
Pine Marten (habitat specialists)	- Takhini River, Takhini Lake, Kusawa Lake and Haines Junction area - Mush-Bates Lakes, Alsek River - marten conservation area from Bear Creek NE past S of Aishihik Lake and S along Alaska Highway to Haines Junction and BC border; released at Rainbow Lake Road, S, NW and N of Kathleen River, Kathleen River, Quill Creek, N shore of Dezadeash Lake - greatest reintroduction potential NE to Alaska highway and SE to Rainbow Lake, W of AK highway near Kluane Lake to lower reaches of Gladstone Creek, confluence of Tatshenshini, Klukshu and Takhanne Rivers near Dalton Post, and area along Nordenskiiold and 30-mile River, lower Klukshu Creek, around Braeburn and	- DRR, 1989 - Blood and Associates, 1975 - Slough and Ward, 1987 - Slough and Smit, 1985

	FoxLakes.	
Regionally uncommon or rare vegetation communities	- Duke meadows vegetation assemblage, EKPR maps 4-12, steppe vegetation at Sheep Mountain, Slims River delta halophytes, vegetation of Hoge/Donjek area, Duke River headwaters, Alsek-Kaskwulsh confluence, nunataks, Steele Creek alpine, Shaft Creek, Goatherd Mountain alpine, communities of lower Alsek valley (moderate climate)	
Highly diverse communities	- NW basin of Kluane Lake (at Kluane River in Brooks Arm) and at Christmas Bay and mouths of Jarvis and Gladstone watersheds - high fish productivity - Sekulmun River - diverse fish species composition - high amount of birds supported by Kloo Lake, Pickhandle complex, Kluane Lake E and W, and Jarvis River wetlands - Fraser Creek fen, Dezadeash flats, highly diverse plants at Klutlan glacier, diverse flora at Lowell glacier, Dezadeash River small mammal community	- deGraff, 1992 - CFS, 1972 - CWS, 1979

APPENDIX 2 - ZONE BOUNDARIES AND RATIONALE

Table A2.1 - Zone Boundary Descriptions and Rationales

Zone	Boundaries	Rationale	Values Present
1 - Steele Creek	North: Cement Creek East: Donjek River South: Donjek Glacier West: Icefields	Includes goat range and scattered patches of sheep range. Excludes moose range to east and goat range to north where it overlaps with caribou range (zone 2).	3 ECOLOGICAL: Mountain Goat, Dall Sheep, Vegetation Communities 4 SOCIAL: International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas
2 - Wolverine Plateau	North: Wolverine Creek, Bull Creek East: Donjek River South: Cement Creek West: Klutlan Glacier	Includes goat and caribou overlapping range, as well as scattered patches of sheep range. Excludes caribou range to north (zone 3).	4 ECOLOGICAL: Alpine Raptors, Mountain Goat, Moose, Dall Sheep 3 SOCIAL: International Biological Program Site, Parks, Environmentally Significant Areas
3 - Klutlan Glacier	North: White River East: Kluane Ranges South: Wolverine Creek, Bull Creek West: Alaska	Includes caribou range up Generc River Valley, along with scattered sheep range. Excludes caribou and moose range around Hazel Creek/Koidern River Valley (zone 8)	6 ECOLOGICAL: Alpine Raptors, Woodland Caribou, Grizzly Bear, Moose, Dall Sheep, Diverse Communities 5 SOCIAL: International Biological Program Site, Parks, Environmentally Significant Areas, Skiing, Snowmobiling
4 - Tchawsahmon Lake	North: Sanpete Creek/Enger Lakes East: White River South: Wolverine Creek, Bull Creek West: Alaska	Includes caribou range around Tchawsahmon Lake and scattered sheep range. Excludes Pickhandle Lakes (zone 5) and Beaver Creek lowlands (zone 54).	7 ECOLOGICAL: Muskrat, Riparian Raptors, Alpine Raptors, Woodland Caribou, Grizzly Bear, Dall Sheep, Hydrological Features 3 SOCIAL: Fishing, Subsistence Hunting, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
5 - Pickhandle Lakes	North: Fish Hole Lake East: Donjek River South: Koidern River/Wolf Creek West: Hazel Creek/White River	Includes Pickhandle Lakes complex with associated moose, goat, waterfowl, muskrat and raptor habitat. Excludes Lake Creek lowlands (zone 6/7).	8 ECOLOGICAL: Muskrat, Riparian Raptors, Alpine Raptors, Waterfowl, Woodland Caribou, Mountain Goat, Moose, Diverse Communities 5 SOCIAL: International Biological Program Site, Nature Appreciation, Hunting, Subsistence Hunting, Subsistence Fishing
6/7* - Lake Creek	North: Pickhandle Lakes East: Donjek River South: Donjek River West: KWS boundary	Includes moose, waterfowl and raptor habitat along Lake Creek. Excludes moose and grizzly bear habitat along the Donjek River (zone 9).	4 ECOLOGICAL: Muskrat, Riparian Raptors, Alpine Raptors, Moose 5 SOCIAL: Historic Sites, International Biological Program Site, Hunting, Camping, Subsistence Fishing
8 - Teepee Lake	North: Pickhandle Lakes/White River East: KWS boundary South: Wolverine Creek, Bull Creek West: Kluane Ranges	Includes caribou range in Hazel Creek/Koidern River valley, scattered sheep ranges, and moose habitat around Teepee Lake - Wolverine Creek Valley. Excludes moose habitat along the Donjek River (zone 9), Lake Creek (zone 7), and Pickhandle Lakes (zone 5).	4 ECOLOGICAL: Alpine Raptors, Woodland Caribou, Moose, Dall Sheep 4 SOCIAL: International Biological Program Site, Parks, Environmentally Significant Areas, Fishing
9 - Donjek River Valley - North	North: Donjek River Valley East: Donjek River Valley South: Donjek Glacier West: Donjek River Valley	Includes grizzly bear and moose habitat, and scattered sheep range along Donjek River Valley. Excludes grizzly bear and sheep range south of Donjek Glacier (zone 13) and moose along Lake Creek (zone 6).	3 ECOLOGICAL: Alpine Raptors, Grizzly Bear, Moose 7 SOCIAL: International Biological Program Site, Parks, Environmentally Significant Areas, Hiking, Camping, Wilderness, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
10 - Quill Creek	North: Murray Creek East: Alaska Highway South: Burwash Creek/Cooper Creek West: Donjek River Valley	Includes caribou, goat, sheep and alpine raptor ranges in hills. Excludes moose habitat in Kluane River lowlands (zone 18) and caribou range on Burwash Uplands (zone 11).	4 ECOLOGICAL: Alpine Raptors, Mountain Goat, Moose, Dall Sheep 3 SOCIAL: Parks, Environmentally Significant Areas, Hiking
11 - Burwash Uplands	North: Burwash Creek East: Alaska Highway South: Halfbreed Creek West: Duke River	Includes caribou and moose habitat on Burwash Uplands. Excludes goat range to south and southwest as much as possible (zone 12).	8 ECOLOGICAL: Mule Deer, Alpine Raptors, Woodland Caribou, Mountain Goat, Grizzly Bear, Moose, Dall Sheep, Geomorphological Features 8 SOCIAL: Parks, Environmentally Significant Areas, Hiking, Nature Appreciation, Skiing, Snowmobiling, Wilderness, Subsistence Fishing
12 - Bighorn Creek	North: Cooper Creek East: Duke River South: Icefields West: Donjek River	Includes goat habitat in the hills and sheep habitat along ridges. Excludes grizzly bear habitat along Donjek River (zone 13) and moose habitat along Duke River (zone 14).	5 ECOLOGICAL: Woodland Caribou, Mountain Goat, Grizzly Bear, Dall Sheep, Vegetation Communities 8 SOCIAL: Historic Sites, Parks, Environmentally Significant Areas, Special Preservation Areas, Hiking, Mountaineering, Nature Appreciation, Wilderness
13 - Donjek River Valley - South	North: Donjek Glacier East: Donjek River Valley South: Icefields West: Icefields	Includes grizzly bear habitat and sheep range on slopes of river. Excludes goat habitat to the east (zone 12).	3 ECOLOGICAL: Grizzly Bear, Dall Sheep, Vegetation Communities 6 SOCIAL: Historic Sites, Parks, Environmentally Significant Areas, Hiking, Nature Appreciation, Wilderness

