



Muskwa Kechika Access Sensitivity  
Seed Project 1999/2000  
Final Report

Prepared for the  
**Muskwa Kechika Advisory Board**  
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## Executive Summary

This seed project was designed to collect information that will be used for future work on creating an access sensitivity mapping methodology. This project has been in progress for seven months and has now come to completion. There have been many activities completed including a literature review, personal interviews, review of similar projects and identification of key data sets for assessing access sensitivity.

There were some trends in information that became obvious along the way. These trends were used to help identify key factors to consider when mapping access sensitivity and develop recommendations for future direction of this project. It is hoped that what has been produced from this effort is meaningful and of assistance to the Muskwa Kechika Board and future people who take on the challenge of this project.

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### **Acknowledgements**

There are many people that have helped me along the way. Mr. Doug Russell, Forest Ecosystem Specialist (FES) for the Ministry of Environment, was the original creator of this project. He was a great influence and provided encouragement at the commencement of this endeavor. Mr. Jules Paquette, GIS Coordinator for the Ministry of Environment, assisted with the technical side of the project and helped to get things off the ground. Both these gentleman left shortly after I arrived. I was pleased to have been able to work with them and learned a great deal.

Mr. Rod Backmeyer, current Forest Ecosystem Specialist for the Ministry of Environment Peace Region, graciously took over as my project supervisor. He is, to my benefit, very knowledgeable and supportive. Mr. Michael Wood, GIS Coordinator for the Ministry of Environment Peace Region, provided me with much appreciated guidance and assistance during this challenging undertaking.

There are so many individuals and staff that have supported me during this experience. I would like to thank them even if it was just for a smile on a lonely day. My appreciation is indebted to all of them, for without their livelihood and encouragement I would not have been able to work so hard on such as complex project.

## **1.0 Introduction**

The Muskwa Kechika (MK) Management Area (Figure 1) in Northeastern British Columbia is one of North America's last true wilderness areas south of the 60<sup>th</sup> parallel. This 4.4 million hectare area supports diverse populations of wildlife and fish, and is often referred to as the "Serengeti of the north". Besides an abundance wildlife, there are unique landforms, old growth forests and productive riparian areas. All these factors contribute to the natural beauty and value of the area. This one of a kind area was recommended for special management in 1997 under the Land and Resource Management Planning (LRMP) process. Access related issues in the MK takes direction from the Fort St. John and Fort Nelson LRMP Tables. One of the principle goals of the LRMP is to sustain wilderness values in the MK while allowing for future resource development. The MK is within the Access Management Area (AMA), which is the current legislation that controls access within the MK. This restricts public access to designated routes only in order to protect wildlife, their habitat and wilderness values. These restrictions refer only to motor vehicles and ATV's and includes a maximum distance that people can be off the designated routes and weight restrictions. Under the LRMP, traditional access methods are allowed to continue, thus meaning that there are currently no restrictions on the use of river boats, snowmobiles or aircraft in the MK.

Access, one term with many variables. Roads, trucks, aircraft, ATV's, riverboats, horses, snowmobiles and foot access are all examples of access methods. The intensity of the disturbance related to access varies from year to year and season to season. And on top off all that variability, is the variability of the perceived value and/or impacts of access that exists from stakeholder to stakeholder and person to person.



This is precisely why special standards for environmental practices within the MK need to be created and a methodology to assess access sensitivity need to be developed. The combination of these two things will allow for realization of the goals set for the MK. The proposed future project will take the information produced as part of this seed project, and develop it into a formal methodology for the assessment of access sensitivity. This methodology will consider relevant factors involving ecological, cultural, recreational and economic values. When developed such a methodology can be used by integrated resource managers to plan access strategies within the MK in order to conserve wilderness and wildlife values.

This project includes a literature review, personal interviews, a review of similar projects and identification of key data required for assessing access sensitivity. An annotated bibliography was created with information pertaining to access and its impacts. Four resource centers were used to find the data including the Ministry of Environment, Lands and Parks library in Fort St. John and Victoria, the University of Victoria library and the internet. Personal interviews were designed to gather input on what people value in and about the MK and their perception on the potential impacts of various methods of access. A search for and review of similar projects was conducted to determine how other resource managers are considering access sensitivity. Finally, the results of the aforementioned activities enabled a list to be produced that identified key data layers and factors to consider when mapping access sensitivity.

## **2.0 Discussion**

### **2.1 Literature Review**

One of the main activities of this project was to compile an annotated bibliography. The purpose of the literature review was to produce an annotated bibliography with reference to specific methodologies that may be applicable for assessing access sensitivity. The search for appropriate research studies done to date was intended to determine their applicability to future studies and data collection in the MK.

The annotated bibliography presents a short summary or abstract for each reference and bibliographic details that will allow people to locate these materials in the future. Results from the literature review revealed plenty of research on the effects of access on wildlife and the environment; for the most part the impacts are negative. Some of the impacts include habitat destruction, habitat fragmentation, disturbance of fish and wildlife during critical periods, environmental and noise pollution, soil compaction and damage to vegetation. Multiple factors need to be taken into consideration when planning access if impacts are to be minimized.

In relation to wildlife some of the most important factors to consider include winter range and travel corridors. Other features that need to be considered include denning sites, mineral licks, rutting and calving areas, nesting sites and spawning areas.

The impacts caused by various type of access have been well documented. To summarize the impacts, the table below lists the type of access and to what degree various elements could be impacted.



