CRITICAL FACTORS CONTRIBUTING TO WILDLIFE-HUMAN INTERACTION IN 
THE WIND VALLEY NATURAL AREA: IMPLICATIONS FOR MANAGEMENT

by

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ABSTRACT

The Wind Valley Natural Area, designated by the Province of Alberta in 1995, is located just east of the Town of Canmore, 15 minutes drive from the boundary of Banff National Park, and approximately an hour from Calgary, Alberta. This area contains a rich diversity of flora and wildlife and offers a wide variety of recreational opportunities. Increasing pressure on this Natural Area and the adjacent community of Canmore are predicted through year 2010 as these areas attempt to accommodate the overflow of tourists and service demands from the National Parks and as they adjust to the development of international resort destinations in the Bow Valley. The recently released management plan for the Wind Valley Natural Area (Anonymous, 1996) identifies the maintenance of ecological integrity as a primary objective. In light of this objective and the evidence of increased recreational and developmental pressures in the Bow Valley corridor, the problem of human-wildlife interaction needs to be understood and addressed.

The Wind Valley Natural Area contains critical patch and corridor systems for two large mammal species, bighorn sheep (*Ovis canadensis canadensis*) and grizzly bears (*Ursus arctos horribilis*). These mega fauna function as umbrella species and by managing for their biological and ecological requirements the habitat needs of many other smaller mammal species may be met.

This study was an attempt to integrate the ecological implications and social context of the problem of wildlife-human interaction in the Wind Valley Natural Areas with the objective of developing a site specific strategy for mitigating current and potential conflicts. This document contains a review of the context for the problem of human-wildlife interaction, the history of the problem, and the factors that contribute to this interaction in the Wind Valley Natural Area. Field data collected over the summer and fall of 1995 on the use of habitat in the Wind Valley Natural Area by bighorn sheep and grizzly bears are summarized and human use was determined through a self-administered survey instrument. These data were used to identify areas of current and potential human-wildlife conflict. Management strategies proposed were based on the present status of the wildlife populations and habitat use with consideration of the possible risks associated with current trends and processes in the Bow Valley corridor. A number of models for evaluating human-wildlife interaction were evaluated and recommendations include suggestions for implementing a long-term monitoring program based on a number of indicators identified in the literature. The problems of the complexity of cause-effect relationships and the lack of baseline data remain limitations to this study.
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CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

INTRODUCTION

A number of factors have led to a recent shift in resource management issues in the Bow Valley, Alberta including an increased number of tourists seeking a wide range of recreational experiences, the growth of tourism resort developments, a general increase in population levels in Alberta and British Columbia, concurrent changes in demographics, and changes in social values toward the environment (White et al., 1995; Coopers and Lybrand Consulting, 1995). Policies of preservation within protected areas and parks are no longer adequate strategies for the conservation and protection of ecosystems containing important natural and cultural heritage. Managers are challenged with resolving disparate and often incompatible interests and values toward particular resources while maintaining ecological integrity at a landscape level.

The Wind Valley Natural Area (see Figure 1) now administered by Alberta Environmental Protection is located approximately 10 kilometers from the boundary of Banff National Park and southeast of the Town of Canmore. The natural area is affected by changes and growth in the Town of Canmore as it becomes an international resort destination, and as it absorbs tourist overflows from Banff National Park. A study by McNichol (1996a:27) found that Canmore residents are concerned about wildlife habitat and migratory corridors, specifically, “reduction of carnivore habitats and migration corridors, disruption of ungulate migration corridors, and possible interference with calving of mountain goats and mountain sheep by noise pollution”.

1Early establishment of parks and protected areas was carried out with the intention of preserving beautiful landscapes and vistas and creating revenue through tourism. With the emergence of conservation biology and ecology, there has been a shift in values toward an ecosystem based approach to the selection and management of these areas. White et al. states (1995, 2) “as sanctuaries of biodiversity, national and provincial parks and wildernesses must be carefully integrated in a regional landscape that sustains entire ecosystems”.
Figure 1: General location of the Wind Valley Natural Area (from Ashton et al., 1994:4) (1:500,000 scale)
Wildlife habitat protection and enhancement were important topics identified in the draft terms of reference for the recently designated (1995) Wind Valley Natural Area (Anonymous, 1995a). The general management issues identified in the literature include concerns such as increased tourism and recreational use, interactions between people and wildlife, conflicts between different types of recreationists, and pressures exerted from land development in the Bow Valley area outside of the Natural Area boundaries (see Figure 2) (Town of Canmore, 1995; Coopers and Lybrand Consulting Ltd., 1995; Anonymous, 1996a).

This study examines the problem of interaction between people and wildlife in the Wind Valley Natural Area and the factors contributing to this interaction. This problem cannot be investigated without an understanding of the other processes and trends in the Bow Valley corridor. Higher numbers of visitors will increase the likelihood of conflicts and some users will be more likely to precipitate human-wildlife interaction than others. Critical to this discussion is an examination of the pressures exerted on the wildlife populations from outside the Natural Area boundaries. Two wildlife species, bighorn sheep (*Ovis canadensis canadensis*) and grizzly bears (*Ursus arctos horribilis*) were selected for examination, because these two species are identified as indicators of the health of the Rocky Mountain ecosystem (White *et al.*, 1995). The Wind Valley contains “a critical patch and corridor for bears and ungulates” (White *et al.*, 1995:7) and managing for these large mammal species will serve as an umbrella strategy whereby the habitat needs of most small mammals can be met by achieving the greater ecological needs of the umbrella (large mammal) species. Paquet and Hackman (1995) found that through the protection of the habitat needs of the grizzly bear, lynx (*Lynx lynx*) and wolf (*Canis lupus*), the habitat needs of 403 other additional species were met. “Maintaining the habitats and ecosystems necessary to sustain grizzly bears is a good way to retain the lines of dependency for
food and other services for a wide range of other animal and plants and thus ensure that biodiversity is maintained throughout the ecosystem” (Anonymous, 1995b:32).

Aims and Objectives

It was the purpose of this project to develop a site specific strategy for avoiding conflict between humans and wildlife (specifically bighorn sheep and grizzly bears) in the Wind Valley Natural Area. The questions examined in this study were:

*What are the factors contributing to current human-wildlife interactions in the Wind Valley Natural Area? What mechanisms can be used to avoid long term detrimental impacts and future conflicts using the examples of bighorn sheep and grizzly bears?*

For the purpose of this study, the problem of interaction between people and wildlife in the Wind Valley Natural Area was divided into four major sections with the following objectives:

1. Identification of the problem, explored through an extensive literature review;
2. Determination of the causal factors contributing to wildlife-human interaction in the Wind Valley Natural Area, explored in the literature review;
3. Elaboration of the potential direct and indirect impacts of this interaction on wildlife populations, also developed through the literature review;
4. Establishment of baseline interaction from field data collected in the summer of 1995 on human use of the Wind Valley as well as the habitat used by grizzly bears and bighorn sheep. This information was used to identify areas of current and potential conflict in the Wind Valley Natural Area; and
5. Selection of management strategies based on the current status of human-wildlife interaction and with reference to the management objective of maintaining the ecological integrity of the area.

A scoping review of relevant literature provides a theoretical framework for understanding the problem of human-wildlife interaction. The historical context including background information from the literature on the history of wildlife management and the
regulatory and management history of the Wind Valley builds an initial perspective on the problem. A review of literature on the direct and indirect impacts of human development, recreation and human use on wildlife allows for the determination of the factors contributing to wildlife-human interaction in protected areas such as the Wind Valley Natural Area. The patterns of human use and the status of bighorn sheep and grizzly bear populations in the Natural Area were elaborated through a summary of what is known about the area and a summary of field data collected during the summer and fall of 1995. This baseline information is critical to understanding how different trends in development and recreation have contributed to human-wildlife conflict in the Wind Valley Natural Area. The findings of this investigation were used to develop a site specific plan for managing conflicts between wildlife and humans in the Wind Valley Natural Area and as a means to implementing long term monitoring and adaptive management strategies aimed at achieving the objective of maintaining the ecological integrity of the area.
Number 1: Three Sisters Golf Resorts Inc.
- proposed major four season resort complex
- will include hotels, multi-family residential and single family residential development
- may include interval ownership, retail stores, camping, RV park and other recreational facilities
- two 18-hole golf courses
- the development is on private land
- lands exchanged or leased for Wind Valley land are represented by this symbol * on the map
- Wind Valley land exchanged is delineated by --- on the map

Number 2: Limestone Valley Resort
- proposed 18-hole golf course
- will include a 150-unit RV park and campground
- may include a 100-room lodge and day-use facilities
- the development is on private and public lands

Number 3: Alpine Resort Haven
- will include 48 time-share chalets and about 40 RV sites
- the development is on public land

Number 4: Mt. Lady MacDonald Tea House
- proposed 35-seat tea house with lookout deck
- will include a gazebo site and two helicopter landing sites
- development is located at the 7600 foot level
- accessed by helicopter or foot
- the development is on public land

Number 5: Stone Creek Development Company
- proposed 500 room Hyatt hotel and convention center with 200 units of staff housing
- will include multi-family and single-family residential development
- one 18-hole golf course
- the development is on private and public lands
LITERATURE REVIEW

A review of the history of wildlife management, policy and legislation in National Parks, particularly Banff National Park, and in Alberta protected areas provides the context for the discussion of human-wildlife interaction in the Wind Valley Natural Area. A survey of literature identifying the human aspects of wildlife management establishes the nature of human-wildlife interaction and the factors contributing to conflicts. Current models for understanding and evaluating the impacts of human-wildlife interactions are discussed. This theoretical framework is further elaborated with an exploration of the literature on the ecology of bighorn sheep and grizzly bears and their responses to human disturbance. The field data collected in 1995 on human use of the Wind Valley Natural Area as well as the habitat used by bighorn sheep and grizzly bears was interpreted within the context established by the literature review and mechanisms for avoiding human-wildlife conflicts were suggested.

The Historical and Theoretical Context

The Emergence of National and Provincial Policy and Legislation

The discipline of wildlife management emerged in the United States with the publication of Leopold's work, Game Management (1933). In this book, Leopold emphasized the utilitarian aspects of wildlife management with his focus on the wildlife productivity of the land base. He also explicated a concept of stewardship and harmony between humans and nature. This concept was downplayed by managers in subsequent years in favor of the utilitarian goals such as an emphasis on increased wildlife productivity for hunting opportunities (Gilbert and Dodds, 1992).

Although Leopold's values of the interdependency of land and wildlife were enshrined in the

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2Management decisions were motivated by the resource opportunities of wildland areas rather than ecological or aesthetic potential. Thus areas that were useful or offered resource extraction opportunities were not priorities for conservation or preservation.
American Game Policy of 1930, economic decline and other factors impeded the implementation of the policy (Gilbert and Dodds, 1992).

Concurrent to the emergence of wildlife legislation and policy in the United States, Canadian wildlife management was slowly developing. In the early 1900's crusaders such as Gordon Hewitt, Sir Wilfred Laurier and James B. Harkin assisted in establishing legislation such as the Conservation Act of 1909, the Migratory Bird Treaty and the National Parks Act (1930) (Gilbert and Dodds, 1992; McNamee, 1993). The Parks Branch of the Department of the Interior administered national wildlife legislation in Canada until 1945 when the Canadian Wildlife Service was established as a division of the National Parks Branch. Parks Canada is still involved in wildlife management within its protected areas in collaboration with the Canadian Wildlife Service. With the passage in 1930 of the first National Parks Act, these parks became absolute game sanctuaries. Extractive use such as mineral exploration and hunting were prohibited and use of green timber was limited to that essential for park use (McNamee, 1993). The Act of 1930 provided both protection for existing parks and a mechanism for the designation of further protected areas. The National Parks Act was the culmination of more than a century of evolution of policy and legislation in North America, beginning with Yellowstone National Park (1872) and the Rocky Mountain Act of 1887 (Cloke, 1987).

In spite of the preservation mandate of the National Parks Act, the three decades following the legislation were characterized by a utilitarian approach. It was not until the 1960s and 1970s that the emphasis in the field of wildlife management began to change. A number of factors such as the publication of Rachel Carson's *Silent Spring*, the increased rate of urban expansion and industrialization, and problems with air and water quality all contributed to a growth in public concern about the environment (McNamee, 1993). International conventions
such as the Ramsar Convention (protection of wetlands of importance) were initiated in the early 1970s due to this change in public attitude (McNamee, 1993).

In national parks, because of the dual mandate of parks for the benefit, education and enjoyment of the public while leaving them unimpaired for the enjoyment of future generations, management initially occurred on an ad hoc basis (McNamee, 1993). Public pressure from groups such as Canadian Parks and Wilderness Society (CPAWS), formerly the National and Provincial Parks Association of Canada (NPPAC), resulted in the release of a policy statement in 1964 (revised in 1979) which established the ecological value of parks as fundamental over utilitarian values. Policy, although indicative of public and administrative goals and values, is not as effective as legislation. Legislation is enforceable by law, while policy that is not supported by legislation is not enforceable and thus is not as strong. It is through changes in legislation that changes in management strategies are effected. The 1988 amendments to the National Parks Act do provide limited elaboration on ecological values in section 5(1.2) stating “maintenance of ecological integrity through the protection of natural resources shall be the first priority when considering park zoning and visitor use in a management plan” (Bill C-36 in Eagles, 1993: 58). With the legislative protection stipulating no hunting and no resource extraction in national parks, wildlife management became a study of maintaining populations, reintroduction, habitat manipulation and the protection of the public from wildlife hazards.

Although ownership of wildlife resources falls under provincial jurisdiction according to the Constitution Act of 1982, the federal government has jurisdiction over all migratory birds, mammals crossing provincial boundaries and all wildlife on federal lands. Further, the Canadian Wildlife Act 1976, administered by the Canadian Wildlife Service provides for joint management with the provinces. Alberta provincial park legislation and policy necessitate a more
complex wildlife management strategy as they maintain the dual mandate of conserving significant and representative natural and cultural features while providing a wide variety of outdoor recreational opportunities. These two goals are ambiguous and often incompatible (Swinnerton, 1993).

In the Bow Valley, legislation and environmental protection have a legacy which dates back to the Rocky Mountain Act 1887. This Act established what is now Banff National Park. In the Canmore area, the Dominion Government established the Rocky Mountain National Forest in 1911 which encompassed the Spray River Valley and the Bow Valley. This legislation provided for the protection of timber, watersheds, birds, fishes and mammals in this area. The transfer of jurisdiction over resources to the Province of Alberta in 1930 allowed for a re-evaluation of the designation of these areas. Resource values and interests at that time precipitated the exclusion of the resource rich river valleys from the boundaries of the Rocky Mountain Park system. Thus the Bow and Spray areas were opened to logging, coal mining, oil and gas extraction and dams were built on both the Spray and the Kananaskis rivers (White et al., 1995).

Management objectives in the 1960s were based on the assumption that parks and protected areas should be created and maintained for the use and enjoyment of the public and should offer recreational opportunities such as hunting, hiking, and horseback riding. These objectives did not encompass important ecological considerations which may have required limiting human use in order to achieve conservation aims. Important provincial legislation and policy changes occurred in the 1970s reflecting changes in public attitudes toward the environment. The Alberta Wilderness Areas Act was passed in 1971 which provided protection for several wilderness areas adjacent to Banff National Park. Kananaskis Provincial Park (now Peter Lougheed Provincial Park) was established in 1977 at the same time as the Eastern Slopes.
Policy was developed and released (White et al., 1995). This policy established a multiple-zoning system for the eastern slopes of the Canadian Rocky Mountains. Although the policy was evidence of a shift in public attitude, oil and gas extraction and development were still allowed even in the Prime Protection Areas (Zone 1). Thus the policy was inadequate in effecting changes to management decisions and practices.

Evidence of a shift in public resource values toward protected areas was manifested in policies developed in the late 1980s and early 1990s. The World Commission on Environment and Development (1987) sponsored by the United Nations and chaired by Gro Harlem Brundtland encouraged all nations to protect 12% of their land base by the year 2000. These new initiatives were based on concepts taken from conservation biology and ecology rather than the previous strategies which protected landscapes that were resource poor (a utilitarian approach). Conservation and ecological approaches emphasize the importance of protecting representative and important ecosystems across the landscape. Alberta developed the Special Places 2000 program in 1992 to meet this initiative. According to this process, any Alberta citizen could nominate any area of the province as a special place and a Provincial Coordinating Committee would review the nominations. The goal of the project is to complete “a system that includes the environmental diversity of the province’s six Natural Regions, by the end of 1998” (Anonymous, 1995). Some critics suggest that the 12% goal is misleading because “a more critical yardstick for evaluating protected areas programs is the extent to which a park system incorporates a representative sample of a country’s or province’s natural diversity” (Swinnerton, 1993: 122). Alberta has still not achieved this latter goal as only 40 per cent of the ecosystems represented in the province are incorporated into a system of protected areas (Swinnerton, 1993).
The Alberta sites selected for special status will not affect existing petroleum or mineral rights (Harvie, 1996) and will allow for a broad range of uses including; “livestock grazing, oil and gas development, recreation and tourism development, and cultural and heritage appreciation” (Anonymous, 1995a: 2). With the range of designations of Special Places, this status does not denote protection, and thus “to call somewhere a ‘special place’ is meaningless” (Harvie, 1996:23). The Alberta Wilderness Association (AWA) also criticizes the Special Places 2000 project as it is duplicating research that has already been carried out. The AWA suggests that the government act now to protect areas already recognized as needing protection instead of requiring that these areas be submitted to the Special Places Committee (Harvie, 1996).

The Wind Valley was proposed as a Natural Area in 1995 under the Wilderness Areas, Ecological Reserves, and Natural Areas Act of 1980 after much controversy over the value of resources and ecosystems in the Valley. Ecological reserves are the most highly protected of the three Special Place designations, whereas Natural Areas may still host extractive activities including oil and gas extraction, and mining operation within the area boundaries. In the case of Natural Areas, the level of environmental protection afforded by the Special Place designation depends upon the management goals and objectives identified by those responsible for administering the areas. Much of this controversy stems from the historical tradition of preserving resource poor lands as protected areas and the Wind Valley offers a wide variety of resource opportunities as well as a rich and diverse natural ecosystem. A brief review of the history of the Valley illustrates this controversy and how trends and processes in the Bow Valley influence the factors contributing to human-wildlife interaction.
The Wind Valley Region: From Mega-resort Development to Natural Area

Three Sisters Golf Resorts (TSR), a Calgary based privately held development company, first submitted a development proposal to the Municipality of Bighorn in 1989 for property adjacent to the Town of Canmore. The land proposed for development was annexed by the Town of Canmore in 1991 and TSR resubmitted a proposal for a $2.5-billion dollar mega-resort development. The proposed development extended from the Quarry Lake area into the Wind Valley region north of Kananaskis Provincial Park (see Figure 2). The resort development would include three golf courses, a number of residential developments, services and hotel complexes. Three Sisters was requested by the province of Alberta to complete a comprehensive environmental impact assessment for the initial proposal. The first stage of the review process was approved for the Stewart Creek Golf Course in 1991 with some revision. The Wind Valley portion of the proposal was then referred to the Natural Resources Conservation Board (NRCB) for further review.

In 1992 the major resort development proposed by Three Sisters Golf Resorts Inc. for the mouth and lower section of the Wind Valley was found not to be in the public interest due to the sensitive nature of the environment (Natural Resources Conservation Board, 1992). The intensive public review process was carried out by the Natural Resources Conservation Board (NRCB) whose mandate as proclaimed at the Board’s inception in 1991 was to provide:

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3 The Tower Mountain Hotel Resort was specifically proposed for the Wind Valley. This would include a hotel/resort complex and a golf course.
Figure 3: Wildlife movement corridors in the Bow Valley Region (White et al., 1995)
an impartial process to review projects that will or may affect the natural resources of Alberta in order to determine whether, in the Board’s opinion, the projects are in the public interest, having regard to the social and economic effects of the projects and the effect of the projects on the environment (NRCB, 1996: 1).