Zone	Boundaries	Rationale	Values Present
14 - Congdon Creek	North: Halfbreed Creek East: Kluane Lake South: Williscroft Creek/Bullion Creek West: Duke River	Includes moose habitat along Duke River and Kluane Lake, as well as grizzly bear and mule deer habitat along Kluane Lake. Excludes sheep range to the south (zone 52) and goat habitat to the west (zone 12).	4 ECOLOGICAL: Alpine Raptors, Grizzly Bear, Moose, Dall Sheep 9 SOCIAL: Historic Sites, International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas, Motorboating, Hiking, Fishing, Camping
15 - Donjek - Kluane Confluence	North: Kluane River East: Kluane River South: Murray Creek/Swede Johnson Creek Headwaters West: Donjek River	Includes moose habitat along Kluane River, caribou range in a valley connecting Kluane River and Donjek River, and overlapping grizzly bear, alpine raptor, muskrat and waterfowl habitat. Excludes moose habitat along Lake Creek (zone 6), extensive grizzly bear habitat to the south (zone 18) and extensive caribou range to the east (zone 17).	8 ECOLOGICAL: Muskrat, Alpine Raptors, Waterfowl, Sharp-tailed Grouse, Woodland Caribou, Grizzly Bear, Moose, Dall Sheep 3 SOCIAL: Hunting, Camping, Subsistence Fishing
16 - Tincup Lake	North: Swanson Creek/Grace Lake East: Onion Creek/Brooks Arm Creek South: Nuntaea Creek/Dogpack Lake West: Kluane River	Includes caribou range north of Tincup Lake. Excludes extensive caribou range near Brooks Arm (zone 17) and north of Swanson Creek/Grace Lake (zone 55).	6 ECOLOGICAL: Muskrat, Alpine Raptors, Waterfowl, Sharp-tailed Grouse, Woodland Caribou, Dall Sheep 2 SOCIAL: Fishing, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
17 - Little Creek/Outlet Hill	North: Nuntaea Creek/Dogpack Lake East: Brooks Arm Creek South: Kluane Lake/Brooks Arm West: Kluane River Valley	Includes caribou range near Brooks Arm. Excludes caribou range around Tincup Lake (zone 16), between Brooks Arm and Talbot Arm (zone 19), moose habitat along Brooks Arm Creek (zone 19), and grizzly bear habitat along Kluane River (zone 18).	4 ECOLOGICAL: Riparian Raptors, Alpine Raptors, Woodland Caribou, Dall Sheep 1 SOCIAL: Environmentally Significant Area
18 - Kluane River	North: Swede Johnson Creek East: Kluane River Valley South: Kluane Lake/Alaska Highway West: Alaska Highway	Includes grizzly bear habitat and riparian raptor range along Kluane River. Excludes caribou range to the west (zones 10 and 11) and east (zones 17 and 19), moose habitat to the north (zone 15) and grizzly bear habitat west of Kluane Lake (zone 14).	8 ECOLOGICAL: Riparian Raptors, Sharp-tailed Grouse, Woodland Caribou, Grizzly Bear, Dall Sheep, Hydrological Features, Diverse Communities, Vegetation Communities 9 SOCIAL: Historic Sites, Prehistoric Sites, International Biological Program Site, Environmentally Significant Areas, Mountaineering, Fishing, Hunting, Camping, Subsistence Fishing
19 - Brooks Arm Plateau	North: Serpenthead Lake East: Talbot Arm South: Kluane Lake West: Brooks Arm Creek	Includes caribou range between Brooks and Talbot Arms, and moose, muskrat and waterfowl habitat along Brooks Arm Creek. Excludes caribou range to west (zone 17) and raptor range to the east (zone 22).	7 ECOLOGICAL: Muskrat, Riparian Raptors, Alpine Raptors, Woodland Caribou, Moose, Dall Sheep, Diverse Communities 3 SOCIAL: Environmentally Significant Areas, Fishing, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
20 - Dwarf Birch Creek	North: Rhyolite Creek/Onion Creek East: Nisling River Valley South: Talbot Creek West: Brooks Arm Creek	Includes caribou range. Excludes bison range to the east (zone 27) and moose habitat along Talbot Creek (zone 21).	5 ECOLOGICAL: Alpine Raptors, Woodland Caribou, Mountain Goat, Moose, Dall Sheep 0 SOCIAL
21 - Talbot Creek	North: Talbot Creek Valley East: Sekulmun lake South: Talbot Creek Valley West: Talbot Arm	Includes moose habitat and sheep range along Talbot Creek. Excludes extensive caribou range to the north (zone 20) and south (zone 22).	3 ECOLOGICAL: Woodland Caribou, Moose, Dall Sheep 1 SOCIAL: Subsistence Hunting
22 - Gladstone Creek/Isaac Creek	North: Talbot Creek Valley East: Sekulmun lake South: Gladstone Creek/Isaac Creek Valley West: Jacquot Island, Kluane Lake	Includes raptor and caribou range in the hills. Excludes riparian habitat along Isaac Creek/Gladstone Creek (zone 23) and moose habitat to the north (zone 21).	3 ECOLOGICAL: Alpine Raptors, Woodland Caribou, Diverse Communities 7 SOCIAL: Prehistoric Sites, Motorboating, Hiking, Fishing, Hunting, Subsistence Hunting, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
23 - Swanson Creek/Venus Creek	North: Gladstone Creek/Isaac Creek East: Sekulmun Lake South: Cultus Creek/Twelfth of July Creek West: Kluane Lake	Includes caribou and raptor ranges along Isaac Creek/Gladstone Creek, and sheep ranges to the east side of Kluane Lake. Excludes grizzly bear habitat along Cultus Creek (zone 24), caribou range to the north (zone 22), and raptor range to the south (zone 26).	4 ECOLOGICAL: Alpine Raptors, Woodland Caribou, Mountain Goat, Dall Sheep 6 SOCIAL: Motorboating, Hiking, Fishing, Hunting, Subsistence Hunting, Subsistence Fishing
24 - Jarvis River	North: Cultus Creek/Twelfth of July Creek East: McKinley Creek/Shutdunmun Lake South: Kloo Lake/Christmas Creek West: Kluane Lake	Includes moose and grizzly bear habitat along Cultus Creek as well as mule deer habitat and small pocket of caribou range. Excludes extensive moose habitat to the south (zone 25), caribou range to the north (zone 23) and raptor range to the east (zone 26).	9 ECOLOGICAL: Mule Deer, Muskrat, Riparian Raptors, Alpine Raptors, Waterfowl, Woodland Caribou, Grizzly Bear, Moose, Diverse Communities 8 SOCIAL: Historic Sites, Prehistoric Sites, Motorboating, Hiking, Fishing, Hunting, Subsistence Hunting, Subsistence Fishing
25 - Kloo Lake	North: Christmas Creek East: Jarvis River/McKinley Creek South: Alaska Highway West: Kluane Lake	Includes moose habitat in lowlands around Kloo Lake, grizzly bear habitat along the east side of Kluane Lake, and raptor range along Christmas Creek. Excludes goat range to the east (zone 26), moose/grizzly bear habitat to the north (zone 24), and moose habitat along Sulphur Creek (zone 51).	9 ECOLOGICAL: Muskrat, Riparian Raptors, Alpine Raptors, Waterfowl, Woodland Caribou, Grizzly Bear, Moose, Dall Sheep, Diverse Communities 7 SOCIAL: Historic Sites, Prehistoric Sites, Motorboating, Hunting, Camping, Subsistence Hunting, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
26 - Killermun Lake	North: Twelfth of July Creek/Bear Lake East: West Aishihik River South: Marshall Creek/Emery Creek West: Jarvis River/McKinley Creek	Includes raptor range, sheep range around Killermun Lake. Excludes bison and moose habitat to the east (zone 28).	2 ECOLOGICAL: Alpine Raptors, Moose 2 SOCIAL: Hunting, Subsistence Hunting
27 - Stevens Lake	North: Nisling River East: MacKintosh Creek South: Aishihik and Sekulmun Lakes West: Nisling River Valley	Includes moose and bison range along the Nisling River Valley. Excludes extensive bison range to the southeast (zone 29).	7 ECOLOGICAL: Bison, Riparian Raptors, Waterfowl, Sharp-tailed Grouse, Woodland Caribou, Mountain Goat, Moose 6 SOCIAL: Environmentally Significant Areas, Fishing, Hunting, Subsistence Hunting, Subsistence Fishing, Subsistence Trapping
28 - Aishihik Lake/Sekulmun Lake	North: Sekulmun River Complex East: Aishihik Lake Road South: Aishihik River West: Sekulmun Lake/West Aishihik River	Includes raptor range, some bison range, and moose habitat along Lister Creek. Excludes bison range east of Aishihik Lake (zone 29).	6 ECOLOGICAL: Bison, Alpine Raptors, Woodland Caribou, Moose, Dall Sheep, Diverse Communities 11 SOCIAL: Historic Sites, Prehistoric Sites, International Biological Program Site, Environmentally Significant Areas, Motorboating, Nature Appreciation, Fishing, Hunting, Subsistence Hunting, Subsistence Fishing, Subsistence Trapping