**Figure 2 Impacts of Access Summary Chart**

**H= high impact**  
**M= medium impact**  
**L= low impact**

**N= no impact**  
**\*= impact depends on amount and type of use**  
**?= impact unknown**

Type of Access	Habitat Destruction	Vegetation Damage	Noise	Pollution	Soil Damage	Water Impacts	Wildlife Impacts
<b>Foot</b>	* Impact is from trails being made	* Impact results if people go off trails and pick flowers, plants, etc	? Impact could be result if animals are disturbed	L Garbage may be left behind	L Impact is from trails being made	? Could impact if trails are cut near water, siltation	* *
<b>Horse</b>	* Impact is from trails being made	M When horses are tied up to trees the damage the trees and eat the plants around that area	? *	* Garbage may be left behind by riders	H Horse hooves chew up trails, as well as compact the soil. When tied up they ruin the soil.	L Could be high is animal waster gets into the water	M Can startle and scare wildlife
<b>Vehicle</b>	H Impact relates to the road being built. Often roads fragment and degrade habitats	H Impact relates to the road being built. Trees and vegetation will have to be cleared.	H Impact relates to the road being built with loud machines.	M Emissions released damage vegetation and effect wildlife	H Impact relates to the road being built. Soil is definitely altered during this process	H Impact relates to roads being built near waterways; bridges and culverts	* Roadkill accidents depends on traffic speed and volume
<b>ATV</b>	* Impact is from trails being made. Potential to be very damaging if people go off trails.	* Impact is from trails being made. Potential to be very damaging if people go off trails.	M May startle wildlife	L Some emissions are released, garbage, etc	H Disturbs and displaces soil	? *	M *
<b>Jet Boat</b>	H For aquatic life, this is especially bad for ruining spawning areas	L Aquatic plant life can be damaged	L Fish will be impacted by noise disturbance. Land animals may be startled also.	L Emission, fuel and garbage	H Can be high when river beds ripped up from powerful motors	H pollution	H More harvesting of fish and wildlife
<b>Snowmobile</b>	* *	M Small trees, shrubs and subnivean fauna	M Can disturb wildlife	M High emission rates	L Alters soil temperature and structure	N *	H Especially if harassed on winter range
<b>Aircraft</b>	N *	N *	M *	L *	N *	L If floatplane the impact increases	* Impacts result if wildlife is chased
<b>Roads</b>	H *	H *	H *	H *	H *	H *	H *

In general, motorized access is considered to have a greater impact than non-motorized. Also the impact that is created is largely dependent on the mode of transportation and the responsibility of the user.

Of all the access methods available today, roads and their construction cause the greatest impact. Trombulak and Frissell (1999) best illustrates this point; *“Roads are a widespread and increasing feature of most landscapes. We reviewed the scientific literature on the ecological effects of roads and found support for the general conclusion that they are associated with negative effects on biotic integrity in both terrestrial and aquatic ecosystems. Roads of all kinds have seven general effects: mortality from road construction, mortality from collision with vehicles, modification of animal behaviour, alteration of the physical environment, alteration of the chemical environment, spread of exotics, and increased use of areas by humans. Road construction kills sessile and slow-moving organisms, injures organisms adjacent to a road, and alters physical conditions beneath a road. Vehicle collisions affect the demography of many species, both vertebrates and invertebrates. Mitigation measures to reduce roadkill have been only partially successful. Roads alter animal behaviour by causing changes in home ranges, movement, reproductive success, escape response, and physiological state. Roads change soil density, temperature, soil water content, light levels, dust, surface waters, patterns of runoff and sedimentation as well as adding heavy metals (especially lead), salts, organic molecules, ozone and nutrients to roadside environments. Roads promote the dispersal of exotic species by altering habitats, stressing native species, and providing movement corridors. Roads also promote increased hunting, fishing, passive harassment of animals, and landscape modifications. Not all species and ecosystems are*

*equally affected by roads, but the overall presence of roads, is highly correlated with changes in species composition, population, size and hydrologic and geomorphic processes that shape aquatic and riparian systems. More experimental research is needed to complement post-hoc correlative studies. This review underscores the importance to conservation of avoiding construction of new roads in presently roadless or sparsely-roaded areas and removal or restoration of existing roads to benefit both terrestrial and aquatic biota.”*

No information was found on how access impacts cultural and recreational values. It would seem appropriate that historic sites, archaeological sites and First Nations traditional use areas would be cultural factors considered in access sensitivity evaluations. Recreation can be further divided into personal and commercial, both of which are flourishing in the MK. The MK Recreation Plan; currently under development, will be completed prior to issuance of further commercial recreation tenures within the MK. This plan will address many of the issues involving non-commercial recreation as well.

It should be noted that the Muskwa Kechika Bibliography CDROM, which contains records for a variety of information pertaining to the MK was reviewed. As this information has already been collected and condensed into a single reference source, it is not duplicated in this report.

A copy of the MK Access Sensitivity Annotated Bibliography can be found in Appendix 1.

## **2.2 Personal Interviews**

Interviews were set up to help identify what people value in the MK, and to determine the perceived impacts occurring from the different modes of access. This information was then used to help identify critical factors that need to be considered for mapping access sensitivity.

Twelve interviews were carried out and several major concerns were revealed. With regards to wildlife, it was made clear that critical habitat and key features should be protected. Also, rare and endangered species should have special priority. With reference to access, many people reiterated that fact that motorized access is increasing. Jet boats, snowmobiles and aircraft seemed to be of main concern, particularly due to the fact that the Access Management Area Legislation does not address these types of access. The negative impacts from these modes of transportation are becoming more and more evident. Many felt that regulations need to be created and heavily enforced before this becomes a problem.

The interview questions and summary of responses can be found in Appendix 3. As well as list of potential contacts for any future interviews can be found in the appendix.

## **2.3 Similar Projects**

To ease in the decision of how to develop a methodology, similar projects have been sought out. A few similar projects were found, although not to the same level of complexity that is envisioned for the future access sensitivity mapping methodology. Supplementary sample projects should be sought in the future because standards and

capabilities are rapidly changing. Similar projects will not only allow for methodology assimilation but will also provide the support and justification for its creation. Briefly described below are some potential sources of guidance.

Comment:

### **2.3.1 Yosemite Valley Plan Project**

Staff at Yosemite National Park in California are currently working on a high value resources map that will accompany a future 'Yosemite Valley Plan'. It identifies and considers both natural and cultural resources. They have considered some of the exact factors that would be addressed in the proposed project including wetlands, riparian zones, wildlife habitat and archaeological sites. The Yosemite project is a good reference and will help provide justification for some of the factors that will be considered in the future methodology. However, their project differs from the proposed project in that they only use the one rating category, which illustrates that the value is present. The future methodology looks to have a rating/weighting system based on the type of impact such as low, medium and high that will occur as a result of human access. The Yosemite Plan and associated map is expected to be completed by the summer of 2000 for public viewing at which time inquiries could be made as to how they identified and classified high value resources. Further information can be found on their website at <http://www.nps.gov/yose/planning/yvp.htm>.

### **2.3.2 Clayquot Sound Mapping Project**

Most people are familiar with the events that took place in Clayoquot Sound. In early June 1993, the government responded by establishing a scientific panel of 19 members from several fields of expertise. The panel reviewed the forest management

standards for Clayoquot Sound and made recommendations for changes and improvements to develop a set of “world class” forest practices for Clayoquot Sound. In May of 1995 they released their report with over 120 recommendations to resolve forest practices and First Nations issues in Clayoquot Sound. To the surprise of many, the recommendations were accepted by all associated groups and even praised by some. However, these ideas for preservation were never mapped to produce a visual representation of what the panel had envisioned.