Over 40 groups or individuals participated in the hearings regarding the construction of the Tower Mountain Resort Center in the Wind Valley. According to the findings of the NRCB, limited recreational opportunities would be acceptable in the Wind Valley as long as they did not compromise the ecological integrity of the area. The Board emphasized the importance of maintaining critical wildlife corridors (see Figure 3) which pass through the area (NRCB, 1992).

The NRCB suggested that the private holdings in the Wind Valley be exchanged for land adjacent to the Town of Canmore and that these areas be retained as public land. This land swap was completed in 1994 and Three Sisters Resorts Inc. was compensated with land within the Town of Canmore area. In 1995, as a part of a push to meet the Special Places 2000 commitment, the Wind Valley was designated a Natural Area under the Wilderness Areas, Ecological Reserves, and Natural Areas Act of 1980. Although a portion of the Wind Valley Region (approximately 12 per cent) is still retained as private land, an estimated 80 per cent is within Kananaskis Country.

A government task force developed a draft management plan (1996) that has “identified a boundary, management intent and objectives, major issues, stakeholders, as well as acceptable and unacceptable activities” (Anonymous, 1996a: 6). One of the concerns listed as a topic to be addressed is “wildlife conflicts” (Anonymous, 1996a: 10). There are two aspects to examining wildlife-human interaction in the Wind Valley Natural Area: the problems of human-wildlife interaction within the Natural Area, and the effects of process and developments outside the boundaries of the designated area. An overview of the human dimensions of wildlife
management offers a context for understanding the nature of human-wildlife interaction, the factors that contribute to them, and the impacts and effects that this interaction may have on the wildlife.

What are the Human Dimensions of Wildlife Management?

Beginning in the early 1960s there was an accelerated accumulation of biological and ecological information collected on both game and non-game species (Robinson and Bolin, 1989). At this time, there was a recognition that “reinforced the view that wildlife biology and ecology were the basis for the practice of wildlife management and reflected the recognition of nonconsumptive uses and users as legitimate beneficiaries of management” (Decker, 1992: 37). This was a shift away from the previous utilitarian and consumption oriented management practices.

Caughley and Sinclair (1994) suggest that there has been a discernible pattern of change in park perceptions and resultant wildlife management practices throughout the last three decades. Parks were originally created to “conserve the scenery and encourage tourism” (Caughley and Sinclair, 1994: 269). This goal implied further development, expansion of facilities and the extermination of dangerous carnivores. In the late 1960s and early 1970s, the next park ‘fashion’ emerged with its emphasis on ‘indicator species’ (Caughley and Sinclair, 1994: 269) or ‘charismatic megavertebrates’ (Primack, 1993: 313). This single species management approach (using indicator species) necessitates protection of habitat particular to the endangered species (e.g. the spotted owl Strix occidentalis and the old growth forest), the control of predators, and management for hunting and game values (Hummel, 1989; Primack, 1993). Although an improvement on the utilitarian management approach, the single species management strategy is limited and often requires a reactive approach.
The human, or social, dimensions of wildlife management began to emerge in the 1980s. Bailey (1984) based his work, *Principles of Wildlife Management*, on the ecological concepts established by Leopold in 1933. He adopted the definition put forward by Leopold which defined wildlife management as “the art of making land produce valuable populations of wildlife” (Bailey, 1984: 6). Expanding on the earlier notions of harmony and utility, Bailey placed wildlife management within the context of the more general framework of wildlife conservation which he defined as “a social process encompassing both lay and professional activities that defines and seeks to attain wise use of wildlife resources and maintain the productivity of wildlife habitats” (Bailey, 1984: 9). Bailey explains wildlife management as an incremental process which involves both biological and sociological aspects, but he does not fully elaborate on the integration of these different factors. Bailey contributes a broader understanding of the value of wildlife that expands on the quantitative or scientific model as “wildlife have several values - commercial, recreational, biological, scientific, social, aesthetic, and negative” (Bailey, 1984: 10). The recognition by authors such as Bailey of the multiplicity of attitudes and values involved in wildlife management established a foundation for the study of human-wildlife interaction.

From 1978 to 1986, there was a proliferation of wildlife oriented ecological texts published (Decker *et al*., 1992). Decker *et al*., identified three themes which emerged from the literature during this period. These themes are consistent with the patterns identified in Caughley and Sinclair (1994). In order of evolution they included: “producing wildlife of recreational interest for recreational use; manipulating wildlife to meet societal goals for the wildlife resource; and manipulating wildlife and people to meet societal goals for the wildlife resource” (Decker *et al*., 1992: 38). The third theme identified by Decker *et al*. (1992), the manipulation of people and wildlife to meet societal goals, refers to an emerging management scheme that moves
beyond the limitations of the single species techniques. This approach has evolved into ecosystem management, a strategy developed by Frankel and Soule (1981). According to these authors, the purpose of nature reserves is to maintain the complex ecological processes along with the genetic diversity, behavioural and physical processes which have resulted from the coevolution of populations in these areas through time. In light of this emergent theme, Caughley and Sinclair (1994: 268) state that in national parks “the conservation of species supposedly takes precedence over all other uses of the land”. The Canadian Council of Ministers of the Environment (CCME) has defined ecosystem management as “the integrated management of ecological systems (natural landscapes, ecological processes, and physical and biological components) and human activities (policies, programs, actions, and evaluations) to maintain or enhance the health and integrity of an ecosystem (CCME, 1996).

Knight and George (1995) consider this new ecosystem management approach to be an advance in the right direction, but still an inadequate management strategy for meeting the stated objectives in protected areas. Many stresses and pressures on protected areas originate outside the boundaries of the area or ecosystem. This problem is addressed by Knight and George (1995: 282) through the strategy that they refer to as “an integrated landscape approach” which avoids the problems of single species and ecosystem management as protected areas are components of a larger landscape to be managed, not limited to the boundary of the management unit. Accordingly, this strategy “manipulates habitat and landscapes in such a way as to collectively influence groups of species in the desired direction” (Knight and George, 1995: 282). Landscape ecology is derived from conservation biology and ecology and based upon concepts fundamental to these disciplines such as: minimum viable population size, island biogeography, patch dynamics, fragmentation, stress ecology, and catastrophe theory (Theberge, 1993).
Forman and Godron (1986) discuss landscape ecology; their approach views regions as a mosaic of patches and corridors within the context of a matrix or background. A very brief synopsis is that patches are areas that contain important habitat for plants or animals and corridors allow for movement between patches. The matrix is the rest of the environment which offers little habitat of value and may even be a barrier to wildlife movement. Kaufmann et al. (1994) developed a framework for different scales of ecosystem management based on this approach. These authors elaborate two levels of ecosystem analysis, the coarse filter which evaluates the majority of attributes at a landscape level with a broad brush approach while the fine filter approach manages for special and unique features of the landscape. The concepts of landscape ecology imply a dramatic alteration of wildlife management practices with an emerging emphasis on both the human land use processes and the complexity of landscape and ecological components. The development of management strategies at a landscape level necessitates the consideration of not only ecological processes occurring within the protected area, but also processes across the landscape adjacent to the protected areas (Knight and George, 1995).

Adaptive management strategies are useful to landscape level decision-making as the constant change, complexity of ecosystems and the interactive nature of components of the landscape make predicting outcomes of decisions impossible. Ongoing monitoring and an experimental approach allow for the mitigation of detrimental effects of decisions and the ongoing collection of biological and ecological data and information. It is not possible to assume complete knowledge of an ecosystem and to use simplistic, deterministic models to manage resource populations (Holling, 1978). The need to address ecological and landscape level management concerns was confirmed by a joint federal and provincial policy document.
Sustainable Development: A Special Role for National Provincial and Territorial Parks” (1990) which states that “park agencies will play a lead role in identifying park values that must be considered in planning and managing the use of nearby lands” (Banff National Park, 1992: 1). This approach is currently being applied to many projects in the Bow Valley corridor and is very useful to resolving human-wildlife conflicts in the Wind Valley Natural Area. A landscape level approach allows for the recognition of the considerable pressure that is placed on wildlife populations within the Wind Valley area by development and processes beyond the Natural Area boundaries.

The Wind Valley ecosystem has been under increased pressure from virtually all sides of the valley (Figure 4). The Nakiska Ski area to the south was constructed for the 1988 Winter Olympic Games, while the Alpine Haven Resort and Three Sisters Resorts to the north will continue to bring increasing numbers of tourists to the boundary of the protected area. The preceding examination of the human dimensions of wildlife management outlines the importance of conserving wildlife species by employing ecosystem-based management approaches. In the case of the Wind Valley, increased development pressures, construction, and increased recreational use are some of the factors that contribute to human-wildlife interaction. Since these pressures originate from both within the Natural Area Boundaries and beyond, it is also necessary to use an integrated landscape approach. A thorough understanding of the multiplicity of factors involved in human-wildlife interaction, and the interactivity and complexity of these factors is critical to a discussion of the potential impacts that these factors may have on wildlife and possible mitigative strategies.
Figure 4: Recreation map of Kananaskis Country Spray Lakes and Canmore Region (Maptown Publishing, 1994).
What Factors Lead to Human-Wildlife Interaction?

Recreation and development trends in the Bow Valley have been identified by Coopers and Lybrand in their *Tourism Outlook Report* (1995). The two major communities in this valley that will provide facilities and services to the region are Canmore and Banff. Canmore is adjacent to the Wind Valley Natural Area and changes there will have a more immediate and direct effect on the area. The *Tourism Outlook Report* (1995) predicts that the numbers of overnight person trips to Banff National Park and thus, the Bow Corridor could increase from the current estimated 39 million to 59 million by the year 2010 (Coopers and Lybrand, 1995: 3). Other trends identified in the literature are population increase, diversification of recreational activities and technologies, and changes in social values toward the environment.

When incorporated in 1965, the population of Canmore was 1,535 and the main industry supporting the community was coal mining. In 1979 the last coal mine closed and the economic base of the community began to diversify and expand to include sand, gravel, limestone, cement, rockwool, hydro power, water and tourism/recreation (Steedsman, 1987). With the changes in the economic and social structure of the Bow Valley, it is not surprising that Coopers and Lybrand (1995) found an increased reliance of the communities of Canmore and Banff on tourism to support the local economy. The environment has become increasingly important not as a traditional resource base, but aesthetically and for provision of tourism opportunities. The Canmore Growth Management Strategy states that “the beauty of the surrounding natural environment is the primary source of economic activity for the community” (Town of Canmore, 1995: 5). Changes in the socio-economic values and status of Canmore are characterized in a brief review of changes in the demographics of the community.
Canmore Community and Demographics

From 1976 to 1984, Canmore grew steadily with an annual average growth rate of 11.9%. A number of factors contributed to this growth including the increase in the tourism industry, increase in regional services located in Canmore, a general economic boom in Alberta, and the annexation of new areas (Steedsman, 1987). Between 1989 and 1994 the population grew from 4,833 to 7,161, a growth rate of 33% (City of Calgary Planning Commission, 1995). The 1988 Winter Olympics hosted by Canmore contributed to the international recognition of the town and its surrounding environment. The growth rate has slowed recently; the total population in 1995 was 7,632 with a rate of change of 6.50% from 1994 (City of Calgary Planning Commission, 1995: 4). Nevertheless it is still a large concern of the resident or permanent population (Town of Canmore, 1992). Another concern of residents is the percentage of the population that is non-permanent.

There is a proportionally larger number of Canmore residents in the age category from 35-44 than any other age groups (Table 1). This may be accounted for by the large number of immigrants that came to Canmore during the boom of the eighties, many of the residents in this category are property owners and actively interested in the growth and development directions of the community. There are tensions between recent newcomers to the community of Canmore, and long-term residents regarding resources and environmental priorities. The representation of youths aged 20-24 is smaller than would be expected. This may be explained by the common phenomenon of emigration of youths from rural and small town areas to areas with larger educational facilities and better job opportunities. There are no post-secondary facilities or technical training institutions in Canmore, so the youths seeking to further their education must go to larger urban centers. In light of the growth in the population over the past 20 years, it is not
surprising that only 23.5 percent of the local residents have lived in Canmore for more than 10 years (Table 2). It is generally accepted that “rising population numbers will be accompanied by a changing socio-economic and socio-demographic community profile” (McNichol, 1996b:25). It is projected that the population of Canmore could go from the current 7,632 to 20,000 by the year 2010 (Coopers and Lybrand Consulting, 1995:10).

Table 1: Age-sex distribution within Canmore, 1995 (From the City of Calgary Planning Commission, 1995: 5)

<table>
<thead>
<tr>
<th>Age</th>
<th>Male</th>
<th>Female</th>
<th>Unknown</th>
<th>Total</th>
<th>Percent of Total</th>
<th>% of AB Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>324</td>
<td>293</td>
<td>5</td>
<td>622</td>
<td>8.1</td>
<td>8.2</td>
</tr>
<tr>
<td>5-9</td>
<td>287</td>
<td>285</td>
<td>4</td>
<td>576</td>
<td>7.5</td>
<td>8.1</td>
</tr>
<tr>
<td>10-14</td>
<td>289</td>
<td>296</td>
<td>4</td>
<td>589</td>
<td>7.7</td>
<td>7.3</td>
</tr>
<tr>
<td>15-19</td>
<td>184</td>
<td>163</td>
<td>2</td>
<td>349</td>
<td>4.6</td>
<td>7.0</td>
</tr>
<tr>
<td>20-24</td>
<td>202</td>
<td>206</td>
<td>1</td>
<td>409</td>
<td>5.4</td>
<td>7.6</td>
</tr>
<tr>
<td>25-34</td>
<td>737</td>
<td>772</td>
<td>0</td>
<td>1,509</td>
<td>19.8</td>
<td>19.3</td>
</tr>
<tr>
<td>35-44</td>
<td>896</td>
<td>883</td>
<td>0</td>
<td>1,779</td>
<td>23.3</td>
<td>16.3</td>
</tr>
<tr>
<td>45-54</td>
<td>397</td>
<td>325</td>
<td>0</td>
<td>722</td>
<td>9.5</td>
<td>9.8</td>
</tr>
<tr>
<td>55-64</td>
<td>212</td>
<td>236</td>
<td>0</td>
<td>448</td>
<td>5.9</td>
<td>7.4</td>
</tr>
<tr>
<td>56-69</td>
<td>113</td>
<td>100</td>
<td>1</td>
<td>214</td>
<td>2.8</td>
<td>3.0</td>
</tr>
<tr>
<td>70-105</td>
<td>155</td>
<td>183</td>
<td>0</td>
<td>338</td>
<td>4.4</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Table 2: Length of residence at present address within the municipality of Canmore

<table>
<thead>
<tr>
<th>Length of Residence</th>
<th>Number of Persons</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 year</td>
<td>1,137</td>
<td>14.90</td>
</tr>
<tr>
<td>1 to 2 years</td>
<td>1,337</td>
<td>17.52</td>
</tr>
<tr>
<td>3 to 5 years</td>
<td>1,699</td>
<td>22.26</td>
</tr>
<tr>
<td>6 to 10 years</td>
<td>1,386</td>
<td>18.16</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>1,795</td>
<td>23.52</td>
</tr>
<tr>
<td>Unknown</td>
<td>278</td>
<td>3.64</td>
</tr>
<tr>
<td>Total</td>
<td>7,632</td>
<td>100.00</td>
</tr>
</tbody>
</table>

(Source: The City of Calgary Planning Commission, 1995: 13)
It is likely that a larger percentage of the population will be non-resident or non-permanent as the larger destination resorts develop hotels and condominiums along with family and staff dwellings. It is estimated that 14 percent of the population is currently non-permanent and the percentage of people buying second homes is increasing which will change the demographics of the community further and bring in new attitudes toward growth and development (Town of Canmore, 1992). This influx could further polarize conservation issues in the community with the newcomers aligning with the developers against the more conservation oriented long-term residents.

Different Environmental Values Within the Canmore Community

Changes in demographics in the Canmore community have influenced decision-making processes concerning resources in the region. The environmental reviews of the Wind Valley NRCB hearings were replete with conflict and controversy. Author Barbara McNichol states that “conflicts between major tourism resort projects and the conservation of areas of outstanding beauty and wildlife habitat emphasize differences in public and private values” (McNichol, 1996a: 1). This author found differences in attitudes among permanent local residents, planners and those with development interests. Both permanent residents and planners find the wilderness and the environment to be important concerns. Permanent residents of the community found Three Sisters Golf Resorts development to be “high environmental impact, (due to) large land areas used, and (the potential of) many wildlife problems” (McNichol, 1996a: 11).

The management planning process for the Wind Valley Natural Area included a component of public participation and comment. The Terms of Reference state that “The public will play a significant role in the preparation of the management plan and its implementation” (Anonymous, 1996a: 3). This participation was achieved through holding open public meetings
in the community of Canmore to discuss the Terms of Reference and identify further issues for discussion and inclusion in the plan. About 100 people attended the Canmore open house on March 5, 1996. Some of the issues addressed at this meeting included mineral extraction, hunting, development and recreational use.

**Trends in Recreation and Changes in Values**

The Wind Valley Natural Area is a wildland recreation area and as such a discussion of recreational interests and values is critical to understanding the causes of wildlife-human interaction. Robinson and Bolin (1989: 338) offer a discussion of recreational values and state that “although it seems intuitively clear that wildlife enhances recreational values for park visitors, there is little quantitative information to support that assumption”. One quantitative study by Browne (1987) that is referred to by Robinson and Bolin (1989: 338) states that “interest-in-wildlife values... compared favorably with those of exercise and outranked such values as the personal achievement of hiking and the opportunity to reflect on personal values”. Yet an increase in the popularity of activities such as wildlife viewing and photography could contribute to an increase in wildlife-human interaction.

Flather and Cordell (1995) have identified future trends in what they term non-wildlife dependent recreational activities. These authors established a method for categorizing wildlife-human interaction which differentiates activities that are dependent on wildlife (consumptive or harvesting specific species and nonconsumptive) versus nondependent activities. Those activities which are wildlife-dependent are “contingent on the expected occurrence of wildlife” (Flather and Cordell, 1995:4) and those nondependent activities may be enhanced by the occurrence of wildlife, but do not depend on this experience. These trends suggest that
activities projected to grow most rapidly are day hiking, bicycling, developed camping, and rafting and tubing. By the year 2000, we expect these activities to grow by 23%, 24%, 20% and 23%, respectively, relative to their 1987 levels. We are likely to see more participation in high-technology activities such as rock climbing, white-water recreation, cave exploration, diving, cross-country snow travel and ice-climbing. As the frequency and spatial scale of these activities grow, so too will the pressures they place on heretofore undisturbed or lightly disturbed areas and resources (Flather and Cordell, 1995: 13).

Mangum et al. (1992: 194) identify trends in nonconsumptive recreational activities although they do not use the differentiation between wildlife-dependent and nondependent activities. They state that the “popularity of wildlife-associated recreation assuredly has never been at higher levels...participation in observing, feeding, and photographing wildlife (nonconsumptive use) often surpasses participation rates in the traditional activities of fishing and hunting (consumptive use)”.

Trends have also been identified in consumptive activities such as hunting and fishing. Numbers of hunters have remained fairly constant since 1975 although more hunters than previously are pursuing large game, and there is an increase in people participating in fishing (Flather and Cordell, 1995).

Although the projection of trends in nondependent activities is useful, this categorization is misleading as it suggests that those activities which are nondependent have no effect on wildlife. Some authors also find the differentiation between non-consumptive and consumptive uses of wildlife to be misleading since non wildlife-dependent activities may also have detrimental effects on wild animals (Wilkes, 1977; Hicks and Elder, 1979 and Hammitt and Cole, 1987). Selective harvesting such as hunting and fishing have direct effects on wildlife, but “the major source of the impact problem is the recreationist who innocently produces stressful situations for wildlife primarily through unintentional harassment of wild animals” (Hammitt and Cole, 1987: 77).
Although Hicks and Elder (1979: 909) state that “there was an apparent correlation between the recent increase in recreational activity and the decline in bighorn numbers,” Vaske et al. (1995) propose that there may not be such a linear relationship. These authors suggest that “the number of people using a given area plays a smaller role in human-wildlife relationships than selected characteristics of recreational use, such as frequency of use, type of use, and the behaviour of the visitor” (Vaske et al., 1995, 34). It is apparent from the literature on recent trends that many factors lead to the increase in human-wildlife interaction. Future patterns in activities and visitor use in protected areas suggest that there will be an ever increasing number of users and diversification of activities pursued. These trends will place pressure on the wildlife in these protected areas such as the Wind Valley Natural Area and on their habitat and will also contribute to further increases in human-wildlife interaction. This will necessitate a more thorough understanding of the factors contributing to this interaction and the impacts that they have on the wildlife.