Zone	Boundaries	Rationale	Values Present
29 - Long Lake	North: MacKintosh Lake area East: Kirkland Creek South: Nordenskiold River/Hopkins Lake West: Aishihik Lake	Includes bison range, and moose and sheep habitat around Long Lake. Excludes moose habitat along Nordenskiold River (zone 30), sheep range to the south (zone 31), and caribou range around Hutshi Lakes (zone 32).	6 ECOLOGICAL: Mule Deer, Bison, Waterfowl, Woodland Caribou, Moose, Dall Sheep 5 SOCIAL: Environmentally Significant Areas, Fishing, Hunting, Subsistence Fishing, Subsistence Trapping
30 - Satasha Lake	North: Kirkland Creek/Cattle Creek East: Study Area boudary South: Nordenskiold River/Hutshi Lakes West: Kirkland Creek	Includes riparian habitat along Nordenskiold River to study area boundary. Excludes Hutshi Lake lowlands (zone 32) and Long Lake lowlands (zone 29).	5 ECOLOGICAL: Elk, Waterfowl, Woodland Caribou, Moose, Dall Sheep 1 SOCIAL: Environmentally Significant Areas
31 - Moraine Lake	North: Nordenskiold River/Hopkins Lake East: Hutshi Lakes/Taye Lake South: Alaska Highway West: Aishihik Lake Road/Canyon Road	Includes scattered sheep range, mule deer habitat along Aishihik Lake, and alpine raptor and grizzly bear habitat north of the Dezadeash River Valley. Excludes caribou range around Hutshi Lakes (zone 32), raptor range near Taye Lake (zone 33), and the moose/sheep habitat around Long Lake (zone 29).	7 ECOLOGICAL: Mule Deer, Riparian Raptors, Alpine Raptors, Waterfowl, Sharp-tailed Grouse, Grizzly Bear, Dall Sheep 5 SOCIAL: Hunting, Camping, Education, Subsistence Hunting, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
32 - Hutshi Lakes	North: Nordenskiold River East: Study Area boundary South: Mendenhall River West: Hutshi Lakes	Includes caribou, sheep and moose range around Hutshi Lake. Excludes moose habitat along Nordenskiold River lowlands (zone 30), moose/sheep habitat around Long Lake (zone 29), lowlands of Taye Lake (zone 33), and sheep habitat to the west (zone 31).	6 ECOLOGICAL: Elk, Beaver, Muskrat, Alpine Raptors, Waterfowl, Moose 3 SOCIAL: Historic Sites, Environmentally Significant Areas, Subsistence Fishing
33 - Taye Lake	North: Mendenhall River East: Study Area boundary South: Alaska Highway West: Moraine Lake area	Includes Taye Lake lowlands with waterfowl, muskrat, beaver, and raptor habitat. Excludes Mendenhall and Dezadeash River lowlands (zone 35), Hutshi Lake lowlands (zone 32), and grizzly bear/raptor range to the west (zone 31).	7 ECOLOGICAL: Elk, Beaver, Muskrat, Riparian Raptors, Alpine Raptors, Grizzly Bear, Dall Sheep 5 SOCIAL: Prehistoric Sites, Environmentally Significant Areas, Hunting, Subsistence Hunting, Subsistence Fishing
34 - Pine Lake	North: Marshall Creek/Emery Creek East: Aishihik River South: Dezadeash River Valley West: Alaska Highway	Includes grizzly bear and moose habitat in the Dezadeash River Valley, moose habitat along Emery Creek, and sheep range along Marshall Creek. Excludes mule deer habitat to the east (zone 35), Kloo Lake lowlands (zone 25), sheep habitat to the north (zone 26), and grizzly bear habitat in Kathleen River Valley (zone 36).	6 ECOLOGICAL: Alpine Raptors, Sharp-tailed Grouse, Grizzly Bear, Moose Dall Sheep, Diverse Communities 11 SOCIAL: Historic Sites, Prehistoric Sites, Canoeing, Motorboating, Hiking, Nature Appreciation, Fishing, Camping, Education, Subsistence Hunting, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
35 - Dezadeash River	North: Alaska Highway East: Takhini River South: Granite Lake/Red Squirrel Creek West: Granite Lake area	Includes moose habitat along the Dezadeash River Valley between Canyon and Champagne, and mule deer habitat around Kusawa Lake. Excludes sheep ranges in hills south of Dezadeash River (zone 36), moose along Sixmile Lake (zone 37), and grizzly bear habitat north of Dezadeash River (zone 31).	9 ECOLOGICAL: Mule Deer, Beaver, Muskrat, Alpine Raptors, Waterfowl, Sharp-tailed Grouse, Grizzly Bear, Moose, Dall Sheep 7 SOCIAL: Historic Sites, Prehistoric Sites, Canoeing, Fishing, Hunting, Camping, Subsistence Hunting
36 - Rainbow Lakes	North: Dezadeash River Valley East: Granite Lake area South: Kathleen River West: Kathleen Lake	Includes grizzly bear habitat along Kathleen River and sheep range in the hills south of the Dezadeash River Valley. Excludes goat range to the west (zone 49), and moose habitat to the northeast (zone 35) and south (zone 37).	3 ECOLOGICAL: Grizzly Bear, Kokanee, Rainbow Trout 6 SOCIAL: Historic Sites, Canoeing, Motorboating, Fishing, Subsistence Hunting, Subsistence Fishing
37 - Dezadeash Lake	North: Granite Lake area East: Dezadeash River Valley South: Dezadeash Lake West: Alaska Highway	Includes moose, waterfowl and raptor habitat along the Dezadeash River and Sixmile Lake. Excludes mule deer habitat to the north (zone 35), sheep range to the east (zone 38), and goat range to the south (zone 39) and west (zone 47).	5 ECOLOGICAL: Riparian Raptors, Alpine Raptors, Waterfowl, Moose, Squanga Whitefish 9 SOCIAL: Environmentally Significant Areas, Canoeing, Motorboating, Fishing, Hunting, Skiing, Snowmobiling, Subsistence Hunting, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
38 - Jo-Jo Lake	North: Alaska Highway East: Klukshu Lake/Takhini River North South: Kluhini River/Frederick Lake West: Dezadeash River Valley	Includes sheep and raptor range in hills around Jo-Jo Lake, moose habitat in Jo-Jo valley, and mule deer habitat west of Kusawa Lake. Excludes goat range to the south (zone 42) and moose habitat to the south (zone 39), west (zone 37) and north (zone 35).	6 ECOLOGICAL: Mule Deer, Riparian Raptors, Alpine Raptors, Woodland Caribou, Moose, Dall Sheep 9 SOCIAL: Prehistoric Sites, Environmentally Significant Areas, Canoeing, Motorboating, Hiking, Fishing, Camping, Subsistence Hunting, Subsistence Fishing
39 - Frederick Lake	North: Kluhini River/Frederick Lake East: Kusawa Lake South: Coast Mountain Ranges West: Dezadeash Lake/AlaskaHighway	Includes moose habitat along Frederick Lake and Dezadeash Lake. Excludes goat and raptor range to the south (zones 42 and 43), sheep range to the east (zone 38), and Dezadeash Lake (zone 37).	5 ECOLOGICAL: Riparian Raptors, Alpine Raptors, Mountain Goat, Moose, Dall Sheep 4 SOCIAL: Prehistoric Sites, Environmentally Significant Areas, Fishing, Subsistence Hunting
40 -Primrose River	North: Takhini River North East: Study Area boundary South: Takhini River South West: Kusawa Lake	Includes sheep and raptor range east of Kusawa Lake to study area boundary. Excludes goat range to the south (zone 41) and moose habitat to the west (zone 35).	2 ECOLOGICAL: Alpine Raptors, Dall Sheep 5 SOCIAL: Environmentally Significant Areas, Rafting, Kayaking, Fishing, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
41 - South Takhini River	North: Takhini River East: Study Area boundary South: British Columbia West: Kusawa Lake	Includes goat range east of Kusawa Lake to study area boundary. Excludes sheep range to the north (zone 40).	2 ECOLOGICAL: Mountain Goat, Dall Sheep 1 SOCIAL: Environmentally Significant Areas
42 - Devilhole Creek	North: Kluhini River/Frederick Lake East: Kusawa Lake South: British Columbia West: Takhanne River/Pass Creek	Includes raptor and goat range between Takhanne River Valley and Kusawa Lake. Excludes moose and sheep habitat around Klukshu Lake (zone 43), grizzly bear habitat to the west (zone 44), and sheep habitat to the north (zone 38).	3 ECOLOGICAL: Alpine Raptors, Mountain Goat, Dall Sheep 4 SOCIAL: Environmentally Significant Areas, Motorboating, Fishing, Subsistence Hunting
43 - Klukshu Lake	North: Coast Mountain Ranges East: Takhanne River South: Takhanne River/Dalton Post West: Fraser Creek	Includes moose, grizzly bear, raptor, and sheep habitat along the Klukshu River Valley and goat ranges in hills on either side of the Alaska Highway. Excludes extensive goat range to the west (zone 45) and east (zone 42), moose habitat to the north (zones 46 and 39) and grizzly bear habitat to the south (zone 44).	6 ECOLOGICAL: Riparian Raptors, Alpine Raptors, Mountain Goat, Grizzly Bear, Moose, Dall Sheep 8 SOCIAL: Historic Sites, Parks, Environmentally Significant Areas, Fishing, Camping, Education, Subsistence Hunting, Subsistence Fishing

Zone	Boundaries	Rationale	Values Present
44 - Tatshenshini River	North: Takhanne River/Dalton Post East: Pass Creek South: British Columbia West: Tatshenshini River Valley	Includes grizzly bear and goat habitat in the Tatshenshini River Valley. Excludes goat surrounding goat range (zones 45 and 42) and riparian habitat to the north (zone 43).	6 ECOLOGICAL: Alpine Raptors, Mountain Goat, Grizzly Bear, Moose, Dall Sheep, Hydrological Features 14 SOCIAL: Historic Sites, Parks, Environmentally Significant Areas, Canoeing, Rafting, Kayaking, Hiking, Mountain Biking, Nature Appreciation, Fishing, Camping, Wilderness, Subsistence Hunting, Subsistence Fishing
45 - Onion Lake	North: Mush-Bates Lakes East: Fraser Creek South: British Columbia West: Icefields/Alsek River	Includes goat habitat south of Mush-Bates Lakes and west of the Tatshenshini River. Excludes moose and raptor habitat along the Mush-Bates Valley (zone 46), goat range to the east (zone 43) and grizzly bear habitat to the south (zone 44).	2 ECOLOGICAL: Mountain Goat, Vegetation Communities 12 SOCIAL: Historic Sites, Parks, Environmentally Significant Areas, Special Preservation Areas, Canoeing, Rafting, Kayaking Hiking, Mountain Biking, Nature Appreciation, Camping, Wilderness
46 - Mush-Bates Lakes	North: Mush-Bates Lakes Valley East: Alaska Highway South: Mush-Bates Lakes Valley West: Bates River	Includes moose and raptor habitat alongside Mush and Bates Lakes. Excludes goat range to the north (zone 47) and south (zone 45), and lowlands to the east (zones 43 and 39).	6 ECOLOGICAL: Riparian Raptors, Alpine Raptors, Moose, Dall Sheep, Diverse Communities, Vegetation Communities 9 SOCIAL: Historic Sites, Parks, Environmentally Significant Areas, Special Preservation Areas, Canoeing, Hiking, Mountain Biking, Fishing, Skiing