Ecotrust Canada, a lower mainland based consulting company, decided to implement the recommendations using GIS to create a final map product. The company gave this provision, “Our intentions were not to create a set of maps showing the definitive boundaries of where logging should or should not take place. Instead, our intentions were two-fold: (1) to create a base-line set of information which could be used as a bench-mark for future studies; and (2) to show at a watershed-scale, what all sectors had agreed to.” (website)

They did their work using the panels recommendations and existing government data sets and created several coverage’s including:

1. Rate-of-Cut Classifications
2. Reserve to Protect Hydroriparian Resources
3. Reserve to Protect Sensitive Soils and Unstable Terrain
4. Reserves to protect forest-interior conditions in late successional forests
5. Reserves to protect cultural values
6. Reserves to protect scenic and recreational values
7. Reserve to ensure links among watershed-planning areas
8. Existing Protected Areas

## 9. Combined reserves and protected areas

## 10. Combined reserves, existing protected areas and pristine watersheds

The final coverage is a combination of all the others. They took it from a constraint point of view and located all the areas where logging should not occur. As seen on the final map (Appendix 3), there is little area where logging could occur based on the recommendations. This type of constraint mapping approach can not be used in the MK because resource extraction will undoubtedly occur. A modified approach could be used to locate where the least amount of impact will occur from access. Many of the same factors that were used in this effort, could be considered in the future mapping project. The mapping methodology could be modified and adjusted to meet assessed needs of the MK. The idea of having a Scientific Panel to make recommendations is a must and should include government staff, industry representatives, First Nations and non-government organizations. Located in Appendix 3 is the explanatory document and associated maps.

This is a sample of some of the recommendations made by the panel with regards to roads:

*“Roads alter slope hydrology and represent a potentially significant source of negative impacts on slope stability, stream morphology, and water quality. Existing road standards are insufficient to ensure that terrestrial and aquatic ecosystems are adequately protected. With respect to roads, Panel recommendations include requirements for:*

- *road location decisions to reflect the following priorities:*
  - protect sensitive terrain (e.g., stability class V), rare habitats, active floodplain areas, and heritage and cultural features;*
  - maintain watershed integrity and ecosystem function; and*
  - mitigate potential damage to scenic or recreational values;*

- *the maximum percentage of the harvestable area designated for permanent access (roads and landings) to be determined on a watershed-specific basis, and, in general, to represent less than 5% of the harvestable area in a watershed (7% is allowed under current standards);*
- *full bench cuts and endhaul construction on main or branch roads consistently greater than 55% slopes; and*
- *revegetating (preferably with indigenous, non-invasive species) all disturbed areas associated with roads. “*

A full copy of the panels recommendations can be found at <http://www.for.gov.bc.ca>

### **Mapping the Scientific Panel's Watershed-based Recommendations**

*Project done by ECOTRUST CANADA*

*Project posted on Aboriginal Mapping Network webpage*

<http://www.nativemaps.org/Methods/science.htm>

### **2.3.3 Northwest Territories GIS Project**

The Northwest Territories government have used a concept created by the World Wildlife Fund (WWF) Canada to do some mapping for their Protected Area Strategy. They are trying to locate and assess areas that would be appropriate for protecting. Some of the factors they considered were roadless wilderness, old growth forests, wetlands and landform heterogeneity. A copy of their CR ROM was received in February 2000. This is the introduction from the CD-ROM that describes the project and its purpose.

*“There are areas of land and water within the Northwest Territories (NWT) with special natural and cultural values. These may be important to local people or may be of territorial, national, or international significance. Protection of these areas is essential.*

#### *The NWT Protected Areas Strategy*

*In 1996, the governments of the Northwest Territories and Canada made a joint commitment to prepare a Protected Areas Strategy (PAS) for the NWT, to conserve its wide range of natural biological diversity. The intent of the PAS is to establish a network*



*of protected areas throughout the NWT using the best traditional, ecological, cultural and economic knowledge available.*

### **Using GIS in Protected Areas Selection**

*The Department of Resources, Wildlife and Economic Development (RWED) has produced this CD-ROM to show how a Geographic Information System (GIS) can be used to help select protected areas. This CD-ROM provides useful information for PAS stakeholders, land-use planners, resource managers, industry and anyone interested in ecology, geology and GIS.*

*In this CD-ROM, a study area of approximately 200 km by 200 km in the Slave Geological Province (SGP) is analyzed as one example of how GIS can be used to assist in the decision making process. We chose this study area because no protected areas currently exist in the region, major mineral development is occurring, and on-going ecological and geological studies provided useful information. The same method could be applied to the entire SGP, as well as to other areas of the Northwest Territories.*

*In this example, several sets of ecological, geological and land-use information are analyzed and mapped in different layers to help identify areas suitable for protection. This method is very flexible and can use many kinds of information. These might include other analyses, research or field studies, traditional and local knowledge, other land use or development activities, and other uses or values identified by communities or other stakeholders.*

*This CD-ROM demonstrates how different kinds of information can be used to help select areas for protection. In this example we have only considered some ecological and geological features. For a real situation in the SGP and elsewhere, additional or other information would be used.”*

Without going into the whole GIS process, the layers of information are divided into grid cells and assigned a value based on what is in the cell. The rating for each cell is based on how much of the cell, percentage wise, is covered with the selected criteria.

Example: if 80% of the cell is grizzly habitat then the cell will be given a value of 10.

This is a high value, and other values would be 5 or 0. You can overlay many layers and come up with an overall cell rating by averaging the scores.

In this project they used five Primary Ecological Themes including landscape unit diversity, eskers, shallow water and wetlands, stream and shoreline shrub and coniferous forest. They have four Modifying Ecological Themes grizzly bear occurrence, wolf occurrence, wolverine occurrence and wolf dens. These criteria are added and averaged together to get a Total Ecological Value. They also have this process for Geological Themes (gold, base metal, etc.), in order to assess mineral potential and where mining may occur in the future. They also take into consideration current land use, mining development and roads. By combining all of these factors and overlaying the results using a GIS you can see areas the are best suited for protection.

Although we do not want to identify Protected Areas, the use of a GIS is a definite for the future and using a similar methodology is a possibility. To make this work for access sensitivity, it will be needed to know where the best areas for development and access routes should be located, based on creating the minimum impact. There is some excellent potential for using this type of process in the future.