What are the impacts?

The specific impacts of recreational activities can be identified through classification schemes and models and the question must be asked whether the impact on wildlife is acceptable⁴ (Pommerantz, et al. 1988). Hammitt and Cole (1987) offer a useful recreation classification scheme which encompasses the wide variety of impacts and recreation types. They expand the definition of human-wildlife interaction to include not only direct interaction (such as harassment, whether intentional or unintentional) but also indirect interaction and secondary effects such as alteration of habitat (see Figure 5). Another model elaborated in the literature by Vaske et al. (1995) established a classification scheme for visitor management strategies which is

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⁴By acceptable the author refers to impacts that do not have a long term detrimental impact on the health of the animals (Pommerantz et al., 1988).
particularly useful to a discussion of mitigation of wildlife-human interaction in the Wind Valley Natural Area.

Figure 5: Major impacts of recreation-wildlife interaction (Hammitt and Cole, 1987:80)

Human disturbance or harassment may result in a number of different wildlife biological scenarios from mortality to changes in physiology, behaviour, reproduction, population levels and species composition and diversity. Geist (1971b:121) defines harassment as “actions which may on one hand cause only some excitement in animals, but on the other hand may lead to panic, severe exertion and consequent damage or the death of the animal”. It is difficult to understand the impacts that disturbance will have on wildlife without understanding their biology. Factors such as yearly cycles, animal age, habitat type, the physiology of pregnancy and
stress, ability to learn, adapt and respond, past experiences and other environmental factors will significantly influence an animal’s response to stress (Geist, 1971b; Knight and Cole, 1995a). It is critical to note that “if a species is already under physiological stress from limited food and other environmental factors, interaction with humans may be especially serious” (Hammitt and Cole, 1987: 79). Knight and Cole (1995a) identify six characteristics of recreationists that determine wildlife responses: type of activity, recreationist’s behaviour, predictability, frequency and magnitude, timing, and location.

From literature on the effects of nonconsumptive activities on wildlife, it is apparent that negative effects are most commonly reported and that few positive reports have been presented. Of 166 reports on the impacts of nonconsumptive recreation on wildlife evaluated by Boyle and Sampson (1985), 81% of the findings were negative (see Table 3). Most authors discussing human-wildlife interaction focus on negative impacts and do not note the fewer positive results. Speight (1986), as quoted in Hammitt and Cole (1987) does outline a number of habitat gains resulting from recreation. These include increased availability of nesting sites for some wetland birds and wood ducks (Aix sponsa), and the creation of habitat for ecotone species as a result of trail, campsite, and pond development.

Purposeful and inadvertent harassment could be caused by many activities. Although hiking, biking, cross-country travel and horse travel on trails can cause changes in the distribution of animals, this type of disturbance “usually has a negligible influence on large mammal distributions and movements” (Hicks and Elder, 1979; Boyle and Samson, 1985). A more deleterious impact of recreational activity is that of feeding animals, leaving food stored improperly or disposing of it inadequately. This problem can profoundly influence bears and may
result in higher densities of small mammals in campgrounds (Boyle and Samson, 1985; Hammitt and Cole, 1987).

**Table 3: Categorization of reports of 166 original studies concerning impacts of nonconsumptive outdoor recreation on wildlife (Boyle and Samson, 1985: 110)**

<table>
<thead>
<tr>
<th>Impact:</th>
<th>birds</th>
<th>mammals</th>
<th>herpetofauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of recreation</td>
<td>Pos Neg None/Unknown</td>
<td>Pos Neg None/Unknown</td>
<td>Pos Neg None/Unknown</td>
</tr>
<tr>
<td>Hiking and camping</td>
<td>4 17 6</td>
<td>5 24 4</td>
<td></td>
</tr>
<tr>
<td>Boating</td>
<td>25 9</td>
<td>1 5 4</td>
<td>1</td>
</tr>
<tr>
<td>Wildlife observation &amp; photography</td>
<td>19 2</td>
<td>7 2</td>
<td>7 1</td>
</tr>
<tr>
<td>Off-road vehicles</td>
<td>1 1</td>
<td>1 7 3</td>
<td></td>
</tr>
<tr>
<td>Snowmobiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spelunking</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Swimming and shore recreation</td>
<td>6 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock climbing</td>
<td>2 3</td>
<td>1 1</td>
<td></td>
</tr>
</tbody>
</table>

Hunting with dogs and certain types of trapping may lead to increased stress on the animals. Hunting can result in altered population structure, changed distribution patterns and altered behaviour patterns (Knight and Cole, 1995b). Although hunting is often used as a management tool for controlling population size, Knight and Cole (1995b) suggest that the compensatory response (if any) of populations to hunting can be negated by the abandonment of habitat due to hunting pressures. This was the case with red deer (*Cervus cervus*) in New Zealand and ruffed grouse (*Bonasa umbellus*) in Wisconsin (Knight and Cole, 1995b). Instead of hunting culling the population and reducing mortality from environmental factors such as disease and starvation, the effects of hunting were actually cumulative to natural mortality (Knight and Cole, 1995b). Although effects are different among species, Hammitt and Cole (1987: 84) suggest that the effects of hunting, fishing and trapping "may eliminate species on a local basis, but it is unlikely that these activities alone could directly result in the extinction of wildlife species". Wishart, (1975) suggests that harvest methods not only may control population, but also may
assist in managing recreational activities. Hunting may reduce the instances of bighorn
habituation to hikers and other recreationists (Ashton et al., 1994). To the contrary, Geist (1979)
points out that selective or consumptive activities such as harvesting particular species are
incompatible with other recreational activities. Habituation and accommodation of wildlife to
recreationists may make them more susceptible to hunting and thus harvesting will “lead almost
inevitably to excessive harassment of the animals and its negative consequences on the
population, except in a few select circumstances” (Geist, 1979: 95).

Nature viewing, although described as a nonconsumptive activity, may have selective
impacts on specific species sought for photography and observation. According to Knight and
Cole (1995b: 55), “nature viewing, by its very definition, has great potential to negatively affect
wildlife”. Many authors note that it is often ignorance by the nature enthusiast that leads to
unintentional impacts on wildlife (Wilkes, 1977). Unlike other recreationists who may
serendipitously encounter wildlife, nature viewers and photographers purposefully pursue certain
species. Thus, “these activities are potentially more disturbing to wildlife, as encounters are
likely to be more frequent and of longer duration” (Boyle and Samson, 1985: 111). Naturally
there will be an increased chance of human-wildlife encounters if the recreationist’s objective is
to find, photograph or observe the wildlife.

Rock climbing, mountaineering, and spelunking often have less direct impact as the
numbers of participants have historically been small. Any increase in their activities will lead to
displacement of bats in caves, and birds from ledges and cliff faces which are established
climbing routes (Boyle and Samson, 1985). These activities may also lead to the harassment of
sheep, goats (Oreamnos americanus), and cougar (Felis concolor) as well as smaller mammals
adapted to the more rugged and arid alpine habitat.
Motorized vehicles, particularly off-road vehicles such as ATVs, four-wheel drives and snowmobiles, have increased in use since the 1960s. These vehicles may result in direct mortality (collision) or injury due to stress, harassment, noise and habitat destruction (Boyle and Samson, 1987; Stemp, 1983; MacArthur, 1982). Radio collared mule deer (*Odocoileus hemionus*) harassed by vehicles were noted to alter feeding and spatial use patterns (Knight and Cole, 1995b). Off-road vehicles can cause substantial damage to vegetation and, “loss of and damage to vegetation affects the food and cover needs of wildlife, resulting in decreased populations” (Bury, 1980: 111). Roads and vehicle access also increase the vulnerability of wildlife to poaching and hunting.

There seems to be a marked difference between the effects of fixed wing aircraft and helicopters on wildlife. Heart-rate monitors in sheep indicate a strong response to helicopters at or under 400m in elevation and no response to the higher flight elevation of fixed wing planes (Stemp, 1983). It is generally accepted that slower and noisier aircraft have a larger disturbance effect on wildlife (Knight and Cole, 1995b).

Other dimensions of human activity that have important impacts on wildlife are resource extraction, development of facilities, road construction, construction and operation of golf courses and other commercial activities, whether inside the protected areas or adjacent to them. Resort development such as down-hill ski areas have long term impacts on both bighorn sheep, and elk (*Cervus elaphus*), resulting in habitat abandonment and harassment (Morrison, 1995; McCallum et al., 1984). Animals have been observed to habituate to activities such as mining if the activity patterns and stimuli are predictable (MacCallum, 1991). Many human activities such as construction and resort development as well as resource extraction have contributed to habitat
destruction, fragmentation, localized population declines and decimation as well as alteration of
behaviour (MacCallum, 1991; Stemp, 1983; Geist, 1979).

Habitat modification and alteration are also discussed by Hammitt and Cole (1987). They
identify impacts such as soil compaction, sedimentation, pollution, eutrophication of lakes, and
the removal of vegetation as primary indirect factors leading to habitat modification. Cole and
Landres (1995:187) extend this list to include other indirect impacts on habitat including altered
soil chemistry and altered vegetative spatial patterns (Table 4).

Table 4: Primary Recreational Impacts on Animal Habitat

<table>
<thead>
<tr>
<th>Soil characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of surface organic horizons</td>
</tr>
<tr>
<td>Reduced soil porosity</td>
</tr>
<tr>
<td>Altered soil chemistry</td>
</tr>
<tr>
<td>Altered soil moisture and temperature</td>
</tr>
<tr>
<td>Altered soil microbiota</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetation characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced plant density/cover</td>
</tr>
<tr>
<td>Altered species composition</td>
</tr>
<tr>
<td>Altered vertical structure</td>
</tr>
<tr>
<td>Altered spatial pattern</td>
</tr>
<tr>
<td>Altered individual plant characteristics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aquatic system characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altered bank/shoreline characteristics</td>
</tr>
<tr>
<td>Altered bed/bottom characteristics</td>
</tr>
<tr>
<td>Altered flow regimes</td>
</tr>
<tr>
<td>Increased sedimentation/turbidity</td>
</tr>
<tr>
<td>Altered organic matter content</td>
</tr>
<tr>
<td>Altered water chemistry</td>
</tr>
</tbody>
</table>

In summation, Hammitt and Cole (1987) contend that the detrimental effects of
recreational activities result in either habitat modification, alteration of behaviour, reduced
reproductive level or changes in species composition and structure. These authors further state
that “the consequences of recreational activities in an area result in an overall decrease in species
diversity in all trophic groups in all parts of the ecosystem” (1987: 88). The model established by
Hammitt and Cole explore the specific impacts of particular recreational activities, but this model has limitations. It fails to examine or accommodate the interactivity of factors and activities. Vaske et al. (1995: 34) suggest that we "must consider the inter-relatedness of impacts, the type of use, the varying tolerance levels of wildlife, and the activity-specific and site-specific influences". Knight and Cole (1995b) have developed a model which extends that of Hammitt and Cole (1987) to include interactivity and longer-term responses of wildlife to disturbances (see Figure 6). In the application of this model, Knight and Cole (1995b: 62) emphasize that recreational activities must not be viewed in isolation as "there may be synergism or interaction when more than one recreational activity is occurring simultaneously". They do account for the impact on the individual, species and community, but not for changes over space and time.

**Figure 6: A conceptual model of response of wildlife to recreational activities (from Knight and Cole, 1995b: 52)**

An interesting model that does account for changes in space and time was developed for the particular analysis of the cumulative effects of development, disturbance and other factors on grizzly bear populations in the Yellowstone ecosystem (Weaver et al., 1985). This approach defines cumulative effects as "the combined effect upon a species or its habitat caused by the
activity or program at hand, as well as other reasonably foreseeable events that are likely to have similar effects upon that species or its habitat” (Weaver et al., 1985: 234). Three major components form the foundation for a cumulative effects model (CEM); habitat quality, displacement and mortality (See Figure 7). Two basic steps are involved in developing a CEM; mapping habitat components and categorizing and mapping land use and potential displacement activities (Weaver et al., 1985). This involves the development of three submodels; a habitat submodel, displacement submodel and a mortality submodel (Figure 7).

Figure 7: A cumulative effects model for grizzly bear management in the Yellowstone Ecosystem (Weaver et al., 1985:235)

An understanding of the ecology of bighorn sheep and grizzly bears and the species’ response to disturbance stimuli is critical to a discussion of current and potential areas of conflict between mammals and people in the Wind Valley and further elaborates the potential direct and indirect impacts and risks.
RESPONSES OF BIGHORN SHEEP TO HUMAN DISTURBANCE (INDICATIONS AND PREVIOUS STUDIES)

In order to explore human-wildlife interaction in the Wind Valley Natural Area, bighorn sheep and grizzly bears were selected as indicator species (Anonymous, 1992). Sheep are an important part of the health of the Wind Valley ecosystem as declines in sheep populations would result in declines in populations of predators (Ashton, 1994: 38). Therefore, understanding the pressures on sheep and their response to human disturbance is critical to maintaining the integrity of the valley ecosystem. Responses of the sheep to human disturbance must be understood in the context of their ecology and biology.

**Bighorn Sheep Ecology**

The bighorn sheep (*Ovis canadensis canadensis* S.) in the Wind Valley is the only one of the seven subspecies of bighorn still known to occur in Alberta (Stemp, 1983). Bighorn sheep tend to live in open, mountainous areas usually close to rocky and cliffy escape terrain. This is a result of the bighorn’s “anti-predator strategy” which includes acute eyesight for the detection of predators at a distance and the rapid escape over cliffs or rocky terrain due to physical adaptation (MacCallum, 1991). This explains why sheep are more likely to run and exhibit increased stress response when approached from above (Geist, 1975).

**Food and Habitat Use**

Bighorn sheep feed largely on alpine and subalpine grasses and sedges (Geist, 1971a). Browse is included as part of the diet in the fall and winter when grasses are not as available or as nutritious (Wishart, 1958). Bighorns usually have distinct home ranges and move seasonally within this range to take advantage of high quality forage (Festa-Bianchet, 1986). The seasonal migration patterns of nursery herds are passed down through lines of common maternal descent.
For the males, Geist (1971a) suggests that rank order is based on the horn size but Festo-Bianchet (1986: 2131) adds that “at some times of the year the tendency to follow conspecifics may be greater than that to return to the same seasonal range”. Thus patterns of movement are determined by traditional ranges and the habitat selection of the older male and female sheep.

In early spring, the ewes will move from the winter ranges to protected and dry cliffs for lambing. This is a very critical period in the annual cycle of the sheep as many different factors including lambing too early or too late, cold, wet weather, or lack of available high quality forage can all increase lamb mortality and reduce the reproductive success of the population (Stemp, 1983).

After lambing, the sheep will move toward summer ranges in nursery herds. At this time they must gain adequate weight to carry them through the winter months. They will follow the contours of elevation offering high quality vegetation. The lambs will be weaned by the end of the summer. In fall, the nursery herds and the rams will congregate on the winter ranges for the rut (Geist, 1971a). Dispersal and the sub-structuring of the population probably maintain the genetic variation within bighorn populations thus, “preserving the evolutionary potential of the metapopulations....should be of concern to managers” (Bleich et al. 1990). It has been suggested that predation and the highly developed bighorn anti-predator strategy are an important means of spurring the bighorn movements throughout their entire range and that a reduction in predation or predator populations results in less effective use of ranges.

Another important determination of spatial distribution of bighorn sheep is the availability of lick sites. It is suggested that licks supply important mineral nutrients critical to
the physiological regulation of imbalances resulting from the ingestion of high levels of potassium through consumption of spring vegetation (Jones and Hanson, 1985).

**Population Parameters**

Population indices include actual counts, survivorship, lamb to ewe ratios, population density, sex ratios, and mortality. Due to the limited nature of the study period and the lack of baseline data, this study only calculated lamb to ewe ratios and documented any population counts available. A five month study period is not adequate for determining survival and little information is available on mortality beyond hunting data (included in Chapter Three under Hunting Regulation and Wildlife Management Boundaries).

**Table 5: Survey Totals of Bighorn Sheep Observed in the Mt. Allan-Wind Ridge Area, 1973-1987**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SURVEY TYPE</th>
<th>NOV.</th>
<th>DEC.</th>
<th>JAN.</th>
<th>FEB.</th>
<th>MAR.</th>
<th>APR.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972-73</td>
<td>Aerial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>136 (86)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1977-78</td>
<td>Aerial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>179 (91)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1978-79</td>
<td>Aerial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>210 (87)</td>
<td>273 (43)</td>
<td>274 (94)</td>
</tr>
<tr>
<td>1982-83</td>
<td>Aerial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>229 (80)</td>
<td>166 (87)</td>
<td>-</td>
</tr>
<tr>
<td>1984-85</td>
<td>Aerial</td>
<td>-</td>
<td>196 (88)</td>
<td>230 (92)</td>
<td>235 (87)</td>
<td>249 (100)</td>
<td>255 (105)</td>
</tr>
<tr>
<td>1985-86</td>
<td>Ground</td>
<td>-</td>
<td>220 (114)</td>
<td>239 (143)</td>
<td>228 (122)</td>
<td>263 (156)</td>
<td>297 (152)</td>
</tr>
<tr>
<td>1986-87</td>
<td>Ground &amp; Aerial</td>
<td>175b</td>
<td>119b (45)</td>
<td>163 (79)</td>
<td>199 (93)</td>
<td>243 (127)</td>
<td>146 (65)</td>
</tr>
<tr>
<td>1987-88</td>
<td>Ground</td>
<td>-</td>
<td>-</td>
<td>216 (127)</td>
<td>244 (120)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1988-89</td>
<td>Ground &amp; Aerial</td>
<td>-</td>
<td>-</td>
<td>262 (143)</td>
<td>-</td>
<td>259 (107)</td>
<td>-</td>
</tr>
<tr>
<td>1989-90</td>
<td>Ground &amp; Aerial</td>
<td>-</td>
<td>-</td>
<td>254 (103)</td>
<td>-</td>
<td>233 (106)</td>
<td>-</td>
</tr>
<tr>
<td>1991-92</td>
<td>Ground &amp; Aerial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>277 (114)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* -Ridges and Pigeon Mountain done by aerial
- -Ridges and Pigeon Mountain not surveyed
( ) -total number seen on Wind Ridge

The survey census data that are available for the Wind Valley-Mount Allan herd have been compiled with the more recent survey data from Alberta Fish and Wildlife Division in
Table 4. These numbers confirm that the Mount-Allan, Wind Valley bighorn sheep herd has a maximum of 297 individuals. These baseline numbers form a benchmark reference for future counts which are done annually and should be evaluated in concurrence with other information such as habitat use and behaviour as well as population structure.

**Lamb to ewe ratios**

Seip (1983) found survival of lambs in Stone’s Sheep to be inversely related to winter snow accumulation while Schaler (1977) determined that nutrition, weather, and population densities were important limiting factors for wild sheep populations in the Himalaya. Beuchner (1960) found that sheep exposed to stress were more susceptible to the lungworm complex which has contributed to major die-offs of bighorn sheep. This parasite is transmitted transplacentally which would contribute to reduced survival of lambs. Reduced lamb counts could also result from an increase in predation.