Zone	Boundaries	Rationale	Values Present
47 - Goatherd Mountain	North: Kathleen Lakes East: Alaska Highway South: Bush-Bates Lakes Valley West: Icefields/Alsek River	Includes goat range north of Mush-Bates Lakes. Excludes goat range north of Kathleen Lakes (zone 49) and west of the Alsek River (zone 48), and lowlands around Mush-Bates Lakes (zone 46)..	4 ECOLOGICAL: Mountain Goat, Geomorphological Features, Diverse Communities, Vegetation Communities 15 SOCIAL: Historic Sites, International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas, Canoeing, Kayaking, Hiking, Mountain Biking, Nature Appreciation, Camping, Skiing, Snowmobiling, Education, Wilderness
48 - Alsek-Kaskawulsh Confluence	North: Dezadeash River Valley East: Alsek River Valley South: Lowell Lake/Icefields West: Icefields	Includes grizzly bear habitat and goat range along the Alsek River. Excludes goat range north of Kathleen Lakes (zone 49), north of Mush-Bates Lakes (zone 47) and along the Kaskawulsh River (zone 50) and glaciers (zone 53).	5 ECOLOGICAL: Mountain Goat, Grizzly Bear, Moose, Geomorphological Features, Vegetation Communities 13 SOCIAL: Historic Sites, International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas, Canoeing, Rafting, Kayaking, Hiking, Mountain Biking, Nature Appreciation, Camping, Wilderness
49 - Kathleen Lakes	North: Dezadeash River East: Alaska Highway South: Kathleen Lakes/Sockeye Lake West: Alsek River	Includes goat range. Excludes grizzly bear habitat along the Kathleen River (zone 36), moose habitat along the Dezadeash River (zone 34), and goat range to the south (zone 47) and north (zone 50).	6 ECOLOGICAL: Alpine Raptors, Mountain Goat, Grizzly Bear, Dall Sheep, Kokanee, Rainbow Trout 15 SOCIAL: Historic Sites, Prehistoric Sites, International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas, Motorboating, Hiking, Mountain Biking, Nature Appreciation, Fishing, Camping, Skiing, Snowmobiling, Education

Zone	Boundaries	Rationale	Values Present
50 - Mt. Archibald/Vulcan Mt.	North: Outpost Mt./Cairnes Mt. East: Mt. Archibald/Mt. Decoeli South: Dusty River Valley West: Icefields	Includes goat range along the edge of the icefields, and grizzly bear and raptor habitat along the Kaskawulsh and Dusty River Valleys. Excludes Slims River grizzly bear habitat (zone 52), moose habitat along Sulphur Creek (zone 51), and goat and grizzly bear range to the south (zone 48).	4 ECOLOGICAL: Alpine Raptors, Mountain Goat, Grizzly Bear, Hydrological Features 10 SOCIAL: Prehistoric Sites, International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas, Hiking, Mountaineering, Skiing, Wilderness, Subsistence Hunting
51 - Hungry Lakes	North: Alaska Highway East: Alaska Highway South: Dezadeash River Valley West: Mt. Archibald/Mt. Decoeli	Includes moose habitat along Hungry Lakes and Sulphur Creek. Excludes grizzly bear habitat and sheep range to the west (zone 52), lowlands to the east (zone 25), and goat range to the south (zones 49 and 50).	5 ECOLOGICAL: Alpine Raptors, Mountain Goat, Grizzly Bear, Moose, Geomorphological Features 14 SOCIAL: International Biological Program Site, Parks, Environmentally Significant Areas, Canoeing, Hiking, Mountain Biking, Nature Appreciation, Fishing, Camping, Skiing, Snowmobiling, Education, Subsistence Hunting, Subsistence Fishing
52 - Slims Valley	North: Williscroft Creek/Bullion Creek Headwaters East: Kluane Lake South: Kaskawulsh Glacier West: Icefields	Includes grizzly bear along the Slims River Valley, and sheep range in the hills north of Slims Delta. Excludes grizzly bear habitat along Kluane Lake (zone 14), sheep range along Duke River (zone 12), and goat and grizzly bear habitat to the southeast (zone 50).	8 ECOLOGICAL: Mule Deer, Alpine Raptors, Mountain Goat, Grizzly Bear. Dall Sheep, Geomorphological Features, Hydrological Features, Vegetation Communities 11 SOCIAL: Historic Sites, Prehistoric Sites, International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas, Hiking, Mountain Biking, Nature Appreciation, Camping, Wilderness

Zone	Boundaries	Rationale	Values Present
53 - Icefield Ranges	North: Klutlan Glacier/Donjek Glacier East: Kaskawulsh Glacier/Lowell Glacier South: British Columbia West: Alaska	Includes only the St-Elias Icefields and goat habitat along the Donjek, Chitina, Disappointment, Fisher, and Lowell Glaciers.	3 ECOLOGICAL: Mountain Goat, Geomorphological Features, Vegetation Communities 5 SOCIAL: International Biological Program Site, Parks, Environmentally Significant Areas, Special Preservation Areas, Mountaineering
54 - White River/Snag	North: Scottie Creek/Caledonia Creek East: White River South: Sanpete Creek/Enger Lakes West: Alaska	Includes caribou range around Beaver Creek lowlands and extensive wetlands around Snag. Excludes Wellesley Lake lowlands (zone 55), caribou range around Tchawsahmon Lake (zone 4), and Pickhandle Lakes (zone 5).	8 ECOLOGICAL: Muskrat, Riparian Raptors, Alpine Raptors, Waterfowl, Sharp-tailed Grouse, Woodland Caribou, Mountain Goat, Moose 6 SOCIAL: Historic Sites, Fishing, Camping, Subsistence Hunting, Subsistence Fishing, Subsistence Trapping
55 - Wellesley Lake	North: Donjek River Valley East: Nisling River Valley South: Rhyolite Creek/Onion Creek, Swanson Creek/Grace Lake West: White River	Includes moose, waterfowl, and muskrat habitat in the Wellesley Lake lowlands, and caribou range. Excludes caribou range south of Swanson Creek (zones 15 and 16) and around Onion Creek (zone 20), lowlands around Snag (zone 54), Pickhandle Lakes (zone 5), and Lake Creek lowlands (zone 6).	4 ECOLOGICAL: Riparian Raptors, Waterfowl, Woodland Caribou, Moose 5 SOCIAL: Historic Sites, Environmentally Significant Areas, Subsistence Hunting, Subsistence Fishing, Subsistence Trapping

* After all zones had been numbered, it was decided that zones 6 and 7 should be combined as they were extremely small in size. Therefore, there are only a total of 54 zones even though the numbering goes to 55.

ZONING RATIONALE

As discussed in Chapter 5, zone boundaries were delineated based on wildlife habitats and major physiographical features since a suitable existing system such Ecological Land Classification Ecodistricts was not available for the study area. In particular, the following steps were taken. First, all wildlife with key habitat in the area of concern were noted. The main wildlife species used during this step were goat, sheep, moose, caribou, grizzly bear, bison, mule deer and beaver. Once the main species present had been noted, associations with major physiographical features were then recorded. For instance, moose habitat was often associated with lowlands while goat habitat mostly occurred at higher elevations. Boundary lines were then drawn to encompass major units of wildlife habitat. To keep zone areas approximately equal in size, boundaries were often drawn along physiographic features which appeared to be natural breaks in wildlife ranges. For instance, zone 1 boundaries were drawn to include the mountainous goat and sheep habitat, while excluding riparian moose habitat which was subsequently used to define boundaries for zone 9.

It is interesting to note the similarities between the zones used in this thesis and existing zoning systems in the region, namely game management units and trapping concessions. The zones used in this thesis were very close in size to Yukon's game management units. In fact, ten zones (5, 6, 15, 17, 18, 19, 28, 33, 40, and 41) had almost identical boundaries to game management units. On average, other zones contained two to three game management units, excluding zones 54 and 55 which are considerably larger than the rest. The zones are also similar in size to the region's trapping concessions, but only four zones (4, 28, 40, 42) actually have matching boundaries. These similarities and overlaps confirm that, although approximate, the zoning approach used for the case study is in fact valid, that zone boundaries are realistic, and that there is some degree of repeatability.

APPENDIX 3 - VALUES TABULATED BY ZONE

Table A3.1 - Ecological Values

Value\Zone	1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Elk																												
Mule Deer										1													1					1
Bison																										1	1	1
Beaver																												
Muskrat				1	1	1								1	1			1					1	1				
Riparian Raptors				1	1	1										1	1	1					1	1		1		
Alpine Raptors		1	1	1	1	1	1	1	1	1			1	1	1	1		1	1		1	1	1	1	1		1	
Waterfowl					1									1	1								1	1		1		1
Sharp-tailed Grouse														1	1		1									1		
Woodland Caribou			1	1	1		1			1	1			1	1	1	1	1	1	1	1	1	1	1		1	1	1
Mountain Goat	1	1			1				1	1	1								1			1				1		
Grizzly Bear			1	1				1		1	1	1	1	1			1						1	1				
Moose		1	1		1	1	1	1	1	1			1	1				1	1	1			1	1	1	1	1	1
Dall Sheep	1	1	1	1			1		1	1	1	1	1	1	1	1	1	1	1	1		1		1			1	1
Geomorphology										1																		
Kokanee																												
Rainbow Trout																												
Squanga Whitefish																												
Hydrology				1													1											
Diverse Communities			1		1												1	1			1		1	1			1	
Vegetation Communities	1										1	1					1											
TOTAL ECOLOGICAL	3	4	6	7	8	4	4	3	4	8	5	3	4	8	6	4	8	7	5	3	3	4	9	9	2	7	6	6