Located in Appendix 4 is the project document with a full description.

**Using GIS to select Protected Areas in the NWT**

**An example from the Slave Geological Province**

Northwest Territories Resources, Wildlife and Economic Development. September 1999.

- Roads should be planned on the basis that they will be reclaimed after extraction is complete. This will help relieve hunting pressure and poaching by eliminating easier access. Also predator efficiency will be reduced because roads are used by some species as travel corridors.
- Roads should not be built near historical or cultural sites! These areas should be protected and preserved.

#### **Resource Development**

- Technology is finding new ways to explore for resources that are low impact. These methods should be used and enforced no matter the cost.
- Although seismic exploration is necessary for oil and gas exploration, this is a devastating process. It fragments habitat and changes the surrounding ecosystem which are both harmful to wildlife. Stringent regulations need to be put in place to control this activity.
- Timber-harvesting methods that are less damaging to the environment, although they are more costly, should be used.

#### **Recreation**

- Limit flights heights to avoid disturbing the animals, some references suggest a minimum 300 meters.
- Restrict recreational access to a minimum during calving and rutting periods. This includes hiking, camping, etc.

#### **4.0 Recommendations**

Research, education and cooperation are three themes that have presented themselves during this project, with respect to the future. They are all key to the success of this future endeavor. From the literature that was reviewed, it was made clear that research and inventory need to be completed before any plans are made, papers signed or construction begins. This involves collection of pre-development data about wildlife population and distribution, land and habitat conditions and current use levels, to mention a few. Past studies on the impacts and effects of development almost always lack pre-development data resulting in inconclusive results because before and after comparisons can not be made. Time and money for inventory work should be given special consideration before anything is done within the MK, especially since there is only a

Example: if 80% of the cell is grizzly habitat then the cell will be given a value of 10.

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Although we do not want to identify Protected Areas, the use of a GIS is a definite for the future and using a similar methodology is a possibility. To make this work for access sensitivity, it will be needed to know where the best areas for development and access routes should be located, based on creating the minimum impact. There is some excellent potential for using this type of process in the future.

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**An example from the Slave Geological Province**

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## 2.4 Key Data

One of the objectives of this seed project was to identify key values and data that need to be taken into consideration for assessing access sensitivity. It is necessary for this information to be identified in order to develop a mapping methodology that will consider all critical factors. Key information to assess access sensitivity can be divided into several categories.

**Muskwa Kechika-** The GIS Section at the Ministry of Environment in Fort St John is the Custodian of this data. All information regarding the boundaries, resource management zones and designated access routes, is available here.

**Cadastral Data-** This category consists of information about roads, legal boundaries and township data. It is under the jurisdiction of the Crown Land Registry Service.

**Water-** Hydrologic data exists at a number of scales for the areas covering the MK. Scales include 1:20,000, 1:50,000, 1:250,000 and 1:2 million.

**Wildlife-** Habitat capability mapping is available for several species in the MK. Information about population status and distribution is continually update by the Wildlife Branch through radio telemetry and block counts. Some special features, such as mineral licks have been identified.

**Vegetation-** The main information in the category is forest cover, which is includes all kinds of data relating to tree species, clearcuts and burn areas. More detailed vegetation inventory exists for some small areas in the MK that were mapped during special Terrestrial Ecosystem Mapping (TEM).

**Cultural-** Archaeological data for the MK is available at 1:50,000 through the Ministry of Small Business, Tourism and Culture, Archaeological Branch. Information regarding First Nations traditional use areas is currently being undertaken by some of the local bands.

**Recreational-** This includes both personal and commercial recreation. Campsites, trails and boat launches would be considered for personal recreation. While guideoutfitter data would cover all guide territories, cabins and campsites as well as trails. This information was recently collected during the creation of the MK Recreation Plan.

**Parks-** The are a number of parks, protected areas and ecological reserves within the MK.

See Appendix 4 for complete details.

### **3.0 Conclusions**

The literature review presented some challenges. There is plenty of literature examining that impacts of access but obtaining that material is another problem. Many relevant materials were encountered during the search for material on access sensitivity. However, only about 40 references were accessible, through the four resource centers that were used. Most of the research and papers relating to access sensitivity have been written and published in the U.S. and were inaccessible. To further expand on the literature presented in the annotated bibliography, more reference materials can be found using the bibliographies of the each entry. Once again accessibility to these materials becomes an issue. The best effort possible was made with the resources available.

After reflection on the effectiveness of the interviews, it was decided that they were premature for this project. Asking the public for input and then trying to identify key factors was much too subjective. The questions were too open ended, subject matter was too broad. Thus the interview process was put on hold until a more definitive view of the process could be presented.

With regards to key data, there is information that needs to be collected for the MK. This includes specific data on wildlife winter habitat and travel corridors, location of weather stations, temperature, rainfall and snowfall for climatic input, soil structure

and more cultural data. These data sets will be extremely important to consider with access sensitivity.

### **3.1 High Priority Planning Consideration**

These general conclusions reflect the basic statements made by many of the documents that were reviewed. They summarize all the important aspects to consider when planning.

#### **Access**

- Vehicular access should be restricted during sensitive periods such as migration, rutting, etc.
- ATV should be limited to designated trails only
- Snowmobiles have access to areas that can only be accessed during the winter season. This should be monitored because they used during a time when wildlife is stressed. Harassment is of particular concern because extra energy expenditure spent avoiding humans during this season can lead to death.
- With an increase in technology, jet boats have become a major concern. They can access more areas than ever before and this means that more people will be using more areas. This may disperse the impact but will also mean that more people will use the area. This access needs to be monitored carefully and regulations imposed accordingly.

#### **Wildlife**

- Mineral licks, denning sites, nesting sites, spawning areas and other notable features should be identified and mapped to ensure that they are planned around with regard to resource extraction
- Wildlife should not be disrupted during critical periods such as rutting, calving, spawning, movement from habitats, etc.

#### **Road construction**

- Avoid constructing roads near primary wildlife habitat especially areas used for rutting, winter range and migration routes.
- Buffer zones should be considered when building roads to minimize visibility, harassment and impacts on wildlife. Buffer width should be calculated based on the adjacent habitat and its condition, some references suggest a minimum of 100 meters.
- Do not build roads through clear-cut areas, this will disrupt rejuvenation and wildlife succession
- Roads should be built to the minimum standard (primitive) and used for their extraction purposes only

- Roads should be planned on the basis that they will be reclaimed after extraction is complete. This will help relieve hunting pressure and poaching by eliminating easier access. Also predator efficiency will be reduced because roads are used by some species as travel corridors.
- Roads should not be built near historical or cultural sites! These areas should be protected and preserved.