**Behavioural Response To Human Disturbance**

The behavioural patterns of bighorn sheep are complex and rather than being based on territoriality, are derived from tradition and social inheritance. A number of factors may influence the bighorn response to disturbance: group size is an important form of avoiding predation as the larger the group, the more likely the sheep are to detect an approaching predator early (Blood, 1963; Stemp, 1983); the need to be proximate to adequate escape terrain may actually limit the ability of the sheep to utilize forage resources in terrain that is not close to cliffs or talus slopes (Shannon *et al.*, 1975; Stemp, 1983). Distance traveled from escape terrain may also limit the reproductive rate and body size of the wild sheep (Wishart, 1958; Beuchner, 1960). It has been established that distance to escape terrain is the most significant environmental factor causing exponential increases in heart rates when wild sheep are disturbed (Stemp, 1983).
Animals will have different levels of tolerance to pressures exerted by humans. If the pressures are beyond the tolerance of the animals, there may be two types of behavioural response. Bighorn sheep may habituate to the disturbance as in MacCallum’s (1991) study of sheep in open pit coal mines, or they may be displaced. In one study, the bighorn use of an area in the San Gabriel Mountains decreased as human use increased (Deforge in Stemp, 1983). According to Geist (1971: 12), displacement could result from harassment for, “at the very least harassment only raises the cost of living to the animals, which in turn must be drawn from the ranges inhabited by them; at worst it can cause their death”. Disturbance of wild sheep is exacerbated by two factors, the relatively low productivity which reduces the chances of population recovery (Beuchner, 1960) and the reliance on traditional habitat (Shannon et al., 1975). Stemp (1983) suggests that because bighorn sheep tend to be bound by traditional home ranges, they are more likely to compress their range if displaced by human activities than to colonize new ranges.

Non-consumptive recreational use (such as hiking, wildlife viewing, photography among others) offers the public an opportunity to appreciate the bighorn sheep in a natural biological niche (Wishart, 1975). Human encroachment, such as development or increased recreational use may cause the displacement of other species such as elk, or mule deer (Odocoileus hemionus) in the case of the Wind Valley and force them to move into some bighorn sheep habitat. These species may be able to out-compete the sheep and thus reduce the forage available to the bighorns (Stemp, 1983). Wishart (1975) found that when elk and mule deer were disturbed by human activities in the valley bottom, they moved into higher elevations and displaced the bighorn sheep.
Bighorn sheep are susceptible to many different stresses which range from environmental to human disturbance. Environmental sources of stress may consist of cold and wet weather, seasonal starvation, heat, and emotional upset due to predators or humans. Stemp (1983: 22) states that “many of these stressors could conceivably be experienced simultaneously resulting in an additive stress load”. Overpopulation can cause stress as there may be a resultant loss in food quality and quantity, and increase in parasitic burdens. These factors can lead to a decrease in productivity (Geist, 1971b; Stemp, 1983).

Recreation pressures in the Wind Valley have not been previously documented and little is known about the human use of this area. One activity that has been documented however, is hunting. The bighorn rams in populations that have been hunted tend to avoid human interaction by moving to the most inaccessible areas of their range (Geist, 1971b). This is the case in the Wind Valley as few rams were seen throughout the 1995 field term.

It is well established that bighorn sheep will habituate to predictable stimuli, but it is not known whether they will habituate to helicopter traffic (Geist, 1971b; MacCallum, 1991; Morgantini, 1979). In a study done by Bleich et al. (1993:386) it was proposed that sheep did not habituate to repeated helicopter overflights. These authors found that “The negative influence of the helicopter was extreme and may override variables that might otherwise be correlated with movement patterns of mountain sheep” (Bleich et al., 1993:386). It is also recognized that helicopters elicit one of the most extreme responses of sheep to a human disturbance (MacCallum, 1991; Wishart, 1975). A more recent study found evidence of alteration of behaviour in desert-dwelling ungulates suggesting that they “habituate to simulated sound levels of low-altitude aircraft” (Weisenberger et al., 1996:52). Pressures from low flying aircraft and helicopter traffic could be cumulative to other stresses in the bighorn habitat. Although studies
about the possibility of habituation are inconclusive, it is possible that the sheep could be displaced from traditional home ranges by unpredictable aircraft disturbances.

MacCallum (1991: 85) found that,

*the most extreme reaction witnessed was to a helicopter that appeared suddenly from the Gregg River below the 50-A-2 dump on October 28, 1985, at 1200 hrs... The sheep, which had been grazing, ran in full panic flight to the first bench located at the base of the hill south of 50-A-2 and proceeded to mill excitedly around and over each other - jumping, bumping and crashing into other sheep. This activity continued for a few minutes after the departure of the helicopter and by 1218 hrs the sheep had bedded.*

This lends support to the concept that helicopter movements can be extremely stressful to bighorn sheep (see Map 3 for helicopter flights over the Wind Valley).

It may be more likely for bighorn sheep to adapt to hikers and backpackers using their habitat if these activities are predictable and not occurring during critical lambing or rutting periods (Geist, 1975). MacArthur et al. (1982) and Stemp (1983) found that hikers approaching bighorn sheep particularly off established trails, contributed to elevated heart rates which can result in increased metabolism and reduced time spent feeding. In a study of human disturbance of bighorn sheep in the Sierra Nevadas, Hicks and Elder (1979) found that “bighorn-human encounters were limited to specific locations” but the authors also found that groups of ewes avoided hikers and did not use good forage habitat concurrently with people.

It is evident from the literature that there are many factors that influence how bighorn sheep will respond to disturbance; these factors may be a result of genetic or ecological traits, or characteristics of the type of recreation and behaviour of the recreationist.
History of Bighorn Management Considerations and Practices in the Canadian Rockies and the Wind Valley Region

From accounts told by early traders and hunters, the period of 1800-1860 was one of an abundance of bighorn sheep in the Canadian Rockies. These populations seemed able to withstand the occurrences of large fires, intraspecific competition and hunting by aboriginal people (Stelfox, 1971). The next period of history was characterized by population decline in the areas well traveled by traders and aboriginals. With the introduction of firearms, large numbers of sheep could be harvested simultaneously. Thus, the populations numbers declined from more than 10,000 in 1860 to about 2,600 in 1915 (Stelfox, 1971).

Possibly due to very successful predator control, the sheep populations increased again following the declines of the early 1900s. The total population in 1936 was near 8,500 sheep. A large percentage of these sheep were found in the parklands of Jasper and Banff (Stelfox, 1971). These numbers could not be sustained due to fire suppression methods causing coniferous forests to encroach on grasslands, and range deterioration due to overpopulation. Despite the initial gains in sheep numbers due to effective predator control, without the predation bighorn sheep do not effectively use all of their historical ranges and parasite loads increased (Geist, 1971). Major die-offs occurred over the next two decades. Beuchner (1960) suggested that other factors such as intraspecific competition and harsh winters also contributed to increased instances of lungworm infections in the sheep. Beuchner (1960: 150) found that, “the lungworm-pneumonia complex is unquestionably the most significant disease in bighorn sheep”. If the bighorn sheep population of the Wind Valley Natural Area is exposed to unacceptable levels of stress, the animals could be susceptible to a large die-off resulting from the lung-worm pneumonia complex.
In the *Bow Corridor Integrated Resource Plan* of 1990 there is a commitment to "maintain current bighorn sheep populations (a minimum of 300) and the use of their habitat for movement, feeding, hiding cover, breeding, etc." (Anonymous, 1990a:31). The habitat used by the bighorn sheep in the Wind Valley Region crosses a number of jurisdictions including public land, municipal lands and private holdings of Three Sisters Golf Resorts Inc. Alberta Fish and Wildlife monitors this population annually and maintains statistics gathered from hunting reports and research projects. The Three Sisters Resorts Consortium development group has been committed to meeting the community objectives for wildlife as established by the Natural Resources Conservation Board in 1992. To achieve the goals established for bighorn sheep, Three Sisters Golf Resorts Inc. began a monitoring program in 1995.

As part of the monitoring design, a series of environmental reports were prepared for Three Sisters Resorts by The Delta Environmental Management Group Ltd. (which later became AXYS Environmental Consulting Ltd.) and UMA Engineering during the environmental review proceedings. The Delta Group developed a *Conceptual Plan for Bighorn Sheep Habitat Enhancement and Reclamation at the Abandoned Coal Mine Exploration Pit-Three Sisters Property* (see Dry Lake area on Figure 4) (Van Egmond and Green, 1991a). In this report, it was observed that existing and interim use of the present licks must not be compromised until new or alternate sites had been accepted.

The Delta Group compiled another report, *A Wildlife Mitigation and Monitoring Program for the Proposed Three Sisters' Golf Course C Project: Addendum to the Deficiency Statement for the Three Sisters Site "C" EIA* (1991b). In this report, the Delta Group and UMA Engineering revised the mitigation plan for bighorn sheep and emphasized the importance of maintaining important movement corridors. It was stated that "no on-ground modifications to on-
site elk and bighorn sheep habitat projects will be undertaken by Three Sisters Resorts Inc. until modifications have been discussed and approved by Alberta Fish and Wildlife Division” (1991b: 9). Also noted in this study are the constraints of construction. More specifically, work that involves mechanical and human disturbance would be done after September 1 as “fewer bighorn sheep are expected to utilize the mineral lick area” (1991b: 11).

According to the previous studies done on the bighorn sheep in the Wind Valley Natural Area, it is important to the sustainability of predator populations to maintain the sheep populations and in turn healthy predator populations contribute to sustainable bighorn numbers. The community and developers involved in areas used by the sheep are committed to maintaining the bighorn sheep, but there is an accumulation of pressures being exerted on the population which makes monitoring and management increasingly complex. Pressures from development of property in the Town of Canmore, recreational use of the valley, hunting and other existing developments in the areas used by the sheep may lead to abandonment if the human use is not carefully managed.

RESPONSES OF GRIZZLY BEARS TO HUMAN DISTURBANCE (INDICATIONS AND PREVIOUS STUDIES)

Grizzly bears are particularly sensitive to habitat fragmentation and human-bear interaction due to a number of factors: grizzlies need large expanses of contiguous habitat containing abundant food; females enter estrous only after four to five years; the females will often spend two to three years with their cubs and may therefore have a two to three year interval of breeding; there is often a low survival rate for cubs (Wielgus, 1986); and finally “the mere presence of people is capable of inducing losses of bears either through direct lethal conflict or displacement from essential habitat” (Gilbert, 1989: 1). As of 1991, the grizzly bear has been
designated by the Committee on the Status of Endangered Wildlife in Canada as vulnerable, indicating a potential risk of continuing population declines that require careful monitoring (UMA Engineering Ltd. 1991). An understanding of grizzly bear ecology, particularly habitat use and food preferences is useful to a discussion of grizzly bear response to human disturbance.

**Grizzly Bear Ecology**

The grizzly bear, with its extensive spatial requirements and wide ranging habits is an indicator of ecosystem health (White *et al.*, 1995). This is the case for all large carnivores as their presence indicates that all other trophic levels of the ecosystem are still intact. In Alberta, the eastern slopes of the Rocky Mountains are recognized as the last stronghold of a significantly reduced provincial grizzly bear distribution in Alberta (McCrorry and Herrero, 1982). Small tributary valleys in the Bow Corridor such as Three Sisters, Stewart, and Wind, are considered important habitat for the bears (UMA Engineering Ltd. 1991).

The Province of Alberta’s Management Plan for Grizzly Bears (1990) states that there are only about 575 bears using Alberta lands. As habitat loss was identified as the primary factor limiting population, it is unlikely that the population will recover to the objective of 1000 bears (Herrero, 1992). For the survival of a population of grizzlies, it is not only critical that they have adequate habitat with abundant food, it is also important that these areas remain relatively undisturbed by humans so that bears do not avoid important food sources or abandon them.

**Food and Habitat Use**

Bears are opportunistic feeders; their life cycle is dominated by the search for foods that provide fat stores to sustain them through the long winter denning period. These largely herbivorous omnivores need to access foods high in digestible solubles and low in fiber as they
lack a rumen and tend to pass food through the digestive system more quickly than ruminants (Hamer and Herrero, 1989). This explains why the Hedyserum root is used in the spring when it is high in nutritive content and late in the fall as solubles are stored in the root system. The predominately vegetative diet is supplemented by animal food when it is available; even the addition of ants to the diet seems to provide critical amino acids (Hamer and Herrero, 1989).

The grizzly bear feeding cycle can be broken into five phases: spring, early summer, late summer, fall and late fall. The preferred foods of these seasons are summarized in Table 5. Habitat use differs between females and males but both sexes tend to follow moisture and plant phenology gradients. The high protein stage of early plant growth is critical to bear growth and tissue construction. Dominance hierarchies suggest that adult males are the most dominant individuals occupying the best habitat and food sources with the females with cubs subordinate but dominant to the lone females and younger males. These patterns of habitat use suggest different strategies for maximizing genetic fitness. Males range larger distances to contact more potential mates while the females with cubs do not use habitat frequented by large males in order to avoid attacks on themselves or their offspring (Wielgus, 1986). Wielgus (1986: 95) suggests that “aggressive and cannibalistic behaviour toward conspecifics reduces competition for both mates and for food”.

Insects (particularly ants), and mammals provide an important source of fat and protein. Hot, south facing slopes with woody or rocky debris are the best sites for ant location. In forested areas, bee hives are sought out for their high calorie honey content. When encountered, the carcass of a mountain goat, bighorn sheep (sometimes buried in avalanche debris) or elk is consumed. Hunting of large mammals is generally limited to the lambing/calving season when the young are unable to escape predation or after the rutting season when exhausted and injured
bulls may be accessible. Other smaller mammals such as ground squirrel (Spermophilus spp.) or marmot (Marmota spp.) are occasionally consumed.


<table>
<thead>
<tr>
<th>Season</th>
<th>Food Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>Hedyserum root and carrion</td>
</tr>
<tr>
<td>Early summer</td>
<td>Hedyserum root, Equisetum, Heracleum and Carex (among other emerging hydrophylic plants)</td>
</tr>
<tr>
<td>Late summer</td>
<td>Hydrophiles, fall berries (Sheperdia, Vaccinium spp. etc.) and ants</td>
</tr>
<tr>
<td>Fall</td>
<td>Hedyserum, some grazing of grasses and sedges, berries</td>
</tr>
<tr>
<td>Late fall</td>
<td>Hedyserum and berries</td>
</tr>
</tbody>
</table>

Response to Human Disturbance

The response of grizzly bears to human disturbance is highly variable and consideration must be given not only to biological and environmental factors such as availability of food and habitat, but also to the history of the bear and its past experience with people (Gilbert, 1989). Gilbert (1989: 2) notes that “prior painful experience with people, especially hunting, can make grizzly bears especially sensitive to human presence”. The response of individuals to human disturbance is highly variable ranging from avoidance to aggression.

Grizzly bears behaviour can be grouped based upon previous experience with humans; there are those bears that are habituated (do not perceive a negative consequence related to proximity or interaction with humans), most of whom have either been fed or managed to acquire human food, and secondly the bears that are unfamiliar with human food and presence (Warner,
1987). The fact that bears are strongly attracted to human food is well documented (Herrero, 1985), but it seems that the effects of food on human-bear encounters is somewhat inconclusive.

It is generally accepted that repeated contact with humans leads to the habituation of bears which ultimately leads to problems of bear management (Taylor et al., 1989; Herrero, 1985). Herrero (1989: 10) confirms that habituated grizzlies are an increased hazard particularly when familiarized to human food but he warns that this is not a simple causality, rather multiple factors interact to contribute to conflicts between bears and people.

Those bears that are unfamiliar with human food (have not been observed feeding on garbage, or begging from tourists) and have no history of interacting with people will tend to avoid areas used by humans (Gilbert, 1989). An example of habitat abandonment by grizzlies is the Clear Creek area of Yellowstone Lake where the grizzly bear use was inversely related to numbers of human intrusions from 1977 to 1984 (Gilbert, 1989). Habituation of grizzlies to human use without familiarity with human food is demonstrated on the Alaska peninsula where the abundance of salmon and the protected status of the bears allow for tolerance. Human use patterns are controlled and remain predictable. The bears are allowed to manage the distance from, or proximity to, the people or wildlife viewers and humans do not perceive a threat to themselves or their property (Gilbert, 1989).

Herrero (1989) notes that grizzlies have an individual distance to which they will allow people to approach. This critical distance varies due to the individual history of the bear, the behaviour of the people, season, location and other environmental factors. If the distance limit is violated, there is a strong likelihood of a conflict or encounter. Physical mauling often results in the mortality of the bear by management personnel (Herrero, 1985). Reducing human-caused
bear mortality is critical to the conservation of the population of grizzlies, particularly adult females (Weaver et al., 1985).

**Policy and Management Status**

The Alberta Provincial Parks Act (revised 1980) does not offer any overall guidelines for bear management, but there are some references to specific power and responsibilities that are relevant to grizzly bear management. Section 11 of the Provincial Parks Act (1980) gives the Minister of Environment the power to govern the treatment and feeding of wildlife. Section 13 provides the Minister with the power to close any part of the Park or Recreation area considered necessary. There are also general regulations regarding the disposition of waste management in Park and Recreation areas (Anonymous, 1980).

Section 81 of the Wildlife Act provides the authority for closing areas to the public and under this act all ownership of live wildlife in Alberta is vested in the crown (Anonymous, 1984). Alberta Parks Provincial Policy (Anonymous, 1973) contains references to bear management. Policy 8.3 outlines methods of minimizing the potential for conflict between park visitors and bears including: facility design, waste disposal systems, education, and managing the park visitors among others. Section 8.9 of the provincial policy outlines the management of problem or nuisance wildlife in parks and recreation areas (Anonymous, 1973).

Two other provincial directives that are relevant to bear management are: A Policy for Resource Management of the Eastern Slopes (1984) and the Kananaskis Country Sub-Regional Integrated Resource Management Plan (1986). The first of these identified 8 land use zones for the Eastern Slopes including: Prime Protection Zones created to preserve the environmentally sensitive areas, and the General Recreation Zone which allows for more dispersed and
concentrated recreational opportunities. The Resource Management Plan outlines guidelines for implementing the policy.

Finally, specific to the Kananaskis area is the *Bear Conflict Prevention Plan: Kananaskis Country* (Anonymous, 1993) which outlines: “management actions for resource protection; visitor management; problem bear management; facility management; emergency procedures in case of bear/human confrontations; public information; monitoring; training requirements; inter-agency cooperation; research and evaluation components” (Anonymous, 1993: 1). Inter-agency cooperation has yet to be adequately implemented.

Herrero (1992) suggests that interagency cooperation is critical where grizzly habitat crosses multiple jurisdictions. In response to this need, the interagency Eastern Slopes Grizzly Bear Steering Committee was formed in 1994 to address the multi-jurisdictional problems of grizzly bear management in the eastern slopes region. Participants in the committee include federal and provincial governments, representatives from the oil and gas industry, the cattle industry, development and tourism industries and environmental groups. The objective of the committee is to identify and implement research that is related to understanding and predicting the cumulative effects of development and human activities in the eastern slopes area on grizzly bears. Currently, two research projects are in progress: a study of habitat mapping across provincial-federal boundaries (Kansas and Herrero, 1994), and a study assessing the effects of development and land use on grizzly bear behaviour and survival (Gibeau, 1994). The study is a regional program which encompasses the Bow River Watershed. Products from the eastern slopes projects such as mapping of habitat quality, displacement and modeling of mortality will all contribute to the development of a comprehensive cumulative effects model for this region.
Management Implications

Site specific management strategies that can be applied to the Wind Valley Natural Area in order to mitigate current conflicts and avoid future interaction between humans and wildlife are derived from baseline data on wildlife habitat use and human use of the area. The strategies for mitigation are based on a model developed by Vaske et al. (1995) which established a classification scheme for visitor management strategies which is particularly useful (see Table 13). Although not exhaustive, this list identifies the main strategy options available to managers. Education is neglected on this list, but it is a critical and useful tool (Geist, 1975; Boyle and Samson, 1985; Sharpe et al, 1994). Education through interpretation has been proven to be effective in Yosemite as a management tool and reduces the need for enforcement of closures and limitations (Sharpe et al., 1994).

Table 7: Classification of visitor management strategies (Vaske et al., 1995: 41).