Table A3.1, cont'd

Value\Zone	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	Total
Elk	1		1	1																							3
Mule Deer		1				1			1														1				7
Bison																											3
Beaver			1	1		1																					3
Muskrat			1	1		1																			1		12
Riparian Raptors		1		1				1	1	1				1			1								1	1	18
Alpine Raptors		1	1	1	1	1		1	1	1	1		1	1	1		1			1	1	1	1		1		39
Waterfowl	1	1	1			1		1																	1	1	14
Sharp-tailed Grouse		1			1	1																			1		8
Woodland Caribou	1								1																1	1	24
Mountain Goat										1		1	1	1	1	1		1	1	1	1	1	1	1	1		23
Grizzly Bear		1		1	1	1	1							1	1				1	1	1	1	1				23
Moose	1		1		1	1		1	1	1				1	1		1		1			1			1	1	33
Dall Sheep	1	1		1	1	1			1	1	1	1	1	1	1		1			1			1				36
Geomorphology																		1	1			1	1	1			6
Kokanee							1													1							2
Rainbow Trout							1													1							2
Squanga Whitefish								1																			1
Hydrology															1						1		1				5
Diverse Communities					1												1	1									11
Vegetation Communities																1	1	1	1				1	1			10
TOTAL ECOLOGICAL	5	7	6	7	6	9	3	5	6	5	2	2	3	6	6	2	6	4	5	6	4	5	8	3	8	4	283

Table A3.2 - Social Values

Value\Zone	1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Historic Sites						1					1	1	1				1						1	1			1	
Prehistoric Sites																	1				1		1	1			1	
IBP Site	1	1	1		1	1	1	1					1				1										1	
Parks	1	1	1				1	1	1	1	1	1	1															
ESA	1	1	1				1	1	1	1	1	1	1			1	1	1								1	1	1
SPA	1										1		1															
Canoeing																												
Rafting																												
Kayaking																												
Motorboating													1								1	1	1	1			1	
Hiking								1	1	1	1	1	1								1	1	1					
Mountain Biking																												
Mountaineering											1																	
Nature Appreciation					1					1	1	1					1										1	
Fishing				1			1						1		1		1	1			1	1	1			1	1	1
Hunting					1	1								1			1				1	1	1	1	1	1	1	1
Camping						1		1					1	1			1							1				
Skiing			1							1																		
Snowmobiling			1							1																		
Education																												
Wilderness								1		1	1	1																
Subsistence Hunting				1	1															1	1	1	1	1	1	1	1	
Subsistence Fishing				1	1	1		1		1				1	1		1	1			1	1	1	1		1	1	1
Subsistence Trapping																										1	1	1
TOTAL SOCIAL	4	3	5	3	5	5	4	7	3	8	8	6	9	3	2	1	9	3	0	1	7	6	8	7	2	6	11	5
TOTAL VALUES	7	7	11	10	13	9	8	10	7	16	13	9	13	11	8	5	17	10	5	4	10	10	17	16	4	13	17	11

Table A3.2, cont'd

Value\Zone	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	Total
Historic Sites			1		1	1	1							1	1	1	1	1	1	1			1		1	1	22
Prehistoric Sites				1	1	1			1	1										1	1		1				13
IBP Site																		1	1	1	1	1	1	1			17
Parks														1	1	1	1	1	1	1	1	1	1	1			21
ESA	1		1	1				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	37
SPA																1	1	1	1	1	1		1	1			11
Canoeing					1	1	1	1	1						1	1	1	1	1			1					11
Rafting											1				1	1		1	1								5
Kayaking											1				1	1		1	1								5
Motorboating					1		1	1	1				1							1							12
Hiking					1				1						1	1	1	1	1	1	1	1	1				20
Mountain Biking															1	1	1	1	1	1		1	1				8
Mountaineering																					1			1			3
Nature Appreciation					1										1	1		1	1	1		1	1				14
Fishing					1	1	1	1	1	1	1		1	1	1		1			1		1			1		26
Hunting		1		1		1		1																			16
Camping		1			1	1			1					1	1	1		1	1	1		1	1		1		19
Skiing								1									1	1		1	1	1					8
Snowmobiling								1										1		1		1					5
Education		1			1									1				1		1		1					6
Wilderness															1	1		1	1		1		1				10
Subsistence Hunting		1		1	1	1	1	1	1	1			1	1	1						1	1			1	1	25
Subsistence Fishing		1	1	1	1		1	1	1		1			1	1							1			1	1	29
Subsistence Trapping																									1	1	5
TOTAL SOCIAL	1	5	3	5	11	7	6	9	9	4	5	1	4	8	14	12	9	15	13	15	10	14	11	5	6	5	348
TOTAL VALUES	6	12	9	12	17	16	9	14	15	9	7	3	7	14	20	14	15	19	18	21	14	19	19	8	14	9	340

APPENDIX 4 - ZONE RANKINGS

Table A4.1 - Zones Ranked by Total Values per Zone.

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Total Values per area	Social Values per area	Ecological Values per area
1	49	Kathleen Lakes - Haines Junction	21	15	6	655	0.00916	0.02290	0.03206
2	44	Tatshenshini/Dalton Post	20	14	6	562	0.01068	0.02491	0.03559
3	47	Lowell Lake/Goatherd Mt.	19	15	4	1143	0.00350	0.01312	0.01662
4	52	Slims Valley and Delta	19	11	8	568	0.01408	0.01937	0.03345
5	51	Hungry Lakes	19	14	5	473	0.01057	0.02960	0.04017
6	48	Alsek-Kaskawulsh Confluence	18	13	5	844	0.00592	0.01540	0.02133
7	24	Jarvis River	17	8	9	457	0.01969	0.01751	0.03720
8	28	Aishihik and Sekulmun Lakes	17	11	6	1393	0.00431	0.00790	0.01220
9	18	Kluane River	17	9	8	287	0.02787	0.03136	0.05923
10	34	Pine Lake	17	11	6	692	0.00867	0.01590	0.02457
11	25	Kloo Lake	16	7	9	368	0.02446	0.01902	0.04348
12	11	Burwash Uplands	16	8	8	389	0.02057	0.02057	0.04113
13	35	Dezadeash River, Canyon to Champagne	16	7	9	827	0.01088	0.00846	0.01935
14	46	Mush-Bates Lakes	15	9	6	360	0.01667	0.02500	0.04167
15	38	Jo-Jo and North Kusawa Lakes	15	9	6	977	0.00614	0.00921	0.01535
16	50	Mt. Archibald/Vulcan Mt.	14	10	4	1319	0.00303	0.00758	0.01061
17	54	White River/Snag	14	6	8	3147	0.00254	0.00191	0.00445
18	45	Onion Lake	14	12	2	910	0.00220	0.01319	0.01538
19	43	Klukshu Lake	14	8	6	476	0.01261	0.01681	0.02941
20	37	Dezadeash and Sixmile Lakes	14	9	5	736	0.00679	0.01223	0.01902

Table A4.1, cont'd

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Total Values per area	Social Values per area	Ecological Values per area
21	5	Pickhandle Lakes	13	5	8	983	0.00814	0.00509	0.01322
22	14	Congdon Creek	13	9	4	738	0.00542	0.01220	0.01762
23	27	Stevens Lake	13	6	7	1140	0.00614	0.00526	0.01140
24	12	Bighorn Creek	13	8	5	536	0.00933	0.01493	0.02425
25	33	Taye Lake	12	5	7	793	0.00883	0.00631	0.01513
26	31	Moraine Lake	12	5	7	1143	0.00612	0.00437	0.01050
27	29	Long Lake	11	5	6	1111	0.00540	0.00450	0.00990
28	3	Klutlan Glacier	11	5	6	1107	0.00542	0.00452	0.00994
29	15	Donjek-Kluane River Confluence	11	3	8	500	0.01600	0.00600	0.02200
30	22	Gladstone Creek/Isaac Creek	10	7	3	1258	0.00238	0.00556	0.00795
31	23	Swanson Creek/Venus Creek	10	6	4	1089	0.00367	0.00551	0.00918
32	4	Tchawsahmon Lake	10	3	7	866	0.00808	0.00346	0.01155
33	9	North Donjek Valley	10	7	3	428	0.00701	0.01636	0.02336
34	19	Brooks Arm Plateau	10	3	7	663	0.01056	0.00452	0.01508
35	39	Frederick Lake	9	4	5	301	0.01661	0.01329	0.02990
36	13	South Donjek River Valley	9	6	3	220	0.01364	0.02727	0.04091
37	32	Hutshi Lakes	9	3	6	893	0.00672	0.00336	0.01008
38	55	Wellesley Lake	9	5	4	4606	0.00087	0.00109	0.00195
39	36	Rainbow Lakes	9	6	3	223	0.01345	0.02691	0.04036
40	6	Lake Creek	9	5	4	549	0.00729	0.00911	0.01639

Table A4.1 (cont'd)

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Total Values per area	Social Values per area	Ecological Values per area
41	53	Icefield Ranges	8	5	3	15199	0.00020	0.00033	0.00053
42	16	Tincup Lake	8	2	6	812	0.00739	0.00246	0.00985
43	8	Teepee Lake	8	4	4	976	0.00410	0.00410	0.00820
44	10	Quill Creek	7	3	4	456	0.00877	0.00658	0.01535
45	40	Primrose River	7	5	2	441	0.00454	0.01134	0.01587
46	1	Steele Creek	7	4	3	662	0.00453	0.00604	0.01057
47	42	Devilhole Creek	7	4	3	1165	0.00258	0.00343	0.00601
48	2	Wolverine Plateau	7	3	4	1034	0.00387	0.00290	0.00677
49	30	Satasha Lake	6	1	5	973	0.00514	0.00103	0.00617
50	20	Dwarf Birch Creek	5	0	5	2114	0.00237	0.00000	0.00237
51	17	Little Creek/Outlet Hill	5	1	4	361	0.01108	0.00277	0.01385
52	26	Killermun Lake	4	2	2	955	0.00209	0.00209	0.00419
53	21	Talbot Creek	4	1	3	435	0.00690	0.00230	0.00920
54	41	South Takhini River	3	1	2	179	0.01117	0.00559	0.01676