### **Resource Development**

- Technology is finding new ways to explore for resources that are low impact. These methods should be used and enforced no matter the cost.
- Although seismic exploration is necessary for oil and gas exploration, this is a devastating process. It fragments habitat and changes the surrounding ecosystem which are both harmful to wildlife. Stringent regulations need to be put in place to control this activity.
- Timber-harvesting methods that are less damaging to the environment, although they are more costly, should be used.

### **Recreation**

- Limit flights heights to avoid disturbing the animals, some references suggest a minimum 300 meters.
- Restrict recreational access to a minimum during calving and rutting periods. This includes hiking, camping, etc.

## **4.0 Recommendations**

Research, education and cooperation are three themes that have presented themselves during this project, with respect to the future. They are all key to the success of this future endeavor. From the literature that was reviewed, it was made clear that research and inventory need to be completed before any plans are made, papers signed or construction begins. This involves collection of pre-development data about wildlife population and distribution, land and habitat conditions and current use levels, to mention a few. Past studies on the impacts and effects of development almost always lack pre-development data resulting in inconclusive results because before and after comparisons can not be made. Time and money for inventory work should be given special consideration before anything is done within the MK, especially since there is only a



limited amount of collected data from this area. The collection of this data will have great benefits including protection of the area and its wildlife and the ability to create effective management plans.

Education is always a key factor. Efforts must be made to educate the public about the impacts they have on the environment and wildlife and how they can reduce them. Education creates awareness, which will hopefully lead to the public demanding protection of the MK and use of environmentally sensitive practices within its boundaries.

Thirdly, cooperation is a must, as this project requires the efforts of many different individuals and groups. Managing land use and access issues are essential to the future of the MK and sustaining its unique wilderness characteristics. Successful management in the MK Management Area can become a reality with interagency cooperation and public participation.

#### **4.1 Future Direction**

From the result of this project, two options for proceeding with the access sensitivity mapping methodology project were presented.

The first option is to put the project on hold and wait while standards for assessing access sensitivity are set. This will allow for the problems to be worked out in the academia and trial applications done by other groups. If this option is chosen, an effort should be made to collect as much data as possible that would allow for all information and materials to be ready once a methodology is created.

Option two is definitely more ambitious. Although this type of work is still being debated and worked on, an attempt to create a methodology could be undertaken. This would require the assistance of many experts. The new methodology should be based on expert knowledge of the impacts created by development and wildlife management techniques. Scientific support and justification for the methodology may still be lacking and therefore, it may be hard to justify. Also, a weighting system that will be incorporated into the methodology would have to be developed to assess the importance of various features. Yet again, questions arise on how and who should set the standards.

Regardless of when access sensitivity assessments proceed the public and stakeholders should be consulted to confirm and critique the data factors identified. A new strategy for interviews and review should be carried out in a future phase of the project. There are three key groups that should be considered for future input. The first group is industry, which include the people who will be working in the MK for resource extraction purposes. This will give them a preliminary opportunity to voice their opinions and concerns about the proposed project. Second, it would seem logical to speak with guideoutfitters for their input as they have extensive local knowledge about the area. Third, consultation with the First Nation groups of Northeastern BC must occur. These groups play a significant role in decision making and have historic knowledge of the land.

Similar projects have been produced, as mentioned earlier, but not to the same extent that is expected for the future mapping project. Consulting with previous projects would help with the creation of a proper methodology where all the key data can be

considered. More projects should be sought in the future to model after, especially since technology and standards are changing so rapidly. This will ensure product quality and effectiveness. It has become evident, that due to the complexity of the access issue, it will be necessary to employ professional expertise to complete the project.

Another recommendation that should be given serious consideration is forming a scientific panel similar to what was done in the Clayoquot Sound. They could implement environmental guidelines, both federal and provincial, to ensure resource development has minimal impact. Some of these materials include the Land Act, Forest Act, Muskwa Kechika Act, Forest Practices Code, Riparian Management, Environmentally Sensitive Areas, Red and Blue listed Species Protection, Identified Wildlife Management Strategy, Navigable Water Act, Fisheries and Wildlife Regulations, Recreation Management, Parks Management, Pre-Tenure Planning, Landscape unit planning. These guidelines should be reviewed and adjusted to specially suit the current conditions and issues in the MK. Ideally the minimum requirements will be expanded for further protection in this special management area.

When the creation of the methodology begins, three groups should partake in the effort and include staff members from different Ministries, private entities and academic institutions. Ministry of Environment, Lands & Parks, Ministry of Forests and Ministry of Energy and Mines are just some of the Ministries that should be involved. These groups can provide input, expertise and information about the legal aspects of future actions and possess a wealth of local area knowledge. Private entities such as consultants with environmental and/or GIS backgrounds would be a good source of experience in

practical applications. The last and very important source of information comes from the academia. There are four well-known major post secondary institutes in BC that all have programs in GIS and resource management. These institutions are up to date with science and technology. These sources of information should be taken advantage of to achieve the best results possible.

The recommendations made here are to advise the MK Board as to the benefits that would result from the proposed access sensitivity methodology and the possible direction that the project could take in the future. These recommendations are based on the input from all the activities that were completed during the seed project.

Appendix 1

**MK Access Sensitivity Annotated Bibliography**

Compiled by Stephanie Beitel

March 2000

## **MK Access Sensitivity Annotated Bibliography**

Access and development are two important issues in the MK. There is literature available examining the linkages between access and its impacts. This includes examination of several forms of access including motorized and non-motorized, which both have impacts on the environment. Motor vehicles, all-terrain-vehicles, snowmobiles, jet boats and aircraft are the main means of motorized access in the MK, while foot and horse use are the non-motorized means. The term impact refers to having an altering effect on the environment and its elements. In the case of access, a negative impact is usually the result. Some of the most easily identifiable impact studies in research included those which effect wildlife, vegetation and landforms. This annotated bibliography presents literature on the impacts cause by access methods such as planes, horses, vehicles and construction and effects of roads.