<table>
<thead>
<tr>
<th>Indirect strategies</th>
<th>Direct Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical alterations</td>
<td>Enforcement</td>
</tr>
<tr>
<td>Improve or neglect access</td>
<td>Increase surveillance</td>
</tr>
<tr>
<td>Improve or neglect campsites</td>
<td>Impose fines</td>
</tr>
<tr>
<td>Information dispersal</td>
<td>Zoning</td>
</tr>
<tr>
<td>Advertise area attributes</td>
<td>Separate users by experience level</td>
</tr>
<tr>
<td></td>
<td>Separate incompatible uses</td>
</tr>
<tr>
<td></td>
<td>Rationing the intensity</td>
</tr>
<tr>
<td></td>
<td>Limit use via access point</td>
</tr>
<tr>
<td></td>
<td>Identify surrounding opportunities</td>
</tr>
<tr>
<td>Economic constraints</td>
<td>Rationing activities</td>
</tr>
<tr>
<td>Charge constant fees</td>
<td>Restrict type of use</td>
</tr>
<tr>
<td>Charge differential prices</td>
<td>Limit size of group</td>
</tr>
<tr>
<td>Limit use via campsite</td>
<td>Limit length of stay</td>
</tr>
<tr>
<td>Rotate use</td>
<td>Restrict camping practices</td>
</tr>
<tr>
<td>Require reservations</td>
<td>Prohibit use at certain times</td>
</tr>
</tbody>
</table>
Table 7 is a component of a Visitor Impact Management Model adapted by Vaske et al. (1995) which contains 8 steps. In the Vaske model the first step includes a problem analysis and an overview of the available background information, the second phase of the process is to review planning objectives and thirdly indicators are selected to measure or observe status of resources (in this case human use and wildlife habitat use). The next step is to establish acceptable limits which in the current study would generally be no impact on the ecological integrity of the Wind Valley Natural Area. Steps five and six involve identifying the factors causing or contributing to habitat degradation and wildlife-human conflict and step seven aims to understand how these factors influence the wildlife of the given area. Finally, step 8 necessitates the long term monitoring of indicators in order to address management objectives.

For the purpose of this study, the above mentioned steps were condensed and the specific problem of human-wildlife interaction was addressed through four parts. The first part was the identification of the problem through an exploration of the background information available on human-wildlife interaction and the history and status of the Wind Valley Natural Area. This general context facilitated the determination of the factors contributing to wildlife-human interaction and the resultant impacts. A summary of field data was the third step in this process and included an overview of the study area, methodology and field results. Finally, the literature review and field findings were integrated to complete the final step, the selection of potential management strategies.

Conclusion

This chapter provides a context for the discussion of wildlife-human interaction and management tools used for predicting potential conflicts. An overview of the historical context,
policy and management history establishes a framework for a discussion of the factors contributing to wildlife-human interaction and the potential direct and indirect impacts that may occur in the Wind Valley Natural Area.

It is evident from the literature that protected areas such as the Wind Valley Natural Area are important for the protection of ecosystems and landscapes which are representative of the different ecosystems in Alberta. These areas are also becoming increasingly important for conservation of landscape features and habitat that are crucial to the maintenance of wildlife populations and healthy ecosystems. The Wind Valley Natural Area contains a range of habitats which are important to a diversity of species. These include important early spring and late summer habitat for grizzly bears and year round habitat for bighorn sheep. Degradation of important landscape features such as wildlife movement corridors or harassment in critical habitat may contribute to declines in populations or alteration of behaviour.

Recent changes in the role of protected areas emphasize that these areas must manage human use and impact on wildlife and on their habitat must be managed to sustain wildlife populations and maintain ecological integrity. In the case of the Wind Valley, these priorities have been identified through the environmental impact assessment process and through public participation in environmental assessments. In order to manage human impacts, both direct and indirect, human use must be understood and the different factors contributing to human-wildlife interaction must be identified.

Wildlife individuals, populations and communities vary in their susceptibility to human interaction. Pressures such as increased recreation and increased construction and development on, and adjacent to, bighorn sheep habitat can elicit a range of different responses in the animals.
There is the possibility that bighorn sheep may habituate to disturbance that is predictable such as motor vehicle traffic and hiking traffic. Human disturbances may be cumulative to other stresses naturally affecting the bighorn sheep and there is the possibility that the sheep could suffer population declines or abandon traditional habitat as a result of human use. Sheep are more susceptible to stress during important biological periods such as lambing in the early spring. Disturbance during critical biological periods may have a detrimental effect on the sheep population structure, and behaviour. Some studies suggest that bighorn sheep may not habituate to helicopter overflights (Bleich et al., 1993; MacCallum, 1991; Wishart, 1975), while others suggest that they may actually habituate to low-level overflights (Weisenberger et al.) but studies are inconclusive as replication is required. It has been confirmed that hikers moving through bighorn habitat contribute to elevated heart rates in the sheep (Stemp, 1983) which increases the energy costs to the animals. It is important to emphasize that there is not often a direct cause-effect relationship between human disturbance and bighorn behavioural response as the other factors will influence behaviour including: the time of year; availability of high quality food; habitat and accessibility to escape terrain, group size and others (Geist, 1971a).

Grizzly bears have less tolerance of human disturbance in their habitat, and interaction between humans and bears tend to have more immediate impacts on the bears. Some tolerance of human use of traditional home ranges may be tolerated as long as the human behaviour is not perceived by the bears to be threatening, or if humans manage to avoid making food available to the bears. The behaviour of grizzly bears depends upon their past experience with humans, particularly on their familiarity with human food. Grizzly bears have a low reproductive rate resulting from the fact that females enter estrous only after four to five years, they spend two to three years with their young and there is a two to three year interval between breeding. This low
reproductive rate and low survival of cubs further exacerbate the problem of human-caused mortality. The complexity of the causes and effects compounded by the interactive nature of factors contributing to human-wildlife interaction over space and time and the lack of adequate baseline data complicate the management process.

The Wind Valley Natural Area offers important habitat to many different species of wildlife including important spring and late summer grizzly bear habitat, important year-round habitat for sheep, crucial wildlife movement corridors and other habitat features. With its proximity to Banff National Park, Kananaskis Country, Canmore and Calgary the Natural Area is vulnerable to increasing recreational use, and pressures from development as numerous golf resorts, hotels, condominiums and other facilities are constructed in the Town of Canmore adjacent to the Wind Valley. The specific factors identified in the literature as contributing to human-wildlife interaction in the Wind Valley Natural Area are:

- increased development of tourism resort destinations in the Bow Valley;
- the overflow of visitors and service requirements from the heavily used mountain parks;
- growth in the community of Canmore, particularly with the recent development restraints in the Town of Banff;
- diversification of recreation activities and technology; and
- an overall increase in recreational use.

In light of these contributing factors the potential impacts include the direct effect of harassment and harvest on wildlife and the indirect effect of habitat modification which may cause alteration of behaviour, displacement or reduced reproductive level. Finally, detrimental impacts of human-wildlife interaction will be observed in changes in species composition and structure.

Literature on wildlife management indicates that landscape level ecosystem management involving interagency and community participation with public support and collaboration is the
only viable method for dealing with the difficulties of managing human-wildlife interaction. A cumulative effects model is probably the most effective way of predicting the effects of human use and development on wildlife over time and space. Other models have been developed to address more specific concerns such as that of Hammitt and Cole (1987) and with more detail, Knight and Cole (1995b). Hammitt and Cole outline four factors that may be used as indicators of detrimental effects of human use of wildlife habitat. These include habitat modification, alteration of behaviour, reduced population level, and changes in species composition and structure. It is proposed that these indicators be monitored in the Wind Valley Natural Area for the umbrella species (grizzly bears and bighorn sheep) in order to avoid a reduction of wildlife diversity and ecological integrity. The indicators established by Hammitt and Cole (1987) are not adequate without the recognition that there is no direct causal link between human recreational use and wildlife responses (Knight and Cole, 1995b). All of the factors outlined in the literature which contribute to wildlife-human interaction are interactive according to Knight and Cole (1995b) and the indicators for impacts to wildlife must be monitored over time and across the entire landscape region.
CHAPTER TWO: THE STUDY AREA

The Wind Valley is located about 100 km west of Calgary and 10 km southeast of the central business distinct of the Town of Canmore in the Bow Valley (Figure 4). This spectacular Natural Area is visible from the Trans-Canada highway and accessible from either the south via highway 40 and the Mount Allan Centennial trail, or the north from the Trans Canada highway at Dead Man’s Flats. This valley offers hiking, hunting, skiing, mountaineering, rock climbing, horse riding and mountain biking opportunities. The valley bottom (montane ecosystem) and lower avalanche slopes are free of snow in the spring allowing early season hiking opportunities and the accessibility of the area makes it ideal for short trips from Canmore or day trips from Calgary. The climate is predominately continental with cool, short summers and long, cold winters. Although the Wind Valley refers only to the West Wind Creek drainage, the Wind Valley Natural Area actually encloses three drainages-Wind Creek, West Wind Creek and Pigeon Creek which constitute a 7,890 ha. parcel of land (see Figure 8).

The Wind Valley was designated a Natural Area in August 1995 by the Minister of the Environment and is predominately administered by Alberta Environmental Protection. The Natural Area consists of approximately 88 percent crown land; the remaining private land is managed by Public Lands and the Town of Canmore. This private land is as yet undeveloped and subsurface mineral rights in part of the lower valley are also privately held. The Natural area is bounded by Kananaskis Country to the southwest and southeast, the Trans Canada highway to the north and private land to the northeast. The Wind Valley is a critical corridor for wildlife movement from the Kananaskis, Bow and Spray Valleys into the Bow Valley (White et al., 1995).
Although not included in the Wind Valley Natural Area, the private holdings of Three Sisters Resorts bound the Natural area to the northeast. This property extends from the mouth of the Wind Valley and the slopes of the Wind Ridge along the south side of the Trans Canada Highway to the town of Canmore.

**PHYSICAL FEATURES**

**Geology**

The Wind Valley Natural Area is found in the front ranges of the Rocky Mountains and is part of the Kootenay Formation. This formation consists of sandstone, shale, conglomerate and a series of coal seams. Elevations range from 1370 to 3095 m at the summit of Wind Mountain (Ashton et al., 1994). The higher elevations are characterized by rugged, rocky cliffs and bedrock outcrops while the lower elevations consist of avalanche slopes and montane valley bottoms.

**Vegetation**

The study area contains extensive montane (1,300 to 1,600 m), subalpine (1,600 to 2,300 m) and alpine ecoregions (2,300+ m) (Gibeau, 1996). The forest cover types in the montane region include open and closed canopies of white spruce (*Picea glauca*) and lodgepole pine (*Pinus contorta*) and closed canopies of trembling aspen (*Populus tremuloides*), mixed wood and Douglas-fir (*Pseudotsuga menziesii*). Subalpine regions contain stands of lodgepole pine, Englemann Spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). MacCallum (1984) offers a more detailed description of some alpine and subalpine community types that may occur in the study area and are more important to the bighorn sheep (Appendix 1). Currently the East Slopes Grizzly Bear Project (ESGBP) is undertaking a vegetation classification and mapping
project for the eastern slopes of the Canadian Rockies (Kansas, 1994) and Three Sisters Resorts Environmental Office (Dhol, 1995) has also done a vegetation inventory of their property. These products offer a partial inventory of vegetational communities in the study region and the work done by the ESGBP will be a component of a cumulative effects model for understanding the effects of human development and disturbance across the landscape on grizzly bears. It is significant to mention that the Wind Valley also contains the largest known fen in Kananaskis Country which is important spring and summer habitat for grizzly and black bear (*Ursus americanus*).

**Wildlife**

Ashton *et al.* (1993: 5) found that the Wind Valley had “the greatest biological diversity of large mammals of any place in Canada within an hour drive and a half hour walk of a major metropolitan center”. Of this abundance of wildlife, the Mount Allen-Wind Ridge bighorn sheep population is one of the largest in North America with up to 280 individuals (Ashton *et al.*, 1994). The female bighorns use the slopes of the Wind Valley above 1630 m, the upper slopes of Pigeon Mountain above 2150 m, and the northern and eastern flanks of Mount Lougheed and Mount Allan as winter range due to the warmer southern exposure and the shallow snow depth resulting from Chinook winds. Cottonwood Consultants (1994:29) found that the Wind Valley supports “one of the most significant bighorn sheep wintering areas in the Canadian Rockies”.

In March to June, the nursery herds use Wind Ridge, Mount Allan and the upper areas of Wind Creek for lambing areas as the rocky terrain and high elevations offer protection from predation. The sections of the Centennial Trail passing along the summit of Mount Allan are closed during the lambing season to protect the area from human disturbance during this critical
biological period. In July, the sheep can be found in the area of Mount Allen, Pigeon Mountain, Wind Ridge, and Mount Lougheed through to November when they will return to the winter grounds (Jorgenson, 1989). While using the slopes of Lougheed and Wind Ridge, the nursery herds tend to travel onto Three Sisters property and frequent the area referred to as the Stewart Creek mineral lick (See Stewart Creek/Dry Lake on Figure 4). The rams migrate further than the females do and are thought to travel into the Bow River Valley, the Kananaskis Valley and the Spray Valley (Anonymous, 1996b).

Elk also use the warmer southern exposures throughout the Wind Valley Natural Area for winter ranges. The elk number approximately 150 while other ungulates such as white-tailed deer (Odocoileus virginianus) and mule deer occur in less numbers and moose (Alces alces) are rarely seen in the valley, possibly due to limited suitable habitat (Anonymous, 1996b).

The Wind Valley Natural Area lies within the confirmed home range of at least one productive female and a second unclassified grizzly bear. Herrero (1992) suggests that it is not unreasonable to assume that “over a 5 year period 19 different grizzly bears might use the resources of the Wind Valley Region” (1992: 13). The habitat available in the Wind Valley is particularly significant to the grizzly bears in the spring as the succulent vegetation in the fen area and the lower avalanche slopes offers high value nutrients. Late season berry crops are important to the diet of grizzly bears and there is also the evidence of grizzly bears scavenging carcasses of ungulates that did not make it through the winter, or were killed by avalanches. In the Kananaskis area, the mountainous terrain causes the timing of green-up to be staggered from micro-habitat to micro-habitat depending on variables such as elevation, aspect, soils, slope, and snowpack depth. The females tended to use higher elevations including young open lodge pole pine and early seral types of habitat while the males will spend more time in the dense older
spruce and pine. Both males and females preferred elevations from 1695 to 2150 m with the females in the higher end of the range and the males toward the lower elevations. Generally the females do not travel as far as the males nor do they have home ranges as large (Wielgus, 1986). The combination of abundant resources in the Wind Valley and increased development of resorts and tourism facilities in the region is potentially lethal to the bears. They will be attracted to an area that is potentially a source of mortality, a scenario that has occurred in Yellowstone National Park previously and is referred to as a mortality sink (Herrero, 1992). Further fragmentation of movement corridors by increased development may isolate Kananaskis Country bear populations and thereby the Four Mountain Park populations. This genetic isolation would reduce each local population’s ability to respond to disease and environmental stresses over generations and ultimately could reduce the likelihood of the maintenance of healthy and sustainable populations in these areas.

Other large mammals species that occur in the study area are: black bear, cougar, lynx, bobcat (*Lynx rufus*), wolves, wolverine (*Gulo gulo*) (endangered) and coyotes (*Canis latrans*) (Ashton et al., 1994). There are numerous small mammals and a diversity of avifauna. For a more detailed description of the wildlife found in the Wind Valley Natural Area refer to Ashton et al. Technical Appendices (1994).

**Disturbance History**

A large part of the Three Sisters Property and the Wind Valley have been disturbed in the past. The western areas of the property were disturbed by a coal mining operation which ran from 1886 to 1960. In 1958 the underground seam (#4 mine) was still actively mined on the eastern side of the property. In 1966, strip mining began near the Stewart Creek/Dry Lake area. The
surface mining left large areas scarred and altered. When the mining concluded in 1979, the mining operation used the Stewart Creek site as a repository for tailings and materials. The Town of Canmore took over this dump site and used it as a landfill site from 1983-84. In 1984-85, the site caught fire and Stewart Creek was diverted to put the fire out. In 1992, the area was reclaimed by Three Sisters Resorts Ltd. Although the larger part of the mining operation occurred on the western side of the TSR holdings, many exploration roads had been put in throughout the property and into the Wind Valley (Van Egmond et al., 1991:1).

The lower slopes of Pigeon Mountain were cleared for a ski operation but presently Alpine Haven Resorts does not function as a ski area, rather it is offering time share accommodation and a trailer park (Figure 2). The Nakiska ski area (in Marmot Basin on Mount Allan) to the south of the Wind Valley Natural Area was constructed for the Olympics in 1989. The construction and operation of the ski area which continues to the present time created a disturbance to bighorn sheep using traditional habitat on Mount Allan. Alberta Fish and Wildlife studied the impact of the ski facility operation on the bighorn sheep and found that there was some displacement on the upper slopes of Mount Allan (Jorgenson, 1987).

Finally, the development of the Bow Valley, including the Three Sisters Resorts property along the base of the Three Sisters mountain and Wind Ridge, will create disturbances associated with construction, increased human population residing in these areas and concurrent increased recreational use of the Wind Valley Natural Area. Of particular importance to the bighorn sheep is the proposed Golf Course C, because the area designated for this development includes the Stewart Creek sheep lick site (Dry Lake on Figure 4). The golf fairways were cleared in 1991-92,
Figure 9: Wildlife Management Units: the lightest shading indicates Alberta land, a shade darker is British Columbia land, the darker gray is federal land while the darkest shade indicates Stoney Indian land (White et al., 1995).
further clearing was done in 1993, 94 and 95, but the construction and operation of the golf course is not yet underway.

**Legal Jurisdiction**

The Wind Valley was designated a Natural Area under the Alberta Special Places initiative which was designed to establish a series of interconnected natural systems (Alberta Environmental Protection, 1996b). The Wind Valley Natural Area Management Plan was compiled with limited information and baseline data guided by the management goal of protection and conservation. It has been designated as Zone 1 (Prime Protection) and Zone 2 (Wildlife Protection) in the Bow Corridor Local Integrated Resource Plan. Also, it has been designated a Conservation District in the Canmore General Municipal Plan (covered by Policy Areas A and B).

**Hunting Regulation and Wildlife Management Boundaries**

The entire study area is covered by two wildlife management units (WMU), 408 and 410. These units meet at the high point of Wind Ridge with 410 to the southwest and 408 to the northeast (Figure 9). In 1995, the hunting season for trophy sheep began September 6 and ended October 31 for residents and on November 25 for non-residents in WMU 410-archery only. The general 1995 season opened in WMU 408 September 6 and ran through to October 31. There was also a non-trophy Sheep Special License available for 408 from September 9 through to October 31 and in WMU 410 from September 6 to November 25. Harvest statistics are not yet available for 1995. Table 7 details past harvest summaries; the license types include “Troph”-ram harvest which is unlimited entry and “Spec A&B”, the special license necessary to hunt ewes and lambs.
WMU 408 is split into two areas, 408A and 408B (see Figure 9) (which includes the traditional range of the Mount Allan-Wind Ridge herd).

The information on harvest of bighorn sheep and on the management units affecting the Wind Valley Area contributes important information on the mortality of the sheep using the Natural Area. Mortality may be caused by other factors such as harassment and habitat loss, and these losses may be cumulative to hunting mortality. Therefore, mortality is an important factor to be monitored over time as an indicator of the status of the bighorn sheep population. Mortality due to hunting can also be charted and if increased mortality is observed and population declines occur, the number of licenses issued for a given hunting season may be limited.

In summary, the Wind Valley Natural Area is characterized by a splendid natural beauty and a diversity of wildlife and flora. The proximity of the Valley to the Bow Valley corridor, town of Canmore, Banff National Park and Kananaskis Country make it susceptible to many different human pressures from development of areas adjacent to its boundaries to increased recreational use. The recreational interests in the Valley have traditionally included equestrian, hunting, hiking and mountain-bike riding but these activities will likely be diversified in the future and numbers of users will likely increase. Little information was available on actual human use of the area prior to this study. Methodology for the data collected on the human use of the valley and the habitat use of bighorn sheep and grizzly bears is summarized in the Chapter Three and is critical to the selection of potential management strategies for avoiding the detrimental impacts of human-wildlife interactions.
Table 8: Harvest summary for Wildlife Management Unit 408

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LIC. TYPE</th>
<th>#HUNTERS</th>
<th>MALE</th>
<th>FEMALES</th>
<th>JUVENILES</th>
<th>TROPHY</th>
</tr>
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<tbody>
<tr>
<td>1985</td>
<td>Troph.</td>
<td>188</td>
<td>18</td>
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<tr>
<td>1985</td>
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<td>250</td>
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<td>0</td>
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<tr>
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<td>15</td>
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</table>

"# Hunters" is the number of hunters per year (only an estimate as entry is unlimited for trophy hunts) (Alberta Natural Resources Service, 1995)
CHAPTER THREE: METHODOLOGY

The patterns of human use and the habitat use of bighorn sheep and grizzly bears in the Wind Valley Natural Area were elaborated through a summary of field data collected during the summer and fall of 1995 for the purpose of developing a strategy for avoiding the detrimental impacts of human-wildlife interaction. This was done through telemetry, direct observation and indirect observation (tracking pads). It was also important to gather information on the human use of the Natural Area as there was no previous information available on numbers of visitors, types of activities, and the potential for conflicts with wildlife. Once these baseline data were collected, the results could be interpreted based on the different processes and factors contributing to human-wildlife interactions identified in the literature, and management strategies could be proposed.