Table A4.2 - Zones Ranked by Social Values per Zone

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Total Values per area	Social Values per area	Ecological Values per area
1	49	Kathleen Lakes - Haines Junction	21	15	6	655	0.00916	0.02290	0.03206
2	47	Lowell Lake/Goatherd Mt.	19	15	4	1143	0.00350	0.01312	0.01662
3	51	Hungry Lakes	19	14	5	473	0.01057	0.02960	0.04017
4	44	Tatshenshini/Dalton Post	20	14	6	562	0.01068	0.02491	0.03559
5	48	Alsek-Kaskawulsh Confluence	18	13	5	844	0.00592	0.01540	0.02133
6	45	Onion Lake	14	12	2	910	0.00220	0.01319	0.01538
7	34	Pine Lake	17	11	6	692	0.00867	0.01590	0.02457
8	52	Slims Valley and Delta	19	11	8	568	0.01408	0.01937	0.03345
9	28	Aishihik and Sekulmun Lakes	17	11	6	1393	0.00431	0.00790	0.01220
10	50	Mt. Archibald/Vulcan Mt.	14	10	4	1319	0.00303	0.00758	0.01061
11	38	Jo-Jo and North Kusawa Lakes	15	9	6	977	0.00614	0.00921	0.01535
12	46	Mush-Bates Lakes	15	9	6	360	0.01667	0.02500	0.04167
13	18	Kluane River	17	9	8	287	0.02787	0.03136	0.05923
14	37	Dezadeash and Sixmile Lakes	14	9	5	736	0.00679	0.01223	0.01902
15	14	Congdon Creek	13	9	4	738	0.00542	0.01220	0.01762
16	11	Burwash Uplands	16	8	8	389	0.02057	0.02057	0.04113
17	12	Bighorn Creek	13	8	5	536	0.00933	0.01493	0.02425
18	43	Klukshu Lake	14	8	6	476	0.01261	0.01681	0.02941
19	24	Jarvis River	17	8	9	457	0.01969	0.01751	0.03720
20	35	Dezadeash River, Canyon to Champagne	16	7	9	827	0.01088	0.00846	0.01935

Table A4.2, cont'd

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Total Values per area	Social Values per area	Ecological Values per area
21	22	Gladstone Creek/Isaac Creek	10	7	3	1258	0.00238	0.00556	0.00795
22	9	North Donjek Valley	10	7	3	428	0.00701	0.01636	0.02336
23	25	Kloo Lake	16	7	9	368	0.02446	0.01902	0.04348
24	54	White River/Snag	14	6	8	3147	0.00254	0.00191	0.00445
25	27	Stevens Lake	13	6	7	1140	0.00614	0.00526	0.01140
26	36	Rainbow Lakes	9	6	3	223	0.01345	0.02691	0.04036
27	23	Swanson Creek/Venus Creek	10	6	4	1089	0.00367	0.00551	0.00918
28	13	South Donjek River Valley	9	6	3	220	0.01364	0.02727	0.04091
29	53	Icefield Ranges	8	5	3	15199	0.00020	0.00033	0.00053
30	31	Moraine Lake	12	5	7	1143	0.00612	0.00437	0.01050
31	40	Primrose River	7	5	2	441	0.00454	0.01134	0.01587
32	3	Klutlan Glacier	11	5	6	1107	0.00542	0.00452	0.00994
33	55	Wellesley Lake	9	5	4	4606	0.00087	0.00109	0.00195
34	29	Long Lake	11	5	6	1111	0.00540	0.00450	0.00990
35	6	Lake Creek	9	5	4	549	0.00729	0.00911	0.01639
36	5	Pickhandle Lakes	13	5	8	983	0.00814	0.00509	0.01322
37	33	Taye Lake	12	5	7	793	0.00883	0.00631	0.01513
38	1	Steele Creek	7	4	3	662	0.00453	0.00604	0.01057
39	39	Frederick Lake	9	4	5	301	0.01661	0.01329	0.02990
40	8	Teepee Lake	8	4	4	976	0.00410	0.00410	0.00820

Table A4.2, cont'd

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Total Values per area	Social Values per area	Ecological Values per area
41	42	Devilhole Creek	7	4	3	1165	0.00258	0.00343	0.00601
42	15	Donjek-Kluane River Confluence	11	3	8	500	0.01600	0.00600	0.02200
43	32	Hutshi Lakes	9	3	6	893	0.00672	0.00336	0.01008
44	10	Quill Creek	7	3	4	456	0.00877	0.00658	0.01535
45	2	Wolverine Plateau	7	3	4	1034	0.00387	0.00290	0.00677
46	4	Tchawsahmon Lake	10	3	7	866	0.00808	0.00346	0.01155
47	19	Brooks Arm Plateau	10	3	7	663	0.01056	0.00452	0.01508
48	26	Killermun Lake	4	2	2	955	0.00209	0.00209	0.00419
49	16	Tincup Lake	8	2	6	812	0.00739	0.00246	0.00985
50	21	Talbot Creek	4	1	3	435	0.00690	0.00230	0.00920
51	17	Little Creek/Outlet Hill	5	1	4	361	0.01108	0.00277	0.01385
52	30	Satasha Lake	6	1	5	973	0.00514	0.00103	0.00617
53	41	South Takhini River	3	1	2	179	0.01117	0.00559	0.01676
54	20	Dwarf Birch Creek	5	0	5	2114	0.00237	0.00000	0.00237

Table A4.3 - Zones Ranked by Ecological Values per Zone

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Total Values per area	Social Values per area	Ecological Values per area
1	35	Dezadeash River, Canyon to Champagne	16	7	9	827	0.01088	0.00846	0.01935
2	25	Kloo Lake	16	7	9	368	0.02446	0.01902	0.04348
3	24	Jarvis River	17	8	9	457	0.01969	0.01751	0.03720
4	18	Kluane River	17	9	8	287	0.02787	0.03136	0.05923
5	5	Pickhandle Lakes	13	5	8	983	0.00814	0.00509	0.01322
6	54	White River/Snag	14	6	8	3147	0.00254	0.00191	0.00445
7	11	Burwash Uplands	16	8	8	389	0.02057	0.02057	0.04113
8	15	Donjek-Kluane River Confluence	11	3	8	500	0.01600	0.00600	0.02200
9	52	Slims Valley and Delta	19	11	8	568	0.01408	0.01937	0.03345
10	31	Moraine Lake	12	5	7	1143	0.00612	0.00437	0.01050
11	27	Stevens Lake	13	6	7	1140	0.00614	0.00526	0.01140
12	33	Taye Lake	12	5	7	793	0.00883	0.00631	0.01513
13	19	Brooks Arm Plateau	10	3	7	663	0.01056	0.00452	0.01508
14	4	Tchawsahmon Lake	10	3	7	866	0.00808	0.00346	0.01155
15	32	Hutshi Lakes	9	3	6	893	0.00672	0.00336	0.01008
16	16	Tincup Lake	8	2	6	812	0.00739	0.00246	0.00985
17	29	Long Lake	11	5	6	1111	0.00540	0.00450	0.00990
18	3	Klutlan Glacier	11	5	6	1107	0.00542	0.00452	0.00994
19	43	Klukshu Lake	14	8	6	476	0.01261	0.01681	0.02941
20	34	Pine Lake	17	11	6	692	0.00867	0.01590	0.02457

Table A4.3, cont'd

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Total Values per area	Social Values per area	Ecological Values per area
21	46	Mush-Bates Lakes	15	9	6	360	0.01667	0.02500	0.04167
22	28	Aishihik and Sekulmun Lakes	17	11	6	1393	0.00431	0.00790	0.01220
23	49	Kathleen Lakes - Haines Junction	21	15	6	655	0.00916	0.02290	0.03206
24	44	Tatshenshini/Dalton Post	20	14	6	562	0.01068	0.02491	0.03559
25	38	Jo-Jo and North Kusawa Lakes	15	9	6	977	0.00614	0.00921	0.01535
26	37	Dezadeash and Sixmile Lakes	14	9	5	736	0.00679	0.01223	0.01902
27	30	Satasha Lake	6	1	5	973	0.00514	0.00103	0.00617
28	39	Frederick Lake	9	4	5	301	0.01661	0.01329	0.02990
29	51	Hungry Lakes	19	14	5	473	0.01057	0.02960	0.04017
30	12	Bighorn Creek	13	8	5	536	0.00933	0.01493	0.02425
31	20	Dwarf Birch Creek	5	0	5	2114	0.00237	0.00000	0.00237
32	48	Alsek-Kaskawulsh Confluence	18	13	5	844	0.00592	0.01540	0.02133
33	6	Lake Creek	9	5	4	549	0.00729	0.00911	0.01639
34	8	Teepee Lake	8	4	4	976	0.00410	0.00410	0.00820
35	17	Little Creek/Outlet Hill	5	1	4	361	0.01108	0.00277	0.01385
36	2	Wolverine Plateau	7	3	4	1034	0.00387	0.00290	0.00677
37	10	Quill Creek	7	3	4	456	0.00877	0.00658	0.01535
38	55	Wellesley Lake	9	5	4	4606	0.00087	0.00109	0.00195
39	23	Swanson Creek/Venus Creek	10	6	4	1089	0.00367	0.00551	0.00918
40	47	Lowell Lake/Goatherd Mt.	19	15	4	1143	0.00350	0.01312	0.01662

Table A4.3, cont'd

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Total Values per area	Social Values per area	Ecological Values per area
41	14	Congdon Creek	13	9	4	738	0.00542	0.01220	0.01762
42	50	Mt. Archibald/Vulcan Mt.	14	10	4	1319	0.00303	0.00758	0.01061
43	42	Devilhole Creek	7	4	3	1165	0.00258	0.00343	0.00601
44	21	Talbot Creek	4	1	3	435	0.00690	0.00230	0.00920
45	22	Gladstone Creek/Isaac Creek	10	7	3	1258	0.00238	0.00556	0.00795
46	1	Steele Creek	7	4	3	662	0.00453	0.00604	0.01057
47	53	Icecfield Ranges	8	5	3	15199	0.00020	0.00033	0.00053
48	36	Rainbow Lakes	9	6	3	223	0.01345	0.02691	0.04036
49	13	South Donjek River Valley	9	6	3	220	0.01364	0.02727	0.04091
50	9	North Donjek Valley	10	7	3	428	0.00701	0.01636	0.02336
51	40	Primrose River	7	5	2	441	0.00454	0.01134	0.01587
52	41	South Takhini River	3	1	2	179	0.01117	0.00559	0.01676
53	45	Onion Lake	14	12	2	910	0.00220	0.01319	0.01538
54	26	Killermun Lake	4	2	2	955	0.00209	0.00209	0.00419