Although the range of environmental issues reviewed from an access perspective is broad, degradation of land, forests and water; the most prominent issue in the literature is the impacts on wildlife resources. This is due to the fact that the importance of wildlife is relatively high, especially in areas such as Northeastern BC where competition for harvesting and protecting wildlife resources contributes to existing conflicts. The linkages between access and environmental factors are frequently indirect or difficult to identify with certainty due to a lack of data. Studies that have attempted to verify empirically the causal relationships between access and environmental variables have shown that access, while contributing to the likelihood of conflict, is extremely difficult to isolate as sole causal variables. It is difficult to measure environmental and resource factors in isolation from geography, history, socioeconomic and cultural variables.

The establishment of a methodology that would allow researchers and decision-makers to assess the relevance of all applicable variables under different circumstances is a major research challenge. This is the focus of the future mapping project and it is anticipated that the information presented here will help in the development of the methodology. Collection of information such as this, is the first step towards better understanding of the complexity of access sensitivity.

1. Arnett, E. and L. Irwin. "Mountain goat / forest management relationships: a review." Technical Bulletin of the National Council of the Paper Industry for Air and Stream Improvements. New York, New York. February 1989. no 562.

This review identifies critical habitat selection characteristics by mountain goats for winter range. These include certain slope angles, aspect, elevations, distance to cliffs and timber volume within mature and old-growth forest types. They also state that "Habitat selection information during all seasons shows mountain goats rarely travel more than ¼ mile from escape terrain." This paper concludes with recommendations that "Until further research information is gathered, the following recommendations seem prudent:

1. Critical mountain goat habitat winter ranges, mineral licks, and kidding areas should be identified and protected in planning [timber harvest options]
2. Areas within ¼ mile of precipitous terrain or cliffs should be designated as critical goat habitat and [logging] should be planned carefully near these areas.
3. Pathways of forest with snow-intercept capabilities may be important as migration corridors between seasonal ranges and wintering sites (Fox 1983). Necessary widths should be determined via field study.
4. Helicopter logging operations should be avoided within one-half mile of occupied mountain goat habitats. Overflights should be a minimum of 1,000 feet above ground or away from canyon walls (Joslin 1986a)
5. Human-related disturbances within one-half mile of mountain goat winter range should be allowed when goats are not present, usually June 1, to November 1 (Smith 1986a)
6. After timber operations are completed, slash must be removed, and roads should be closed to minimize disturbance, over-harvest and poaching.

Keywords: Mountain goat, management

2. Bamfield, A. "Relationship of caribou migration behavior to pipeline construction." The Behaviour of Ungulates and its relation to management. IUCN: International Union for the Conservation of Nature and Natural Resources. no 45, 1974 pg 797- 804.

Abstract: An investigation of the impact of a proposed buried gas pipeline across the migration routes of the Porcupine caribou herd of the Yukon Territory is being conducted by a consortium of oil and gas companies sponsoring the proposed pipeline. It was noted that the caribou have been quick to use seismic line clearings for travel routes, probably because they present unrestricted view and compacted snow conditions. It is anticipated that they would similarly use a pipeline right-of-way.

Keywords: caribou

3. Bloomfield, M. "Impact of development, settlement and associated activities on Mountain Caribou in central British Columbia, Canada." Proceedings of the Second International Reindeer/Caribou Symposium. Roros, Norway. September 1979 pg. 705-715

Abstract: The size and distribution of mountain caribou (*Rangifer tarandus*) herds in Central British Columbia have decreased considerably in recent years. A comparative



study of contemporary and historic populations attributed the decline to the accumulative effect of several major factors associated with the recent settlement and development of the region. Habitat destruction, increased access and recreational hunting play principal roles. Indiscriminate logging affected herd status through the loss of key habitats, particularly travel routes and breeding, calving, and wintering areas. Important secondary effects include barriers to movement, range discontinuity, increased human access and harassment. Excessive local harvest resulted from a general failure to incorporate increasing development into caribou management strategies. Developmental impacts should have been counteracted with shortened, closely regulated seasons but these measures were not implemented. Liberal hunting regimes contributed to a general population decline through harvests of calf-producing females, a reduction in social traditions. Unmitigated development and continued hunting ultimately could result in the disappearance of local populations. An exhaustive review of industrial programs is required and must be followed by development of strict guidelines for activity on caribou range. Critical habitats and movement corridors must be protected. Hunting seasons, for both sexes, should be closed for an extended period and must not be reopened until a sizeable and significant population increase has been realised.

This study used three pieces of information, spatial distribution, status and seasonal patterns, to see what the effects of development, settlement and associated activities were on caribou. The contemporary information was based on aerial photos, knowledge and statistics while historical information was gathered from archives, museums and interviews. The two datasets were then compared to find out what the impacts were resulting. Three main issues were brought to light based on the comparison including habitat destruction, recreational hunting and pressures on a declining population.

Some of the key points from this paper include:

- No attempt was made to design harvest programs compatible to caribou management, control access or identify and protect critical areas. The overall impact was a reduction in the quality, size, availability and inaccessibility of caribou range. Important secondary impacts included barriers to movement, range discontinuity, increased human access and harassment. Furthermore, uncontrolled access increased caribou susceptibility to over-harvest.
- To avoid problems associated with discontinuous range, travel corridors must be identified prior to industrial activity and developmental guidelines prepared to ensure their integrity. Forest cover along movement routes should be a minimum of 400 meters in width to provide necessary security, and every effort must be made to minimize or eliminate developmental and recreational disturbance along and within travel corridors (Johnson et al. 1977). Impassable barriers of debris, industrial facilities, including roads and recreational activities should be prohibited in travel corridors to avoid disruption of movement patterns and range abandonment and to permit animals to move freely.
- The loss of calving and breeding sites, mineral licks and wintering areas is as least as serious. Identification of these seasonally critical areas should be completed prior to logging in caribou range. Adequate forest cover should be provided to allow harassment-free use of these special areas. Stands at least 400 meters in diameter are recommended (Johnson et al. 1977)
- Subalpine forests, above 1500 meters, critical during late winter, should be protected in their entirety (Bloomfield 1979, Freddy 1974, Laysen 1974). In lower elevation forests special developmental guidelines are required to ensure the integrity of

important habitat and travel corridors. The first step should be identification and designation of critical range as special- management areas. Harvestable timber should be sacrificed in these areas to provide a continuum of adequate and sufficient habitat.

- One of the most serious consequences of industrial activity has been creation of a vast network of access into previously inaccessible [caribou] range. Unrestricted access and liberal hunting season, combined with the inherent susceptibility of caribou to excessive harvests, were the most serious decline causing factors.
- Government and industry must immediately undertake intensive population and habitat inventory which should proceed any further industrial or recreational opportunity.