Bighorn sheep movements and behavioural response to disturbance were observed over a five month field season as were the movements of a radio collared female grizzly bear and other incidentally observed grizzly bears. Observations of bighorn sheep habitat usage were made from designated observation sites and included serendipitous encounters while researchers and volunteers traveled throughout the study area. The movements of grizzly bears were monitored by researchers from the Eastern Slopes Grizzly Bear Project. The study area was flown regularly by a fixed wing aircraft and researchers recorded and photographed sites where signals of radio-collared grizzly bears were observed. Human use was documented through a self-administered trail survey and a number of direct people counts.

BIGHORN SHEEP

Two methods, direct and indirect observation, were used for the collection of data on bighorn sheep. The direct observations included noting the location of sheep, counting the sheep (census), and age classification. Indirect observations included establishing tracking pads and
monitoring them in order to gather information about the movement of the sheep around the important Stewart Creek lick site.

When sheep were observed, the location was noted on a 1:50,000 topographical map with the aid of aerial photographs. The method of instantaneous scan sampling (counting) was adapted from Altmann, (1973) and Stemp (1983). Age classification methods were adapted from Geist (1973) and Jorgenson (1989). Tracking pad data collection was adapted from previous studies on Three Sisters property (Phil Rhem, pers. comm) and Bookhout (1994).

**Spatial Distribution**

**Habitat Usage (Direct Observation)**

The bighorn sheep were observed from established sites in the Wind Valley, on Wind Ridge, at the Stewart Creek mineral lick, and in the Mount Allan area (see Figure 4) from May 22 to September 30, 1995. The study area was divided into a sampling grid by vertical projection based on a method developed by Jon Jorgenson (1987). According to this grid system, all of the visible sheep habitat in the Wind Valley-Mount Allan area was divided into square grids approximately equal in size. The observer would use an aerial photograph and a 1:50,000 scale topographical map along with the grid map to determine which grids the sheep were located in. The animals were counted by direct ground observation from predetermined vantage points covered on foot or by mountain bike. There are distinct seasonal changes in distribution of bighorn sheep. These could be grouped into five time periods:

- spring - April to June which is characterized by use for lambing;
- summer - July and August when the sheep use alpine summer ranges;
- early autumn from September to October which is the pre-rut move to winter ranges;
• early winter - November and December including the rut; and

• late winter-February to April use of winter home ranges and movement to lambing sites (Shannon et al., 1975).

In May, 1994, a study design was implemented based on the Latin squares method (Bookhout, 1994). This design (a field schedule which alternates between the different observation sites such that the bias of a non random sample can be reduced and each site is equally sampled) is useful for small samples as it ensures that each weekday is equally selected for each designated location. Four observation posts were established: Mount Allan, Wind Valley, Wind Ridge and Stewart Creek (see Figure 4). The objective was to reach each of the observation sites once a week. The researchers traveled to the designated observation post with a spotting scope and recorded the number and class of sheep observed as well as the distance from observer and other environmental information (using the scope, aerial photographs and topographical maps). If it was not possible to classify the sheep, the number of sheep would be counted and this figure would be documented as a nursery herd (we saw few rams outside of the nursery herds). We also collected more specific information on the sheep use of the mineral lick site located at the Dry Lake as this site occurs on private property which is part of a planned golf course.

Tracking Pads (Indirect Observations)

Twenty tracking pads were established along major game trails in the Stewart Creek/Dry Lake area. Pads consisted of a sandy loam bedding and were approximately 0.5 x 1.0 m in size. This soil mixture remained relatively moist and friable to capture ungulate prints between bi-
weekly inspection and maintenance. Data regarding species use, direction of travel and general traffic levels were collected in field notebooks and on 1:20 000 scale mapsheets.

There is likely a bias in the time that the direct and indirect observations were made due to weather and transportation constraints. In order to avoid these biases for the Stewart Creek area, beginning July 26, a camp was established in the trees with a view of the Dry Lake mineral licks site. The mineral lick on the haulage road was also accessible from this camp. This observation vantage was maintained for six days and time spent observing the site is summarized in Figure 10. The intensive observation period in July is evident in Figure 10 as are the regular observation periods throughout the field season. Although the intensive week of observation did allow for longer observations periods as researchers and volunteers rotated duty throughout the day, there was not a noticeable increase in sheep observed during this period.

Census and Age Classification

The method of instantaneous scan sampling used for determining the age classification was derived from Altmann (1973). The number and class of sheep observed were recorded according to 8 distinct classes of sheep (Geist, 1971). This method identified sheep based on horn size, body size and sex. The 8 classes include: lambs, female yearlings, females, male yearlings, and class one, two, three and four rams.
Figure 10. Time spent observing the Stewart Creek/Dry Lake lick sites.
Table 9: Age classification of bighorn sheep (Geist, 1971:55-56)

<table>
<thead>
<tr>
<th>CLASS</th>
<th>AGE</th>
<th>BODY WEIGHT</th>
<th>OTHER CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambs</td>
<td>Birth to 13 months of age</td>
<td>Smallest body size</td>
<td>- Tend to be light in color</td>
</tr>
<tr>
<td>Female Yearlings</td>
<td>13 to 24 months</td>
<td>27 - 50 kg</td>
<td>- Shorter face than yearling males and adult females</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Horns come to complete point</td>
</tr>
<tr>
<td>Male Yearlings</td>
<td>14 to 24 months</td>
<td>Larger than females of same age</td>
<td>- Slightly longer horns than adult females</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Differ from females in use of ram urination posture and use of low-stretch</td>
</tr>
<tr>
<td>Adult Females</td>
<td>Older than 24 months</td>
<td>Average 72 kg</td>
<td>- Constant appearance as horns do not continue to grow when adults</td>
</tr>
<tr>
<td>Class I Males</td>
<td>26-36 months old</td>
<td>Larger than adult females in body size</td>
<td>- Testes may be visible after 18 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Sexually mature and participate in rut</td>
</tr>
<tr>
<td>Class II Males</td>
<td>3-6 years of age</td>
<td>82 - 91 kg appear larger than class I rams, but lighter than more mature rams</td>
<td>- Horn tips still complete</td>
</tr>
<tr>
<td>Class III Males</td>
<td>5-8 years old</td>
<td>Excess of 91 kg</td>
<td>- 3/4 curl horns with full thickness and beginning to splinter</td>
</tr>
<tr>
<td>Class IV Males</td>
<td>8 years of age or older</td>
<td>Slightly heavier than class III</td>
<td>- Horn tips reach at least to eye level even if broomed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Darkest in appearance, may have almost no white</td>
</tr>
</tbody>
</table>
GRIZZLY BEARS

Field plot data collection, as part of the Eastern Slopes Grizzly Bear Project, followed the methods developed by John Kansas (1994). Three Sisters Resorts personnel have further developed a simple wildlife sighting system to document bear activity on the property which consists of laminated maps of the property bound so that workers can record any wildlife observations made while on the property. This information is then put into a database.

Location of Grizzly bears

Plots of grizzly bear locations were determined by radio telemetry, incidental location, and direct observation.

Radio Telemetry Locations

The Eastern Slopes Grizzly Bear Project team performed regular flights over the project area collecting radio telemetry location points from a subset of (radio-collared) bears. U.T.M. coordinates that fell within the Wind Valley Natural Area or on Three Sister’s Property were forwarded to TSR’s environmental office. After waiting a minimum of 10 days for the area to be clear of any bear hazard, a field crew was dispatched to the site, with the aid of a Global Positioning System (G.P.S.), to carry out a five meter fixed radius Habitat Use Plot. If evidence of bear use was not discovered at the telemetry location, the researchers searched the surrounding area for signs of recent use. Multiple signs of activity may have been encountered during the search. In this case, the plot center was located within the area of most concentrated use. Activity may have been in the form of digging, bedding, grazing/foraging, rock disturbance, log tearing or scats. In the event that no bear use was discovered after one hour of reconnaissance, a
data sheet was filled in with enough information to describe the plant community based on the Banff-Jasper Biophysical Inventory (1993).

**Incidental Locations**

Incidental plots were those located opportunistically during field crew movement through bear habitat. These sites were often found during travel to and from telemetry points, and may be in proximity to them. If the incidental site occurred within a micro-habitat inclusion more than 500 m from an existing plot, or in a plant community different to that of the local radio located plot, a Habitat Use Record was completed. However, a site in the same plant community and within 500 m of a radio-located plot center was disregarded and simply noted.

**Direct Observation**

Field plots may originate from actual grizzly bear sightings. TSR's field crew and construction personnel, as well as local helicopter operators, have all observed bears on or near the TSR property between June and August 1995. Once a bear had cleared the area, the crew isolated use sites and located a plot around the point of highest use concentration. Exact location of the plot center was recorded using the G.P.S. If no sign of habitat use was apparent, information regarding plant community type was recorded.

**HUMAN USE SURVEYS**

A trail register was constructed approximately 50m along the trail from the Alpine Resorts parking lot where the loop dissects and branches into the Skogan Pass trail and the Wind Valley trail (Figure 4). The register had information about the wildlife studies that were currently ongoing in the area and laminated photographs of the different wildlife species that frequent the valley to assist the visitors in wildlife identification. The recreationists were asked to fill in their
name and postal code. The questionnaire was developed with assistance from Parks Canada and included questions such as the trail used, duration of trip, and whether the visitor saw any wildlife. The survey was concluded with an open ended question asking the participant to comment on what he/she felt were the most important management issues in the Wind Valley Natural Area and what management strategies he/she would like to see pursued (see Appendix 2). Surveys were calibrated through direct counts of people on trails (which were compared to the number of surveys filled out). The results of the open-ended question were analyzed using a thematic analysis.

In conclusion, the methodology outlined above was developed with the objective of collecting baseline information on the grizzly bear and bighorn sheep habitat use of the Wind Valley Area and particularly the Wind Valley and Wind Ridge. This information was used to document areas of current wildlife-human interactions and to predict areas of potential conflict in light of the management objective of maintaining the ecological integrity of the Wind Valley Natural Area.
CHAPTER FOUR: RESULTS

This chapter summarizes the baseline data collected throughout the 1995 field season. Information was gathered about the patterns of human use of the Wind Valley Area, bighorn use patterns were documented along with age classification (population structure), the habitat used by bighorn sheep was compared to data previously collected by other researchers, and grizzly bear seasonal use patterns were documented. There were no previous data available on grizzly bear use of the Wind Valley Natural Area and thus the data summarized here documents only the bear use observed over the 1995 field season.

HUMAN USE OF THE WIND VALLEY REGION

Summary of the demographics of visitors to the study area

Survey responses indicated that there was an average of 45 people visiting the Wind Valley Natural Area from the Alpine Haven Resorts access on an average weekend day ranging from 15 on a cold, rainy day to 60 counted on a warm early summer day. The response rate to the survey was approximately 38%. Of the 211 respondents, 42% were visiting the Wind Valley for the first time and 56% were returning (2% did not answer this question). The trail that was used the most frequently by visitors was the Wind Ridge trail (see Figure 4 and Table 9).

Information on group size and average length of stay are important as these factors will potentially influence the impact of recreational use on wildlife. Large groups will be more disturbing to wildlife than smaller groups and indications of the use levels of different trials is also important to developing strategies for managing human-wildlife interactions. The average number of visits to the valley was 4 with a minimum of 1 and a maximum of 35. The average group size was 4 with a standard deviation of 5.3 (N=209), the minimum was 1 and the
maximum was 35 people. The variation in group size is explained by the fact that groups ranged from individuals to hiking groups of up to 35 organized by local clubs. Those visiting the valley for one day spent an average of 4 hours and 50 minutes with a minimum of 30 minutes and a maximum of 10 hours and 30 minutes (std dev. 150 minutes and n=189). People who spent more than one day in the valley, stayed from a minimum of 2 days to a maximum of 10 days. Most visitors to the Natural Area were from Alberta (see Table 10), and of these 71% were from Calgary and 20% were from Canmore. Of the visitors who were hiking in the valley 30% reported that they did not stay on the trails.

**Table 10: Recreational use of trails in the Wind Valley Natural Area**

<table>
<thead>
<tr>
<th>Trail used</th>
<th>Percentage of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Valley</td>
<td>16%</td>
</tr>
<tr>
<td>Wind Ridge</td>
<td>30%</td>
</tr>
<tr>
<td>Centennial</td>
<td>19%</td>
</tr>
<tr>
<td>Skogan Pass</td>
<td>2%</td>
</tr>
<tr>
<td>Pigeon Mountain</td>
<td>13%</td>
</tr>
<tr>
<td>West Wind Creek</td>
<td>2%</td>
</tr>
<tr>
<td>Unknown</td>
<td>18%</td>
</tr>
</tbody>
</table>

**Table 11: Province or Country of origin.**

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>131</td>
</tr>
<tr>
<td>British Columbia</td>
<td>5</td>
</tr>
<tr>
<td>Other Provinces</td>
<td>7</td>
</tr>
<tr>
<td>Overseas</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>6</td>
</tr>
<tr>
<td>No response</td>
<td>42</td>
</tr>
</tbody>
</table>

Fifty-six percent of visitors to the Wind Valley Natural Area were hiking and another 17% combined hiking with wildlife viewing. Ten percent of the respondents recorded that they
were in the area taking photographs, 6% of the people were mountain biking, predominantly on
the Skogan Pass trail and only 4% of respondents were in the area hunting. Other users included
horse back riding and rock climbing. Finally, the most important theme emerging from the open-
ended question on the survey was to keep the area natural, increased development was requested
by only three respondents.

**Thematic analysis of open-ended management question**

The open-ended question was included in the survey as a means of allowing respondents
to express concerns and interests not accommodated in the other questions. This question also
contributed information on the management objectives that visitors to the valley wished to see
achieved. This question was analyzed using a thematic analysis whereby responses are
categorized and grouped according to dominant themes (Table 11).

**Table 12: Thematic analysis of open-ended question, “Please take a moment to tell us how you
would like to see the Wind Valley used in the future and what in your opinion is the most
important aspect of this area to be managed?”**

<table>
<thead>
<tr>
<th>Themes from Responses to Question 17 on Survey</th>
<th>Number of Respondents of From 191 Surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Keep the Area Natural</td>
<td>76</td>
</tr>
<tr>
<td>2. As Undeveloped as Possible</td>
<td>46</td>
</tr>
<tr>
<td>3. Better Trail Signage/Maps/Elevation Markers</td>
<td>36</td>
</tr>
<tr>
<td>4. No Motorized Vehicles</td>
<td>28</td>
</tr>
<tr>
<td>5. Want to See a Wildlife Refuge Established</td>
<td>28</td>
</tr>
<tr>
<td>6. No Commercial Development</td>
<td>17</td>
</tr>
<tr>
<td>7. Too Many Helicopters/Too Low</td>
<td>10</td>
</tr>
<tr>
<td>8. Do Not Expand Trails</td>
<td>6</td>
</tr>
<tr>
<td>9. No Commercial Horse Use</td>
<td>6</td>
</tr>
<tr>
<td>10. No Hunting</td>
<td>3</td>
</tr>
<tr>
<td>11. Hunting Should be Allowed</td>
<td>3</td>
</tr>
<tr>
<td>12. More Developed Trails</td>
<td>3</td>
</tr>
</tbody>
</table>
BIGHORN SHEEP

Habitat Usage and results of instantaneous scan samples

Direct Observation: Comparison of 1994 findings to telemetry results from 1986

Bighorn sheep use of the Wind Valley Natural Area in 1986 is documented on Figure 11 and can be compared to the habitat use observed over the 1995 field season as documented on Figure 12. Our observations of the sheep confirmed that they use the Wind Ridge in the early spring for lambing, and continue to use this ridge throughout the summer. We also documented use at the Stewart Creek/Dry Lake mineral lick site which confirmed the 1986 data results.

Lamb to Ewe Ratios

The lamb to ewe means ratio was 2.8/8, the maximum number observed was 12/27. The means ratio of lambs to ewes in 1986 was 5 lambs to 7 ewes with a maximum of 31 lambs and 65 ewes observed. The ratio of lambs to ewes was considerably lower in 1995 than in previous counts done in the study area.

Age Class Distribution

A summary of the age classification of bighorn sheep done in SPSS is in Table 12.
Figure 11: 1986 sheep use of the Wind Valley-Mount Allan area.
Figure 12: 1995 sheep use of the Wind Valley-Mount Allan area.

Summer use (June to September 1995)
Spring use (May 1995)
Table 13: Summary of age class observations from the Wind Valley Natural Area to Mount Allan over the 1995 field season.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Valid Minimum</th>
<th>Valid Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Female</td>
<td>7.97</td>
<td>7.01/0</td>
<td>27</td>
<td>70</td>
</tr>
<tr>
<td>Class 1 Male</td>
<td>0.80</td>
<td>0.79/0</td>
<td>2</td>
<td>70</td>
</tr>
<tr>
<td>Class 2 Male</td>
<td>0.29</td>
<td>0.46/0</td>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>Class 3 Male</td>
<td>0.06</td>
<td>0.23/0</td>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>Class 4 Male</td>
<td>0.00</td>
<td>0.00/0</td>
<td>6</td>
<td>70</td>
</tr>
<tr>
<td>Lambs</td>
<td>2.81</td>
<td>3.35/0</td>
<td>12</td>
<td>70</td>
</tr>
<tr>
<td>Yearling Female</td>
<td>1.9</td>
<td>2.32/0</td>
<td>9</td>
<td>70</td>
</tr>
<tr>
<td>Yearling Male</td>
<td>1.89</td>
<td>2.10/0</td>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>Nursery Herd</td>
<td>10.24</td>
<td>14.09/0</td>
<td>54</td>
<td>123</td>
</tr>
</tbody>
</table>

Summary of bighorn use of the Stewart Creek/Dry Lake Mineral Lick

The numbers of sheep observed at the lick site and licking on the main haulage road are summarized in Figure 13. The largest group consisted of 42 individuals and multiple observations were made of 1 or 2 individuals. It is possible that the same group was observed from August 18 to 25 as the group size was consistent during that time.

Tracking Pads

The number of tracking pads used by sheep on trails surrounding the mineral lick site at Stewart Creek/Dry Lake are summarized in Figure 14. During August, all 20 tracking pads were used and use dropped off in September to a low of 5 tracking pads out of 20 showing use.
Figure 13: Number of sheep observed in Stewart Creek/Dry Lake Area over the 1995 field season.
GRIZZLY BEARS

Telemetry and Incidental Locations

Over the summer and fall of 1995, a total of 9 Grizzly Bear Habitat Use Records were completed (see Table 13 for summary and Figure 14 for location of plots). Four of these originated from aerial radio-locations of bear #26 (an adult female observed with two cubs of the year). The remaining five were located incidentally. Table 11 summarizes the habitat use plots.

Digging, including log tearing and rock disturbance, was the dominant form of habitat use, occurring in 78% of the plots. Of these, 71% involved the presence of ants in either a rocky or woody substrate. The remaining 29% involved the search for *Hedysarum* roots. Vegetation use, in the form of *Heracleum lanatum* grazing and *Arctostaphylos uva-ursi* berry feeding, proved to be the second most dominant type of habitat use, occurring in only 22% of the plots.
The least frequent use was carcass feeding. This was observed on a Rocky Mountain Bighorn Sheep that was most likely killed in an avalanche on Wind Ridge during the winter of 1994-95.