Table A4.4 - Zones Ranked by Total Values per Unit Area

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Ecological Values per Area	Social Values per Area	Total Values per Area
1	18	Kluane River	17	9	8	287	0.02787	0.03136	0.05923
2	25	Kloo Lake	16	7	9	368	0.02446	0.01902	0.04348
3	46	Mush-Bates Lakes	15	9	6	360	0.01667	0.02500	0.04167
4	11	Burwash Uplands	16	8	8	389	0.02057	0.02057	0.04113
5	13	South Donjek River Valley	9	6	3	220	0.01364	0.02727	0.04091
6	36	Rainbow Lakes	9	6	3	223	0.01345	0.02691	0.04036
7	51	Hungry Lakes	19	14	5	473	0.01057	0.02960	0.04017
8	24	Jarvis River	17	8	9	457	0.01969	0.01751	0.03720
9	44	Tatshenshini/Dalton Post	20	14	6	562	0.01068	0.02491	0.03559
10	52	Slims Valley and Delta	19	11	8	568	0.01408	0.01937	0.03345
11	49	Kathleen Lakes - Haines Junction	21	15	6	655	0.00916	0.02290	0.03206
12	39	Frederick Lake	9	4	5	301	0.01661	0.01329	0.02990
13	43	Klukshu Lake	14	8	6	476	0.01261	0.01681	0.02941
14	34	Pine Lake	17	11	6	692	0.00867	0.01590	0.02457
15	12	Bighorn Creek	13	8	5	536	0.00933	0.01493	0.02425
16	9	North Donjek Valley	10	7	3	428	0.00701	0.01636	0.02336
17	15	Donjek-Kluane River Confluence	11	3	8	500	0.01600	0.00600	0.02200
18	48	Alsek-Kaskawulsh Confluence	18	13	5	844	0.00592	0.01540	0.02133
19	35	Dezadeash River, Canyon to Champagne	16	7	9	827	0.01088	0.00846	0.01935
20	37	Dezadeash and Sixmile Lakes	14	9	5	736	0.00679	0.01223	0.01902
21	14	Congdon Creek	13	9	4	738	0.00542	0.01220	0.01762
22	41	South Takhini River	3	1	2	179	0.01117	0.00559	0.01676
23	47	Lowell Lake/Goatherd Mt.	19	15	4	1143	0.00350	0.01312	0.01662
24	6	Lake Creek	9	5	4	549	0.00729	0.00911	0.01639
25	40	Primrose River	7	5	2	441	0.00454	0.01134	0.01587

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Ecological Values per Area	Social Values per Area	Total Values per Area
26	45	Onion Lake	14	12	2	910	0.00220	0.01319	0.01538
27	38	Jo-Jo and North Kusawa Lakes	15	9	6	977	0.00614	0.00921	0.01535
28	10	Quill Creek	7	3	4	456	0.00877	0.00658	0.01535
29	33	Taye Lake	12	5	7	793	0.00883	0.00631	0.01513
30	19	Brooks Arm Plateau	10	3	7	663	0.01056	0.00452	0.01508
31	17	Little Creek/Outlet Hill	5	1	4	361	0.01108	0.00277	0.01385
32	5	Pickhandle Lakes	13	5	8	983	0.00814	0.00509	0.01322
33	28	Aishihik and Sekulmun Lakes	17	11	6	1393	0.00431	0.00790	0.01220
34	4	Tchawsahmon Lake	10	3	7	866	0.00808	0.00346	0.01155
35	27	Stevens Lake	13	6	7	1140	0.00614	0.00526	0.01140
36	50	Mt. Archibald/Vulcan Mt.	14	10	4	1319	0.00303	0.00758	0.01061
37	1	Steele Creek	7	4	3	662	0.00453	0.00604	0.01057
38	31	Moraine Lake	12	5	7	1143	0.00612	0.00437	0.01050
39	32	Hutshi Lakes	9	3	6	893	0.00672	0.00336	0.01008
40	3	Klutlan Glacier	11	5	6	1107	0.00542	0.00452	0.00994
41	29	Long Lake	11	5	6	1111	0.00540	0.00450	0.00990
42	16	Tincup Lake	8	2	6	812	0.00739	0.00246	0.00985
43	21	Talbot Creek	4	1	3	435	0.00690	0.00230	0.00920
44	23	Swanson Creek/Venus Creek	10	6	4	1089	0.00367	0.00551	0.00918
45	8	Teepee Lake	8	4	4	976	0.00410	0.00410	0.00820
46	22	Gladstone Creek/Isaac Creek	10	7	3	1258	0.00238	0.00556	0.00795
47	2	Wolverine Plateau	7	3	4	1034	0.00387	0.00290	0.00677
48	30	Satasha Lake	6	1	5	973	0.00514	0.00103	0.00617
49	42	Devilhole Creek	7	4	3	1165	0.00258	0.00343	0.00601
50	54	White River/Snag	14	6	8	3147	0.00254	0.00191	0.00445
51	26	Killermun Lake	4	2	2	955	0.00209	0.00209	0.00419
52	20	Dwarf Birch Creek	5	0	5	2114	0.00237	0.00000	0.00237
53	55	Wellesley Lake	9	5	4	4606	0.00087	0.00109	0.00195
54	53	Icefield Ranges	8	5	3	15199	0.00020	0.00033	0.00053

Table A4.5 - Zones Ranked by Social Values per Unit Area

Rank	Zone	Name	Social Values	Ecological Values	Total Values	Area (km^2)	Ecological Values per Area	Social Values per Area	Total Values per Area
1	18	Kluane River	9	8	17	287	0.02787	0.03136	0.05923
2	51	Hungry Lakes	14	5	19	473	0.01057	0.02960	0.04017
3	13	South Donjek River Valley	6	3	9	220	0.01364	0.02727	0.04091
4	36	Rainbow Lakes	6	3	9	223	0.01345	0.02691	0.04036
5	46	Mush-Bates Lakes	9	6	15	360	0.01667	0.02500	0.04167
6	44	Tatshenshini/Dalton Post	14	6	20	562	0.01068	0.02491	0.03559
7	49	Kathleen Lakes - Haines Junction	15	6	21	655	0.00916	0.02290	0.03206
8	11	Burwash Uplands	8	8	16	389	0.02057	0.02057	0.04113
9	52	Slims Valley and Delta	11	8	19	568	0.01408	0.01937	0.03345
10	25	Kloo Lake	7	9	16	368	0.02446	0.01902	0.04348
11	24	Jarvis River	8	9	17	457	0.01969	0.01751	0.03720
12	43	Klukshu Lake	8	6	14	476	0.01261	0.01681	0.02941
13	9	North Donjek Valley	7	3	10	428	0.00701	0.01636	0.02336
14	34	Pine Lake	11	6	17	692	0.00867	0.01590	0.02457
15	48	Alsek-Kaskawulsh Confluence	13	5	18	844	0.00592	0.01540	0.02133
16	12	Bighorn Creek	8	5	13	536	0.00933	0.01493	0.02425
17	39	Frederick Lake	4	5	9	301	0.01661	0.01329	0.02990
18	45	Onion Lake	12	2	14	910	0.00220	0.01319	0.01538
19	47	Lowell Lake/Goatherd Mt.	15	4	19	1143	0.00350	0.01312	0.01662
20	37	Dezadeash and Sixmile Lakes	9	5	14	736	0.00679	0.01223	0.01902
21	14	Congdon Creek	9	4	13	738	0.00542	0.01220	0.01762
22	40	Primrose River	5	2	7	441	0.00454	0.01134	0.01587
23	38	Jo-Jo and North Kusawa Lakes	9	6	15	977	0.00614	0.00921	0.01535
24	6	Lake Creek	5	4	9	549	0.00729	0.00911	0.01639
25	35	Dezadeash River, Canyon to Champagne	7	9	16	827	0.01088	0.00846	0.01935
26	28	Aishihik and Sekulmun Lakes	11	6	17	1393	0.00431	0.00790	0.01220