Keywords: impact, development, caribou

4. Calef, G. , Elmer A. DeBock and Grant M. Lortie. 1976. "The Reaction of Barren-Ground Caribou to Aircraft." Arctic vol 29, no. 4, December 1976. pg 201-212

Abstract: The responses of barren-ground caribou to fixed-wing aircraft and to helicopters were observed in the Northern Yukon and Alaska. Effects of aircraft altitude, type of aircraft, season and terrain were determined together with the activity and size of group of the caribou. Panic reactions or strong escape reactions were observed in a high percentage of all groups when aircraft flew at altitudes of less than 60 meters. Flying at a minimum aircraft altitude of 150 meters during spring and fall migrations, and 300 meters at other periods, would prevent the caribou reacting in the ways most immediately injurious to them.

Flights were made on predetermined routes and data was upon sighting of the caribou. The caribou were not collared and information such as location, altitude, group number, sex and age of caribou ,vegetation and topography were collected for further examination and statistics.

Five categories of responses were defined:

- 1) Panic response: animals were out of control; they stumbled, collided with one another and ran into obstacles such as willow patches or trees.
- 2) Strong escape response: animals trotted or ran and continued running after the aircraft had passed.
- 3) Mild escape response: animals moved away from the aircraft or from the original direction of movement on the case of travelling animals. This class included only animals that walked or trotted a short distance.
- 4) Stationary response: animals stopped feeding, rose from resting position, or assumed alarm posture.
- 5) No visible response: animals continued feeding or resting or, if moving, continued at the same pace in the same direction.

This study used both helicopters and fixed-wing aircraft for monitoring. They found that animals reacted less intensely to jet turbine helicopters than to fixed-wing aircraft based on response totals.

Keywords: caribou, aircraft

5. Demarchi, D. Wildlife Capability Classification for British Columbia : an Ecological (biophysical) Approach for Ungulates Manual 4. BC Ministry of Environment. Victoria, BC. Dec 1983.

This manual helps clarify the process and reasoning behind capability mapping for ungulates within BC. This information helped to identify key factors that should be considered when mapping wildlife habitat. Capability mapping will be used to help map access sensitivity in the future.

Keywords: wildlife, ungulates

6. Donihee, J and Gray, P. A review of Road Related Wildlife Problems and the Environmental Management Process in the North. Information Report no 2. Department of Renewable Resources. Yellowknife, N.W.T 1982

Abstract: Road development potentially can cause significant direct and indirect impacts on wildlife and wildlife habitat. To avoid or minimize detrimental effects associated with road development, wildlife resource concerns must be incorporated during the initial planning stages of development. Three classes of impact reduction measures exist. Spatial measures seek to avoid areas of environmental importance, while timing measures eliminate disturbance during critical periods of the life cycle. Operational measures embrace codes of good practice that serve to reduce the overall effects during each development phase. Ignoring or failing to undertake comprehensive environmental programs can result in expensive delays and design changes.

The paper intends to provide:

- 1) a brief review of the literature on road-related wildlife problems and concerns;
- 2) a discussion of impact reduction strategies, an indication of how they fit into engineering design process and a review of some case histories; and
- 3) recommendations for an approach to solving the problems identified above.

Several topics related to impacts caused by road development are discussed including habitat loss, disturbance of wildlife, access and hunting, problem wildlife and road kills. Measures to reduce impacts are discussed such as spatial, timing and operational measures. From the mapping point of view, the spatial measures play a key role. The paper indicates that “spatial measures seek to avoid areas of environmental significance such as critical wildlife habitat or unique landscape features. Identification and avoidance of critical habitat should be a major goal of the corridor selection process. Avoidance of areas such as wintering ranges, nesting areas, calving and post-calving grounds is the best solution to minimizing or eliminating impacts.”

This paper makes a critical point stating that “almost all studies on the effects of roads on wildlife suffer from a lack of pre-development information on population abundance and distribution. Comparisons with information during and after construction are therefore impossible. Documentation, especially quantitative, of long-term effects from linear facilities on wildlife in northern Canada is virtually non-existent.” Being aware of this fact, the MK Board has the opportunity to address this issue by collecting pre-development data in order to see and address the impacts of development.

This paper gives a thorough review of many issues associated with roads including their development, usage and problems caused by them. Examples are given to illustrate the impacts that occur. Although this was written almost twenty years ago the issues are still relevant today.

The recommendations are outstanding and identify two main concerns. 1-Planning with environmental consideration is imperative. The idea that an environmental assessment is a one-time event should be disregarded. This should be an ongoing process that monitors impacts, therefore dictating management action and direction. 2- Extensive information regarding species population and distribution is needed for proper studies. This includes population and distribution of the species and location of critical habitat. This type of data will help look at the long-term effects of roads on wildlife that is lacking in the studies done on wildlife.

Keywords: road, wildlife, environmental, management

7. Fredrick, G. Effects of Forest Roads on grizzly bears, elk and gray wolves: A literature review. USDA Forest Service, Kootenai National Forest, Montana. April 1991.

This excerpt sums up the article:

“The objective of this paper was to summarize some of the research on the effects and impacts of forest roads on wildlife populations. Because the literature on this subject is vast, I have attempted to include only the most important and primary works. Three species were concentrated in depth: grizzly bear, North American Elk and gray wolf. In addition, I briefly reviewed some of the impacts to other sensitive forest taxa that have been documented. Although many other wildlife species are affected by roads, these species were selected for more detailed coverage because (1) the grizzly bear and wolf are federally listed species, (2) elk is an indicator species and an extremely important big game animal, and (3) all three species are apparently sensitive to roads. Furthermore, most studies on the influence of roads on wildlife are limited to a relatively small group of highly visible mammals.”

Impacts of roads are discussed in relation to fisheries, snag dependent wildlife, birds of prey, small mammals, badgers, marten and wolverines and black bears. The three main mammals that are discussed are the grizzly, elk and wolf; the topics focused on are their responses to roads, factors influencing response to roads, impacts of roads and management recommendations.

Some of the recommendations included:

Grizzly-

- Provide buffer zones of 100 m (328 ft) wide between important grizzly use areas and roads. Visual screens may include leave strips in harvest units or shrubs adjacent to roads. Buffer widths should be adjusted according to habitat conditions.
- Locate new road construction away from seasonally important habitats and movement corridors, including moist areas, ridgetops, saddles and creek bottoms.