Plots fell in several different plant communities, ranging from pine forest with moss dominated understory (D.P. 04) to open alpine and sub-alpine meadows (C.W. 02, D.P. 01/02/03). Plots D.P. 01/02/03 all occurred in Fish and Wildlife Enhancement Sites in the Wind Valley. These areas had been cleared of mixed wood overstory and have been supplementally seeded with ungulate forage species. The remaining windrows of woody debris were in moderate stages of decay, providing habitat for carpenter ants and other insect species on which both black and grizzly bears feed.

Of the 9 plots completed, 2 occurred on TSR property, 2 were just south-west of TSR property in the Quarry Lake area, and 5 occurred in the Wind Valley region. All plots ranged between aspects of 45° and 175° azimuth, North-east and South-south-east respectively. Due to lack of telemetry information, no records were taken east of West Wind Creek.

Table 14: Summary of grizzly bear habitat use records.

<table>
<thead>
<tr>
<th>Record No.</th>
<th>Date</th>
<th>U.T.M. Coordinates</th>
<th>Aspect (° Azimuth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.W. 01</td>
<td>95/06/19</td>
<td>153580</td>
<td>47</td>
</tr>
<tr>
<td>C.W. 02</td>
<td>95/06/22</td>
<td>209524</td>
<td>116</td>
</tr>
<tr>
<td>C.W. 03</td>
<td>95/06/22</td>
<td>199524</td>
<td>133</td>
</tr>
<tr>
<td>D.P. 01</td>
<td>95/06/25</td>
<td>203520</td>
<td>174</td>
</tr>
<tr>
<td>D.P. 02</td>
<td>95/06/26</td>
<td>210523</td>
<td>168</td>
</tr>
<tr>
<td>D.P. 03</td>
<td>95/06/27</td>
<td>208521</td>
<td>171</td>
</tr>
<tr>
<td>D.P. 04</td>
<td>95/06/28</td>
<td>143581</td>
<td>45</td>
</tr>
<tr>
<td>C.W. 04</td>
<td>95/07/02</td>
<td>129589</td>
<td>45</td>
</tr>
<tr>
<td>D.P. 05</td>
<td>95/08/18</td>
<td>193554</td>
<td>47</td>
</tr>
</tbody>
</table>
### DIRECT OBSERVATIONS

Three positive sightings of grizzly bears were made between 15 June 1995 and 15 August 1995. A productive sow grizzly with two cubs of the year was seen twice (Table 14). In late July 1995, this bear was positively identified as bear #26 by the Eastern Slopes Grizzly Bear Project (M. Gibeau, pers. comm.). The other bear, spotted by an Alpine Helicopters pilot, was likely a boar traveling through the female’s home range.

### ADDITIONAL INFORMATION

After 2 July 1995, no radio-telemetry locations were made in the Wind Valley Natural Area, or on TSR property. According to Mike Gibeau of the E.S.G.B.P., bear #26 had been frequenting the area between the west side of Skogan Pass and the Kananaskis Golf Course (pers. comm., 1995). As a result, the only sign of grizzly activity in the study area since that time was through direct observation and incidental plot location.

---

<table>
<thead>
<tr>
<th>Record No.</th>
<th>Plot Origin</th>
<th>Dominant Type of Use</th>
<th>Plant Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.W. 01</td>
<td>radio-location (bear #26)</td>
<td>digging - roots</td>
<td>open Pinus/Picea-Hylocomium</td>
</tr>
<tr>
<td>C.W. 02</td>
<td>radio-location (bear #26)</td>
<td>feeding - carcass</td>
<td>Heracleum-Bromus/Elymus</td>
</tr>
<tr>
<td>C.W. 03</td>
<td>radio-location (bear #26)</td>
<td>grazing - Heracleum</td>
<td>Ribes-Elymus/Bromus</td>
</tr>
<tr>
<td>D.P. 01</td>
<td>incidental</td>
<td>digging - ants</td>
<td>Hedysarum-Fragaria-Elymus</td>
</tr>
<tr>
<td>D.P. 02</td>
<td>incidental</td>
<td>rock disturbance - ants</td>
<td>Heracleum/Teroxacum-Elymus</td>
</tr>
<tr>
<td>D.P. 03</td>
<td>incidental</td>
<td>digging - ants</td>
<td>Teroxacum-Elymus</td>
</tr>
<tr>
<td>D.P. 04</td>
<td>incidental</td>
<td>digging - ants</td>
<td>Pinus-Pleurozium</td>
</tr>
<tr>
<td>C.W. 04</td>
<td>radio-location (bear #26)</td>
<td>digging - ants</td>
<td>Pinus/Picea-Sheperdia-Arctostaphylos</td>
</tr>
<tr>
<td>D.P. 05</td>
<td>incidental</td>
<td>feeding - berries</td>
<td>open Pinus-Rosa-Arctostaphylos-Pleurozium</td>
</tr>
</tbody>
</table>
Table 15: Summary of direct observations of grizzly bears on TSR property or in the Wind Valley Natural Area over the 1995 field season.

<table>
<thead>
<tr>
<th>Observation No.</th>
<th>Date</th>
<th>U.T.M. Coordinates</th>
<th>Origin</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSR 01</td>
<td>95/06/26</td>
<td>209525</td>
<td>TSR field crew</td>
<td>dark brown sow with 2 cinnamon coloured cubs of the year</td>
</tr>
<tr>
<td>TSR 02</td>
<td>95/06/19</td>
<td>152581</td>
<td>construction personnel</td>
<td>dark brown sow with 2 cinnamon coloured cubs of the year</td>
</tr>
<tr>
<td>TSR 03</td>
<td>95/08/07</td>
<td>146592</td>
<td>Alpine Helicopters pilot</td>
<td>single bear, large, brown coloured with black shoulders</td>
</tr>
</tbody>
</table>

In summary, during the field season in 1995 baseline data were collected on bighorn habitat use and population structure, grizzly bear habitat use and human use of the Wind Valley Natural Area. Humans were found to travel the Wind Ridge and Wind Valley and Centennial trails the most frequently. Visitors tended to be from Alberta predominantly and the majority of these visitors were participating in hiking and wildlife viewing. Bighorn sheep were found to occur throughout the field season on Wind Ridge and on Three Sisters Property near the Stewart Creek mineral lick site. The Wind Ridge was important habitat for the sheep during spring lambing. There is a decline in the lamb to ewe ratio in 1995 but without reference to population statistics it is difficult to determine whether this is indicative of a longer term population decline.

Grizzly bears were found to use the Wind Valley bottom in early spring and Skogan Pass trail in the late summer during berry season. Bears did travel from Wind Valley onto Three Sisters Property affirming that the transition from Wind Valley to TSR property is a movement corridor for at least one adult female grizzly and another male grizzly.

This baseline information on both human and wildlife use is critical to a discussion of current human-wildlife interaction in the Wind Valley Natural Area as areas of potential conflict.
can be identified by examining the overlap in the human use and wildlife habitat use. A discussion of the results is included in Chapter Five and the management strategies are outlined in Chapter Six.
CHAPTER FIVE: GENERAL DISCUSSION

The 1992, NRCB decision that the land in the Wind Valley was too environmentally sensitive to sustain a golf resort development was based on the submissions of more than 40 interest groups. This mobilization of community interest emphasizes the importance of environmental issues to residents of the community of Canmore and the Bow corridor. The designation of the Wind Valley as a Natural Area was the first step toward achieving the objective of maintaining the ecological integrity of the area. This study has contributed further information including baseline data on human and wildlife use of the Wind Valley Natural Area as well as a discussion of the different factors that contribute to human-wildlife interaction. This information was used to identify areas of current and potential risk of human-wildlife interaction and management strategies were developed to mitigate detrimental impacts to wildlife.

Factors such as the increased growth rate of Canmore, the marketing of the community as a tourist resort destination, the proximity of the Natural Area to Banff and Kananaskis Country, and the projected trends of increased tourism to the Bow Valley suggest that recreational pressures in the Wind Valley Natural Area may increase dramatically by the year 2010. If the objectives of preservation and conservation of important habitat in the Wind Valley are to be met, recreational use of the Natural Area will have to be limited and controlled and indicators of detrimental impacts of human use on wildlife will have to be monitored. Wildlife will respond to pressures exerted by recreation, construction and development over their entire home range including activities in important habitat not contained within the boundary of the protected area.

This study was divided into four main sections: an analysis of the problem; an examination of the causal factors contributing to wildlife-human interactions in the Wind Valley Natural Area and the potential direct and indirect impacts; field data collected in the summer of
1995 established the baseline for human use of the Wind Valley as well as the habitat used by grizzly bears and bighorn sheep; and finally this information was used to identify areas of current and potential conflict in the Wind Valley Natural Area.

The human use of the Wind Valley has not been documented previously, and little is known about the numbers of people annually using the area and their preferred activities. This study offers a brief sketch of human use of the Valley during the peak of the 1995 tourist season. The growth in the community of Canmore has been documented, and following the Olympics, Canmore was internationally recognized as a tourist resort destination, so it is likely that the human use of the valley has increased since then. It also is likely that increased tourism in the Bow Valley and the new focus of Canmore’s Growth Management Strategy (1995) on tourism will lead to even more recreational pressure in Wind Valley Natural Area in the future.

The following discussion of the results of the field data establishes the areas of current and potential risk for human-wildlife interaction.

**HUMAN USE**

The largest number of people recorded accessing the Wind Valley Natural Area in a single day in 1995 from the parking lot at Alpine Haven Resorts was 60 counted in mid-June. The Wind Valley trail is free of snow and accessible earlier than many of the popular hiking trails in Banff National Park which may explain the heavy use early in the season. As the Wind Valley is easily accessible from Canmore, and a little more than an hour’s drive from Calgary, it is not surprising that 71% of the visitors were from Calgary and 20% were from Canmore. The promotion of the community of Canmore as an international tourist resort destination and the
development of facilities such as the Three Sisters Resort will likely lead to an increase in visitors from other areas in Canada, and other countries.

The type of recreational use in the Wind Valley Natural Area does reflect trends identified in the literature. Hiking and wildlife viewing are the most popular activities with photography also an important pursuit. It is likely that there was a lower response rate to the survey from other types of recreational users of the valley such as hunters and horse back riders. These visitors may not have used the main trailhead to access the area, and thus may not have seen the survey site. Mountain bikers did not tend to respond to the survey possibly due to the location of the information station at the base of a hill descending from Skogan Pass. It was observed that cyclists did not stop at the base of the trail where the information and surveys were posted, although heavy cycle use was not observed while ground-truthing surveys. According to trends identified in the literature, it is likely that mountain biking use of the Wind Valley will increase. This activity has a high risk of human-wildlife encounters due to the relatively quiet and fast movement of the humans. There was an encounter on the Skogan Pass trail in mid August recorded on a survey where a cyclist frightened a young grizzly bear which initially fled from the cyclist, but pursued him after he had passed. This activity must be carefully monitored and cyclists must be educated about safe travel in bear country.

The evidence of interest in wildlife viewing and photography in the Wind Valley Area suggests that there is definitely the risk of human-wildlife conflict in areas known to be used by wildlife such as the Wind Valley and Wind Ridge. According to Vaske et al. (1995), the characteristics of visitor use in a natural or protected area determine whether they will lead to human-wildlife interaction. The behaviour of the visitors and the frequency of use of different
trails in the valley will determine how much stress is exerted on the bighorn sheep and other wildlife. The type of use will also influence the risk of wildlife encounters.

During the field season hikers were observed accessing Wind Ridge from the old abandoned mining road, and following the height of land to the summit of the ridge. Often the hikers would continue on to do a circuit returning to the valley bottom via an avalanche path (Figure 4). This trail, like many in the Wind Valley Natural Area, is not marked. Of the surveys collected, 30% of respondents reported that they did not stay on the trails, most often because the trails were not marked well enough. Hiking and wildlife viewing were the most popular activities in the Wind Valley area, and the Wind Ridge Trail was the most used trail. The data suggest that the ridge is important habitat for bighorn sheep throughout the spring and summer and thus the potential for conflict between sheep and hikers is high. In the Management Plan for the Wind Valley Natural Area it is stated that the Wind Ridge Trail “will not be designated (mapped, signed and maintained)...in order to reduce the visitor numbers” (Anonymous, 1996b). The most important themes emerging from the open-ended question on the survey instrument were that the area should be kept natural, and as undeveloped as possible. Few respondents requested more developed trails and thus it may be effective to mark the trails obviously, but not maintain or develop them further.

**BIGHORN SHEEP**

A comparison between the observations of sheep use of the Wind Valley and Mount Allan areas in 1986 and in 1995 showed some differences. The 1986 data were collected with the use of telemetry and thus facilitated location of the sheep allowing for a greater number of observations throughout the field season. The 1995 data were collected without telemetry, and thus areas where visibility of the sheep may have been obscured such as the slopes of Mount
Lougheed were not well represented in the 1995 data set. The most important limitation of direct observation is visibility. There are a number of different factors which can limit visibility including weather and "differential visibility among habitats" (Bookhout, 1994:257). Direct observation was also restricted to diurnal periods.

The objective of the 1986 study was to examine the impact of the Nakiska Ski development on Mount Allan on the bighorn use of that area. More intensive data were collected during this study on the Mount Allan area accounting for the greater number of early season observations. The 1995 study focused mainly on the Wind Ridge area adjacent to the Three Sisters property holdings as access to the Mount Allan area was limited in the early season and lambing on Mount Allan had been well documented by Jorgenson (1987). It is apparent from the two data sets that Wind Ridge is used as a lambing area for a sub-population of the Wind Ridge-Mount Allan sheep herd. Although the Mount Allan lambing area is closed during the lambing season to protect the females and lambs during this biologically sensitive time period, there is no such spring closure for the Wind Ridge area. Early season use of the Wind Ridge Trail was documented in 1986 and it was confirmed in 1995 observations from early June. Statistics gathered on human use of the area suggested heavier use in the late spring and early summer than in July and August.

Also evident from both data sets was the bighorn sheep use of the Stewart Creek/Dry Lake mineral lick site; this is another potential location for wildlife-human conflict. Although not located within the boundaries of the Natural Area, it is an important site used by the Wind Ridge-Mount Allan sheep herd. Jorgenson (pers. comm.) stated that all of the sheep in the herd will be seen at the Stewart Creek/Dry Lake lick site over the summer season. Stress exerted on the sheep at this site will influence the entire population. This site and the movement corridor descending
from Wind Ridge and passing Stewart and Fall Creeks are critical to the sheep. Use of the mineral lick site was elaborated further in the results of intensive observations during August of 1995 and through the indirect observations collected by the use of tracking pads. A maximum of 45 sheep were observed at the site at one time, and sustained use was observed during August of 1995. Tracking pads were used from early July through to late September when the use declined. The lick site is the location of the undeveloped Stewart Creek Golf course with the main clubhouse of the golf course proposed to overlook the mineral lick. It was observed that sheep at the mineral lick site would move off the main haulage road when a vehicle approached and would return to licking once the vehicle was out of view. If individual humans or small groups approached the sheep from trails adjacent to the road, the sheep exhibited disturbance responses and left the site, not returning. In one instance, sheep disturbed by hikers were observed using the cliffs of the Fall Creek waterfall as escape habitat.

There is also the potential that construction and development of the Stewart Creek golf course may affect the spatial distribution of the bighorn sheep. Monitoring of the sheep population structure, and response to disturbances by Three Sisters Resorts and Kananaskis Country managers will allow for mitigation of any negative impact observed. It is also documented that stress may not be exhibited as a flight or fright response. It is only through a thorough examination of the population numbers, structure and use of habitat that stress responses in any one part of the habitat may be understood. Some other techniques for monitoring stress response of sheep over time would be testing fecal samples for increases in lungworm parasites, and the use of heart rate telemetry to better understand the response of the sheep to disturbance throughout their habitat.
A potential source of error in age classification results from the fact that the adult females and yearlings look very similar in the late summer and fall months and thus may have been incorrectly identified from long distances. The summary of age classification of the sheep observed in 1995 documents few adult males. This was because the study focused on the habitat used by the nursery herds, which do not have home ranges as large as those used by the males, and are more biologically sensitive. Males do not travel with the nursery herds in the summer season, and they tend to use different habitat. It is likely that due to hunting, the adult male sheep avoid areas frequented by humans and are thus less visible. Hunting statistics are summarized in Chapter 3. Further research should be done on the interaction of hunting and other recreational activities as they affect bighorn sheep.

The lamb to ewe means ratio of 1995 was lower than that of 1986. It is possible that some counts do not include all lambs as early in the spring and summer the lambs may not have been with the females, or they may not have been visible. It is possible that the decline in lambs may be indicative of an overall decline in the population or it could be a slight decline following a recent expansion. Fluctuations in lamb to ewe ratios occur naturally, these numbers would have to be compared through time in order to get a more accurate understanding of the relationship to population characteristics. Low reproductive rates could be caused by other factors such as increased lungworm parasites resulting from a harsh winter or stress, lack of high quality forage or increased population density. The lamb to ewe ratio significance must be confirmed by referring to other population parameters and other indicators including behaviour and habitat use patterns.

It is evident from the data that the use patterns of bighorn sheep and humans overlap in some critical areas which could contribute to increased human-wildlife conflict or interaction as
recreation and development increase in the area. In order to avoid habitat abandonment by the sheep of areas such as the Stewart creek/Fall Creek sites, and the summit of Wind Ridge, the movement and behaviour of humans have to be managed carefully. Some recommended strategies for avoiding the detrimental impacts of human-wildlife interactions are included in Chapter Six.

GRIZZLY BEARS

There is a potential risk of human-bear conflicts in the Wind Valley fen in the early spring (Figure 16). The Habitat Use Plots completed in 1995 showed a concentration of bear use in the Wind Valley in the spring (6 of 9 total plots). This supports the claim made in the 1991 E.I.A. report that the Wind Ridge area provides valuable grizzly bear habitat. The 1992 land trade completed between TSR and the Provincial Government, setting aside the proposed development area in the Wind Valley, retained a large area of prime bear habitat for continued use by bears. At the time of the designation of the Wind Valley Natural Area, it was not specified which management techniques would achieve the protection of the bears in the Wind Valley. Although the area has been afforded some protection, the female grizzly that uses the valley ventures onto the privately owned property adjacent to the valley. When this property is further developed, there will be increased pressure on the grizzly sow.

At the time of the Environmental Impact Assessment (1991), it was suggested that two grizzly bears used the Wind Creek area as part of their annual range, one breeding female and another bear of unknown sex and as many as 19 bears could pass through the area. There is also evidence that human-bear interactions are increasing in the Valley and in some instances mitigative action must be taken in order to avoid potentially hazardous encounters. According to Herrero (1986:187) “Certain trail characteristics, such as whether a trail passes through grizzly
bear habitat, the time of year used, the extent of visibility along the trail, and the density of cover, influence the chances of a sudden encounter with a grizzly bear.” Since hikers familiar with bear behaviour may be less likely to contribute to human-bear interaction, hiker behaviour and the past experience of the bear with humans will influence the potential for encounters.

A productive sow grizzly (bear #26) and her two cubs of the year were positively identified as utilizing the study area in 1995. Radio-located plots occurred on TSR property only 25% of the time (1 of 4 plots); of the remaining three plots, two were on Wind Ridge and the other above Quarry Lake. The sighting of a large brown coloured grizzly with black shoulders near the North-east property boundary indicated that a second bear used the same habitat as the collared female. It is likely that this was a boar traveling through part of its annual range rather than another sow because grizzly social behaviour generally isolates female home ranges so they do not overlap.

It is not surprising that there was only one female grizzly bear using the valley as her home range, as this area is proximate to the heavily developed Bow Corridor which contains barriers to wildlife movement such as the Trans-Canada Highway and the Trans-Continental Railway. The wildlife movement corridor connecting the Wind Valley with the Bow Valley (Figure 3) is increasingly blocked. A recent report in Canadian Geographic (Marty, 1997:32) states that “The Bow Valley corridor is a dead end for female grizzlies that refuse to cross the divided Trans-Canada Highway which blocks the natural paths linking grizzly bear ranges”. Bear #26 is a small female over 20 years in age. She likely uses habitat close to human development because these areas will be avoided by other larger bears, particularly the males which might kill her young. Due to her size, #26 is not likely able to defend highly valuable habitat from larger bears which would also explain her early season use of the valley. It is also
possible that other bears traveled through the Wind Valley area but were not observed by researchers (who were deliberately trying to avoid bear encounters) or were not radio collared.