Rank	Zone	Name	Social Values	Ecological Values	Total Values	Area (km^2)	Ecological Values per Area	Social Values per Area	Total Values per Area
27	50	Mt. Archibald/Vulcan Mt.	10	4	14	1319	0.00303	0.00758	0.01061
28	10	Quill Creek	3	4	7	456	0.00877	0.00658	0.01535
29	33	Taye Lake	5	7	12	793	0.00883	0.00631	0.01513
30	1	Steele Creek	4	3	7	662	0.00453	0.00604	0.01057
31	15	Donjek-Kluane River Confluence	3	8	11	500	0.01600	0.00600	0.02200
32	41	South Takhini River	1	2	3	179	0.01117	0.00559	0.01676
33	22	Gladstone Creek/Isaac Creek	7	3	10	1258	0.00238	0.00556	0.00795
34	23	Swanson Creek/Venus Creek	6	4	10	1089	0.00367	0.00551	0.00918
35	27	Stevens Lake	6	7	13	1140	0.00614	0.00526	0.01140
36	5	Pickhandle Lakes	5	8	13	983	0.00814	0.00509	0.01322
37	19	Brooks Arm Plateau	3	7	10	663	0.01056	0.00452	0.01508
38	3	Klutlan Glacier	5	6	11	1107	0.00542	0.00452	0.00994
39	29	Long Lake	5	6	11	1111	0.00540	0.00450	0.00990
40	31	Moraine Lake	5	7	12	1143	0.00612	0.00437	0.01050
41	8	Teepee Lake	4	4	8	976	0.00410	0.00410	0.00820
42	4	Tchawsahmon Lake	3	7	10	866	0.00808	0.00346	0.01155
43	42	Devilhole Creek	4	3	7	1165	0.00258	0.00343	0.00601
44	32	Hutshi Lakes	3	6	9	893	0.00672	0.00336	0.01008
45	2	Wolverine Plateau	3	4	7	1034	0.00387	0.00290	0.00677
46	17	Little Creek/Outlet Hill	1	4	5	361	0.01108	0.00277	0.01385
47	16	Tincup Lake	2	6	8	812	0.00739	0.00246	0.00985
48	21	Talbot Creek	1	3	4	435	0.00690	0.00230	0.00920
49	26	Killermun Lake	2	2	4	955	0.00209	0.00209	0.00419
50	54	White River/Snag	6	8	14	3147	0.00254	0.00191	0.00445
51	55	Wellesley Lake	5	4	9	4606	0.00087	0.00109	0.00195
52	30	Satasha Lake	1	5	6	973	0.00514	0.00103	0.00617
53	53	Icefield Ranges	5	3	8	15199	0.00020	0.00033	0.00053
54	20	Dwarf Birch Creek	0	5	5	2114	0.00237	0.00000	0.00237

Table A4.6 - Zones Ranked by Ecological Values per Unit Area

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km^2)	Ecological Values per Area	Social Values per Area	Total Values per Area
1	18	Kluane River	17	9	8	287	0.02787	0.03136	0.05923
2	25	Kloo Lake	16	7	9	368	0.02446	0.01902	0.04348
3	11	Burwash Uplands	16	8	8	389	0.02057	0.02057	0.04113
4	24	Jarvis River	17	8	9	457	0.01969	0.01751	0.03720
5	46	Mush-Bates Lakes	15	9	6	360	0.01667	0.02500	0.04167
6	39	Frederick Lake	9	4	5	301	0.01661	0.01329	0.02990
7	15	Donjek-Kluane River Confluence	11	3	8	500	0.01600	0.00600	0.02200
8	52	Slims Valley and Delta	19	11	8	568	0.01408	0.01937	0.03345
9	13	South Donjek River Valley	9	6	3	220	0.01364	0.02727	0.04091
10	36	Rainbow Lakes	9	6	3	223	0.01345	0.02691	0.04036
11	43	Klukshu Lake	14	8	6	476	0.01261	0.01681	0.02941
12	41	South Takhini River	3	1	2	179	0.01117	0.00559	0.01676
13	17	Little Creek/Outlet Hill	5	1	4	361	0.01108	0.00277	0.01385
14	35	Dezadeash River, Canyon to Champagne	16	7	9	827	0.01088	0.00846	0.01935
15	44	Tatshenshini/Dalton Post	20	14	6	562	0.01068	0.02491	0.03559
16	51	Hungry Lakes	19	14	5	473	0.01057	0.02960	0.04017
17	19	Brooks Arm Plateau	10	3	7	663	0.01056	0.00452	0.01508
18	12	Bighorn Creek	13	8	5	536	0.00933	0.01493	0.02425
19	49	Kathleen Lakes - Haines Junction	21	15	6	655	0.00916	0.02290	0.03206
20	33	Taye Lake	12	5	7	793	0.00883	0.00631	0.01513
21	10	Quill Creek	7	3	4	456	0.00877	0.00658	0.01535
22	34	Pine Lake	17	11	6	692	0.00867	0.01590	0.02457
23	5	Pickhandle Lakes	13	5	8	983	0.00814	0.00509	0.01322
24	4	Tchawsahmon Lake	10	3	7	866	0.00808	0.00346	0.01155

Rank	Zone	Name	Total Values	Social Values	Ecological Values	Area (km²)	Ecological Values per Area	Social Values per Area	Total Values per Area
25	16	Tincup Lake	8	2	6	812	0.00739	0.00246	0.00985
26	6	Lake Creek	9	5	4	549	0.00729	0.00911	0.01639
27	9	North Donjek Valley	10	7	3	428	0.00701	0.01636	0.02336
28	21	Talbot Creek	4	1	3	435	0.00690	0.00230	0.00920
29	37	Dezadeash and Sixmile Lakes	14	9	5	736	0.00679	0.01223	0.01902
30	32	Hutshi Lakes	9	3	6	893	0.00672	0.00336	0.01008
31	38	Jo-Jo and North Kusawa Lakes	15	9	6	977	0.00614	0.00921	0.01535
32	27	Stevens Lake	13	6	7	1140	0.00614	0.00526	0.01140
33	31	Moraine Lake	12	5	7	1143	0.00612	0.00437	0.01050
34	48	Alsek-Kaskawulsh Confluence	18	13	5	844	0.00592	0.01540	0.02133
35	14	Congdon Creek	13	9	4	738	0.00542	0.01220	0.01762
36	3	Klutlan Glacier	11	5	6	1107	0.00542	0.00452	0.00994
37	29	Long Lake	11	5	6	1111	0.00540	0.00450	0.00990
38	30	Satasha Lake	6	1	5	973	0.00514	0.00103	0.00617
39	40	Primrose River	7	5	2	441	0.00454	0.01134	0.01587
40	1	Steele Creek	7	4	3	662	0.00453	0.00604	0.01057
41	28	Aishihik and Sekulmun Lakes	17	11	6	1393	0.00431	0.00790	0.01220
42	8	Teepee Lake	8	4	4	976	0.00410	0.00410	0.00820
43	2	Wolverine Plateau	7	3	4	1034	0.00387	0.00290	0.00677
44	23	Swanson Creek/Venus Creek	10	6	4	1089	0.00367	0.00551	0.00918
45	47	Lowell Lake/Goatherd Mt.	19	15	4	1143	0.00350	0.01312	0.01662
46	50	Mt. Archibald/Vulcan Mt.	14	10	4	1319	0.00303	0.00758	0.01061
47	42	Devilhole Creek	7	4	3	1165	0.00258	0.00343	0.00601
48	54	White River/Snag	14	6	8	3147	0.00254	0.00191	0.00445
49	22	Gladstone Creek/Isaac Creek	10	7	3	1258	0.00238	0.00556	0.00795
50	20	Dwarf Birch Creek	5	0	5	2114	0.00237	0.00000	0.00237
51	45	Onion Lake	14	12	2	910	0.00220	0.01319	0.01538
52	26	Killermun Lake	4	2	2	955	0.00209	0.00209	0.00419
53	55	Wellesley Lake	9	5	4	4606	0.00087	0.00109	0.00195
54	53	Icefield Ranges	8	5	3	15199	0.00020	0.00033	0.00053

APPENDIX 5 - LATIN NAMES

Common Name	Latin Name
PLANTS	
alder	*Alnus sp.*
birch	*Betula sp.*
spruce, white	*Picea glauca*
willow	*Salix sp.*
MAMMALS	
bear, black	*Ursus americanus*
bear, grizzly	*Ursus horribilis*
beaver, American	*Castor canadensis*
bison, wood	*Bison bison athabascae*
caribou, woodland	*Rangifer tarandus caribou*
deer, mule	*Dama hemionus*
elk	*Cervus canadensis*
fox, red	*Vulpes vulpes*
goat, mountain	*Oreamnos americanus*
hare, snowshoe	*Lepus americanus*
lemming, brown	*Lemmus trimucronatus*
lemming, collared	*Dicrostonyx groenlandicus*
lynx	*Lynx canadensis*
marten, pine	*Martes americana*
mink	*Mustela vison*
moose	*Alces alces gigas*
muskrat	*Ondatra zibethicus*
otter, river	*Lontra canadensis*
pika, collared	*Ochotona collaris*
sheep, Dall	*Ovis dalli*
shrew	*Sorex sp.*
squirrel, Arctic ground	*Spermophilus parryii*
vole	*Microtus sp.*
wolf	*Canis lupis*
wolverine	*Gulo gulo*

Common Name	Latin Name
BIRDS	
eagle, bald	*Haliaeetus leucocephalus*
eagle, golden	*Aquila chrysaetos*
falcon, peregrine	*Falco peregrinus anatum*
goshawk, northern	*Accipiter gentilis*
grouse, ruffed	*Bonasa umbellus*
grouse, sharp-tailed	*Tympanuchus phasianellus*
grouse, spruce	*Dendragapus canadensis*
gyrfalcon	*Falco rusticolus*
harrier, northern (marsh hawk)	*Cirus cyaneus*
hawk, red-tailed	*Buteo jamaicensis*
hawk, sharp-shinned	*Accipiter striatus*
hawk-owl, northern	*Surnia ulula*
osprey	*Pandion haliaetus*
owl, boreal	*Aegolius funereus*
owl, great gray	*Strix nebulosa*
owl, great horned	*Bubo virginianus*
owl, short-eared	*Asio flammeus*
ptarmigan, rock	*Lagopus mutus*
ptarmigan, white-tailed	*Lagopus leucurus*
ptarmigan, willow	*Lagopus lagopus*
swan, trumpeter	*Olor buccinator*
tattler, wandering	*Heteroscelus incanus*
FISH	
burbot	*Lota lota*
grayling, Arctic	*Thymallus arcticus*
pike, northern	*Esox lucius*
salmon, chinook	*Oncorhynus tshawytscha*
salmon, chum	*Oncorhynus keta*
salmon, coho	*Oncorhynus kisutch*
salmon, Kokanee/sockeye	*Oncorhyncus nerka*
trout, lake	*Salvelinus namaycush*
trout, rainbow	*Salmo gairdneri*
varden, Dolly	*Salvelinus malma*
whitefish, round	*Prosopium cylindraceum*
whitefish, Squanga	*Prosopium coulteri*

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