Habitat use and maintenance of a home range are functions of the need to acquire energy rich and seasonally-variable forage (UMA Engineering Ltd., 1991). Preservation of the Wind Valley/Wind Ridge ecosystems assures representation of critical habitat types - most notably wetland and alpine meadow plant communities. These important early season feeding sites such as the Wind Valley fen are sites of potential human-bear conflict. Education in the form of interpretive signage, pamphlets, interpretive programs or facilities (even referring visitors to facilities available in Kananaskis County or Banff National Park) could be useful here as this method has previously reduced human wildlife interactions in other protected areas (Knight and Cole, 1995b). The trail through the valley bottom is obvious, and informing the public of the importance of the habitat to bears may encourage them to stay on the trail, look for recent bear sign and make sufficient noise to warn bears of their approach.

Another important food source for the grizzly bears is berries in the late summer and early fall. During the summer of 1995 there were a number of encounters between a couple of young grizzly bears (possibly subadult cubs from bear #26) and people hiking or mountain biking. These bears were repeatedly surprised by hikers and mountain bikers while feeding on berry bushes beside the trail. The trail was closed for the latter part of August after reports of aggression during bear encounters were made to Alberta Fish and Wildlife. As numbers of tourists increase in the Natural Area, these encounters will also increase. Seasonal closures on the Skogan Pass trail during the late summer may be a means of avoiding human-bear conflicts on the Skogan Pass trail. Informative interpretive signage at the trial head may also mitigate or prevent unintentional harassment of grizzly bears.
Because the bears tend to move from the Natural Area onto Three Sisters private property, conflicts between visitors and bears can also result from improper disposal of garbage, or landscaping which places high quality bear food near human development. Conflicts could be reduced if enforcement of clean construction sites is strict and garbage disposal in the Three Sisters Developments is bear safe. Resources such as signage and pamphlets should also be made available to the public via the Three Sisters access road to educate them on bear identification and behaviour. Education is key. People need information in order to assist authorities in reducing the costly conflicts with bears.

Mapping of the study area done by John Kansas as part of the Eastern Slopes Grizzly Project is based on the habitat inventory plots and is mapped at a scale of 1:50,000. This scale is not adequate for site specific planning in areas such as the Wind Valley Natural Area. The information generated from mapping habitat should be used in conjunction with the displacement and disturbance work currently being compiled by Mike Gibeau (1997) to develop a site specific plan which protects the important habitat features such as the fen, and reduces the bear hazard to people visiting the area. This research will make available information critical for management planning such as bear population estimates and important habitat area. The only way that habitat protection for grizzly bears can be effected is through interagency and cross-jurisdictional cooperation. There are a number of stakeholders listed in the Wind Valley Natural Area Management Plan (1996). The role that these and other groups play in management of the area will be critical to avoiding wildlife displacement due to human-wildlife interactions.

**FUTURE RESEARCH OPPORTUNITIES**

The interactions between humans and wildlife should be examined so that the relationship between the effects of different activities such as hunting and wildlife
viewing/photography can be better understood. Habituation and accommodation of wildlife to visitors may make them more susceptible to hunting and thus harvesting will "lead almost inevitably to excessive harassment of the animals and its negative consequences on the population, except in a few select circumstances" (Geist, 1975: 95).

There are a number of important questions that should be addressed in future research including: Are hunting and other forms of recreation compatible in the Wind Valley? How much recreational use is too much? What are the influences of different types of recreational activities on the wildlife populations in the area? What is the level of public understanding of wildlife ecology and behaviour?

Further research is required on the site specific habitat use of the Wind Valley by grizzly bears. The information that will be generated by the Eastern Slopes Grizzly Study will facilitate management of the recreation area for important grizzly bear habitat. As these bears are endangered, it should be a priority to manage human use to minimize disturbance to bears during important biological periods.

CONCLUSION

The areas of higher risk of human-wildlife interaction in the Wind Valley Natural Area have been identified and possible corrective actions can be proposed. The approach taken in this study was an attempt to integrate the social and ecological factors that influence the risk and impact of wildlife-human interaction. The different factors that contribute to these interactions were outlined in the literature review and it was noted that trends and processes in the Bow Valley would likely contribute to an increase in wildlife-human interaction in the Natural Area.
through the year 2010. The objective of maintaining the ecological integrity of the Wind Valley Natural Area will be met only if detrimental human-wildlife interactions are mitigated.
CHAPTER SIX: RECOMMENDATIONS AND CONCLUSIONS

A series of management strategies have been developed to mitigate the negative impacts of human-wildlife interaction on wildlife populations in the Wind Valley Natural Area. These strategies are derived from an understanding of the factors contributing to wildlife-human conflicts, and the recognition of the areas of increased risk. A number of recommendations result.

It is recommended that:

1. The Wind Ridge Trail should be clearly marked with some type of blazing or signage. In order to address the danger of displacement of bighorn sheep from the Wind Ridge trail, it is recommended that in areas of heavy sheep use, trails be well marked to avoid unpredictable movements of people passing through the sheep habitat. It is documented in the literature that sheep will habituate to predictable stimuli (Geist, 1971b; MacCallum, 1991; Morgantini, 1979) and hikers and those intending to view wildlife are more likely to cause stress or unintentionally harass sheep if they wander off the designated trails. Marking the trails and posting signs encouraging hikers to stay on the trials will reduce the risk of human-sheep encounters, and prevent damage to the fragile alpine ecosystem. It is not necessary to further develop the trails if they are adequately marked.

2. There should be a seasonal closure for the Wind Ridge Trail during bighorn sheep lambing (from early May to mid-June). Early season use of the Wind Ridge Trail was documented in 1986 and was confirmed in 1995. Statistics gathered on human use of the area suggest heavier use in the late spring and early summer than in July and August. There is no evidence to suggest that the sheep using the Wind Ridge during this biologically critical time would use the lambing cliffs on Mount Allan if displaced from the Wind Valley.
3. Three Sisters Resorts should collaborate with Alberta Environmental Protection to develop some interpretive signage that can be posted at the access to the property and along the seasonal closure at Stewart Creek/Dry Lake from June 15 to September 1 (see Figure 16). There is a seasonal closure for the Stewart Creek/Dry Lake area from June 15 to September 1 (see Figure 16), but due to poor signage and lack of information available to the public, the closure was not effective. Education will be a critical tool to convert visitors to Three Sisters Resorts and the Wind Valley Natural Area from tourists into environmental stewards.

4. There should be no construction along the movement corridor used by the bighorn sheep to access the Stewart Creek/Dry Lake mineral lick site or the Fall Creek escape terrain. There should be no trail development to the Fall Creek waterfall. Although bighorn sheep have been documented to habituate to predictable disturbances, sustained stresses and long term disturbance of the sheep can lead to habitat abandonment and population decline. Developments of trails up to the Fall Creek waterfall could fragment the habitat use and movement patterns of the sheep (Figure 3). The movement corridor from Wind Ridge to the mineral lick site is very important for the sheep as they are stressed when moving through the montane ecosystem. Adaptations for avoiding predators require accessible escape terrain which is available at the Fall Creek waterfall (currently designated for trail development).

5. Three Sisters Resorts should continue to monitor the behaviour of bighorn sheep at the mineral lick site on their property for any changes which may result from construction and development activities. Annual counts of the Wind Ridge-Mount Allan herd along with behavioural data and tests of fecal samples for increases in instance of lungworm parasites will all serve as indicators for monitoring the response of bighorn sheep to human interaction. Further information should be gathered on population parameters including lamb to ewe.
ratios. These data must be collected over time in order to monitor changes in species composition and reduction in overall population levels.

6. The frequency of use and the behaviour of visitors using the Wind Valley should be monitored. Information should be gathered on an ongoing basis and management decisions adapted in response to changes in human use patterns in order to avoid negative impacts on wildlife habitat. This study was the first documentation of human use of the Wind Valley and it offers only a preliminary baseline and estimates of numbers of users. More data are needed to document use patterns.

7. Visitors should be educated through interpretive signage at the trailhead to the Wind Valley and at the entrance to Three Sisters Property on the ecology and habitat needs of wildlife, particularly bears. Education has been proven to be an effective tool in increasing the effectiveness of closures and other management strategies.

8. Cyclists should be educated on safe travel through bear country through interpretive signage at the trail head and pamphlets. Cyclists must be aware of the increased risk of cyclist-wildlife interactions on trails. This mode of transport necessitates careful management to avoid hazardous encounters particularly with grizzly bears.

9. The Skogan Pass Trail should be closed during berry season. This Trail (Figure 16) among others in the Wind Valley offers high quality bear food during the late summer and bears tend to use the trails as movement corridors for following berry production through the valley. There is already a history of human-bear encounters on the Skogan Pass trail and aggressive activity on the part of the bears was documented on one survey. This situation is potentially hazardous to people visiting the Skogan Pass area during berry season.
10. Demographic studies should be continued by the Eastern Slopes Grizzly Project to obtain accurate estimates of populations of grizzly bears in Kananaskis Country. This information would be combined with other factors such as population structure and habitat use in the final Habitat Model being developed by ESGP. The information generated by the ESGP should be applied at the site specific level to the Wind Valley Natural Area.

11. An interagency, multi-stakeholder group responsible for regional grizzly bear management should be established (Gibeau, 1997). Management of grizzly bears must be done at the landscape level and requires the cooperation of all stakeholders including the different private property owners, and different levels of government.

12. Further habitat fragmentation should be avoided and any habitat links that are existing should be maintained so that bears do not become geographically isolated (Gibeau, 1997). If the movement corridor which is currently used by grizzly bears to access the Bow Valley is further fragmented it is possible that the bears in this area could become geographically isolated from other grizzly bear subpopulations. This would reduce the viability of an already threatened population.

13. Enforcement of clean construction sites on TSR property and bear-safe garbage disposal are necessary. Resources such as signage and pamphlets should also be made available to the members of the public at the Three Sisters Access road to educate them on bear identification and behaviour. TSR property owners should be educated about bear food, and landscaping should be carefully monitored so that important bear foods are not planted near human use areas. It is not possible for grizzly bears and humans to coexist in close contact, but specific strategies can be implemented to avoid attracting bears to areas heavily used by people.
RESPONSIBILITIES OF STAKEHOLDERS

In the Draft Terms of Reference for the Wind Valley Natural Area (1996) and the Wind Valley Natural Area Management Plan (1996), a number of stakeholders were identified and responsibilities were outlined. It was suggested that the position of Volunteer Stewart be created. Volunteer Stewards would include individuals and groups volunteering to visit the Natural Area and observe, record and report conditions and activities in the area. These Stewards could include recreational groups such as the Bow Valley Naturalists and members of the Canmore community, among others.

There are three jurisdictions which share the responsibility for management of the Natural Area; MD 8, the Town of Canmore, and Kananaskis Improvement District. It was suggested in the management plan (1996) that these agencies coordinate through the proposed Bow Corridor Ecosystem Advisory Working Group which would have representation from each of the different jurisdictions and would function as a coordinating body overseeing research activities, land use and municipal planning issues. This is the type of interagency collaboration that is critical to landscape level ecosystem management. It is difficult to coordinate and organize such a body, and other problems encountered in interagency collaboration are lack of power and means of enforcement of recommendations.

Implementation of management plans and resource recommendations is the role of Alberta Environmental Protection staff. The important role of educating the public, making information available and enforcing regulations is the responsibility of this agency. In the management plan (1996:13), it is noted that “Educational or interpretive use of the Natural Area will not be actively encouraged”. It is the concern of Environmental Protection that interpretive signs and facilitates will encourage heavier use. The use of the area was underestimated by
Environmental Protection staff at 10 people per summer weekend day versus our average of 45 people per weekend day. Possibly the strategies of neglecting access and not dispersing information about the site are appropriate strategies for indirectly avoiding the problems associated with heavy use of the area. In light of evidence of higher numbers of users than originally estimated and the potential for human-wildlife conflicts, this strategy should be revisited. More direct strategies such as prohibiting use during certain times (seasonal closures) and restricting camping activities may be useful. Support must be made available to Environmental Protection in order to ensure that they have adequate resources to monitor the use of the Wind Valley Area and if necessary address the important needs of education and information.

It was stated in the management plan (1996:3) that “the public will play a significant role in the preparation of the management plan and its implementation”. Public meetings were held in the Canmore community during the development of the plan. The first announcement of the public meetings was in the Canmore Leader on March 5, 1996. In the same paper was an article which criticized Kananaskis Country for their “lack of desire to seek meaningful public participation” (Burke, 1996a: 3). About 100 people attended the Canmore open house on March 5. Some of the issues addressed at this meeting included mineral extraction, hunting, development and recreational use. One participant avidly denounced any further development in the Valley region stating “(W)e’re not against development. I just want to make them understand that development for development’s sake is foolish” (Burke, 1996a: 3). This resident went on to say later that development is proceeding at such a rate in Canmore and the Bow Valley in general that it is no longer simply sustaining the community, or contributing to sustainable growth. He
maintained that development was out of control and the rate of growth was something that needed to be looked at.

Although participants at the open house generally felt that the meeting was productive and that many important issues were discussed, one local resident stated that the government officials did not have enough information to answer questions or respond adequately. He noted that the officials were pushing the management plan through before they adequately understood the environment.

Three Sisters Golf Resorts has a responsibility as recommended by the NRCB (1992) to maintain the bighorn sheep population and mitigate disturbance to wildlife populations using their property holdings. As TSR is developing their property over a 20 year period, they are in the unique position of having baseline data on wildlife populations using their land. These data can become a reference for data collected on an ongoing basis during development.

Bleich (1990) states that, “Only with the recognition that stewardship responsibilities extend beyond areas of traditional habitat and what are perceived to be “viable” populations will we assure the long-term stability of desert-dwelling mountain sheep and other vagile species that similarly inhabit naturally fragmented habitat”. The “integrated landscape approach” (Knight and George, 1995: 282) combined with adaptive management strategies allows for the management of human use and wildlife populations through time to achieve an established objective (in this case maintaining wildlife and ecological integrity).

If the stakeholders involved in the management of the Wind Valley and surrounding wildlife habitat and movement corridors including the Town of Canmore, Alberta Environmental Protection and Three Sisters Resorts collaborate, it is possible that landscape level and adaptive
management strategies can be effective. The construction of housing developments and golf courses can be seen as manipulations or treatments and the comparisons of habitat use and behaviour of bighorn sheep and other species before and after treatments will allow for strong inferences regarding responses. This information can then be used under the model of adaptive management to modify management strategies to mitigate negative impacts on wildlife. This method has been used in other management situations as an experimental management strategy to study the changes in distribution over space and time (Boyle and Sampson, 1985). Only in this way will the management objectives of maintaining the ecological integrity and biodiversity of the Wind Valley Natural Area be achieved.

**CONCLUSIONS**

It is not adequate to implement the proposed management strategies without also enacting a program of long-term monitoring for indicators of negative impacts to wildlife or wildlife habitat. The indicators for assessing the direct and indirect impacts of recreation on wildlife adapted in the Chapter One from Hammitt and Cole (1995) are: habitat modification, alteration of behaviour, reduced productivity levels, and changes in species composition and structure. This study has provided some baseline data that can be used to apply the Hamitt and Cole model (1995) and it is important to note that the factors that contribute to human-wildlife interactions are interactive and synergistic as was suggested in the model developed by Knight and Cole (1995) (see Chapter One). There is no simple cause-effect relationship and the resultant impacts observed in the Wind Valley ecosystem may be complex. The status of human use of the Wind Valley, and the progress of development along the mouth of the valley and on TSR property should all be monitored continually for possible adverse results in the selected wildlife indicators (eg. altered behaviour). Adaptive management is an appropriate means to incorporate this
information back into the management decision-making process. If negative impacts are observed in wildlife populations, the management strategies should be altered, and measures should be taken to mitigate the negative responses.
Figure 16: Summary of the proposed management strategies for the Wind Valley Natural Area.


Strategies. Northwest Territories Department of Renewable Resources. Yellowknife, Northwest Territories, Canada.


Kaufmann, M. R. et al. 1994. An Ecological Basis for Ecosystem Management. Rocky Mountain Forest and Range Experiment Station, Southwestern Region, Forest Service, USDA.


APPENDICES

APPENDIX 1: ALPINE AND SUBALPINE COMMUNITY TYPES IN THE WIND VALLEY

Rockland and Talus
Hairy Wildrye (Elymus innovatus) meadows
Kobresia (Kobresia myosuroides) meadows
Tall willow (Salix glauca, S. drummontiana, S. barrattiana, S. farriae)
Dwarf willow (Salix arctica type and S. nivalis type) shrublands
Krummholz spruce-subalpine fir/grouseberry (Picea glauca and P. engelmannii - Abies lasiocarpa/Vaccinium scoparium) forest
White mountain aven (Dryas hookeriana) dwarf shrublands
Sedge (Carex spp.) meadow
Seepage meadows
Hairgrass (Deschampsia caespitosa) meadows
Heather (Phyllodoce glanduliflora - Cassiope tetragona) dwarf shrublands
Spruce-subalpine fir/pinegrass (Calamagrostis rubescens) forest
Spruce-subalpine fir/grouseberry forest
Lodgepole pine/pinegrass (Pinus contorta/Calamagrostis rubescens) forest
Lodgepole pine/grouseberry forest
Spruce-subalpine fir - whitebark pine (Pinus albicaulis/grouseberry) forest
Aspen (Populus tremuloides) woodland
Rough fescue (Festuca scrabrella) grasslands
APPENDIX 2: SURVEY OF RECREATIONAL INTERESTS IN THE WIND VALLEY NATURAL AREA

Survey of Recreational Interests in the Wind Valley Area
P.O. Box 2891
Canmore, Alberta T0L 0M0
Phone: 587-6657

This questionnaire is part of a masters study in Natural Resource Management at the University of Northern British Columbia (UNBC), Prince George. The research is being undertaken by Carolyn Whittaker and is jointly supported by UNBC and Three Sisters Resorts Inc., Canmore, Alberta.

The Wind Valley Region constitutes about 3700 ha. of montane, subalpine and alpine ecosystems. It includes the three drainages; Wind Creek, West Wind Creek and Pigeon Creek. The variety of ecotypes in the valley facilitate a wide diversity of wildlife, and makes the valley an appealing place to view animals. The Wind Valley is currently being designated a Natural Area which puts it under the jurisdiction of Alberta Forest Service and Alberta Lands and Parks.

We ask that one person from each group take the time to fill out this questionnaire after your excursion. There is little information available on the manner in which the valley is currently used by local people and visitors. You are an important resource to those making management decisions. We are most interested in how often you use the area, your activities, and your experiences with wildlife. Your identity will remain confidential. For any further information, please contact Carolyn Whittaker at the above address.

Thank you for participating in this study!

Questionnaire

1. Date: month/day/year

2. Is this your first visit ever to the Wind Valley?  
   _Yes (if yes, go to question #4) _No (if no proceed to question #3)

3. If not how many times have you been in the Wind Valley in the past five years?  

4. How many people in your group?  

5. Which trail did you travel on this trip?  

6. What length of time did you spend in the Wind Valley this trip?  

7. Did you travel the off of the trail?  
   _Yes ___No Comments

8. While in the area did you see any large animals?  
   _Yes ___No (if no proceed to question #15)

9. If yes, which of the following animals did you see? DESCRIBE WHERE SEEN. Pictures are displayed on the information board here to help you identify animals.

- Grizzly bear # where seen  
- Black bear # where seen  
- Goat # where seen  
- Cougar # where seen  
- Wolf # where seen  
- Coyote # where seen  
- Bighorn sheep # where seen  
- Elk # where seen  
- Deer # where seen  
- Other # where seen

10. Did you or anyone in your party approach the animals?  
    _Yes ___No (if no proceed to #12)

    Comments

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