#### Elk-

- Avoid constructing roads in important elk habitats and travel corridors such as saddles, meadows, stream corridors, valley headwater slopes, calving grounds and winter range.
- Avoid locating straight stretches of road > .4km (.2mi) long in forested sites.
- Avoid building roads across an uncut slope that opposes a cutover unit.

#### Wolf-

- Reduce open road densities in wolf habitat by closing roads or restricting access. Open road densities in occupied areas should not exceed 0.58km/km<sup>2</sup> (0.94 mi/mi<sup>2</sup>). Access restrictions should be monitored and enforced.
- Protect wolf den sites by closing roads and restricting human access within a 2.4km (1.5mi) radius of an occupied den from 4 weeks prior to whelping to the end of denning activity. Closure should include viewpoints from which the den can be seen and be irregular in shape to avoid pin-pointing dens. Rendezvous sites should be similarly protected with area closures.
- Planned road construction should avoid mesic sites and other important wolf habitat components.

Keywords: effects, forest, road, grizzly bear, elf, wolves

8. Jalkotzy, M., P. Ross and M. Nasserden. The Effects of Linear Development of Wildlife: A Review of Selected Scientific Literature. Prep. For Canadian Association of Petroleum Producers. Arc Wildlife Services Ltd. Calgary, Alberta May 1997 115 pg

A review of effects created by linear developments (roads and pipelines) on wildlife, particularly large mammals, was conducted. This task was undertaken by searching for and reviewing scientific literature pertaining to the effects of development of roads and pipelines. An extensive bibliography was produced with over 1500 references. Findings of the literature are summarized in the report in different sections including disturbance effects, linear development types and species/group summaries. Some of the species discussed include grizzly bears, wolves, cougars, elk, caribou, deer, moose, mountain goat, mountain sheep, and birds. There is also a section about mitigative measures that discusses regional planning strategies and access management.

Keywords: effects development, wildlife

9. Johnson, D, D. Millar, and J. Peek. Guidelines for human activity within the range of mountain caribou, Southern Selkirk Mountains. University of Idaho; Forest, Wildlife and Range Experiment Station. Moscow, Idaho January 1997.

Introduction "The environment of mountain caribou (*Rangifer tarandus montanus* Seton) inhabiting the southern Selkirk Range of British Columbia and adjacent parts of the United States is subject to increasing human influence. The International Mountain Caribou Technical Committee deemed it advisable to develop guidelines regarding access, hazards to movement and timber harvest within the range of this caribou population in order to minimize the adverse effects of human activities. These guidelines

are based on the best judgements of knowledgeable individuals in public and private organizations familiar with these caribou, plus review of existing information pertinent to this population of approximately 30 caribou. These guidelines represent a current state-of-the-art effort to coordinate caribou management with other resource uses rather than to create a description of 'ideal' caribou management."

Keywords: human, caribou

**10.** Lodico, N. Environmental effects of off-road vehicles: a review of the literature. US Department of the Interior. Washington, D.C. September 1973.

This is an extensive review of literature that looks at the impacts created by snowmobiles, motorbikes, four-wheel drive vehicles, all-terrain vehicles and several other off-road vehicles. The author has divided the literature based on its type including scientific papers, reports, meetings and conferences, periodical articles and miscellaneous publications. Some of the effects looked into are the impacts on vegetation, animals and soil as well as noise impacts and recreational conflicts. Although the review was done eighteen years ago, the basic concepts and issues are still applicable.

Key Words: off-road vehicles

**11.** Lyon, J. "Habitat effectiveness for Elk as influenced by roads and cover." Journal of Forestry vol 77 no 10 October 1979. pg 658-660.

Abstract: Pellet collection conducted over an eight-year period confirmed that elk in Western Montana tend to avoid habitat adjacent to open forest roads. The area avoided increased where the density of tree cover is low. Forest roads open to traffic cause available habitat to be less than fully effective. A method for determining the losses of effective habitat is presented.

Keywords: habitat, elk, roads,

**12.** Lyon, J. "Road Effects and Impacts on Wildlife and Fisheries." USDA, Forest Service, Denver, Colorado. 1984 pg 98- 118.

Abstract: One of the objectives of this paper was to develop a presentation in which both positive and negative influences of forest roads on wildlife and fisheries could be presented. This proved to be extremely difficult because benefits are generally hard to confirm. Most of the research in this subject areas consists of reports of immediate impacts of road construction and of longer term disturbances associated with traffic on the roads. In these reports, there is little to indicate any intrinsic benefit to wildlife or fish in the construction of forest roads. Fortunately, the immediate impacts and accumulated effects of roads are rarely fatal for any wildlife population. And, in the long run, some roads can be closed while others enable the manager to manipulate habitats to favour wildlife or fisheries resources. The important point, and the most significant conclusion presented in this paper, is that benefits for wildlife through road development almost never occur without some specific effort on the part of the manager.

Keywords: road, effect, impacts, wildlife, fisheries

13. McClaran, M. and D. Cole. Packstock in Wilderness : Use, Impacts, Monitoring, and Management. US Forest Service. September 1993

Research Summary: This report summarizes information relevant to managing packstock in wilderness. It presents the results of a survey of managers of all area in the National Wilderness Preservation System, as well as summaries of information from literatures reviews. Section describe: the amount and compositions of packstock use in the wilderness, impacts associated with packstock use, methods for monitoring impacts caused by packstock, techniques for managing packstock in the wilderness, examples of packstock management programs and research needs.

Packstock may harm vegetation, soils, water quality, wildlife and visitor experiences in wilderness. Monitoring and management of packstock should focus on soil erosion and defoliation near streambanks and popular camping areas. Some methods for monitoring packstock impacts are described.

Specific impacts that are addressed in detail include trampling, defoliation, animal wastes, and interaction with wildlife and visitors. This is an excellent reference paper on the topic of horse use in the wilderness.

Keywords: wilderness, impacts, management, packstock

14. Martell, A. and D. Russell. Caribou and Human Activity. Canadian Wildlife Service. Ottawa, Ontario 1985.

This is a compilation of many articles, some full length and some abstracts.

Listed below are the relevant titles and authors.

Full Length (separate entries under authors name)

Gauthier, D. et al. Movement and behaviour of the Burwash Caribou Herd relative to the proposed Alaska Highway Gas Pipeline

Gunn, A. et al. Behavioural responses of barren-ground caribou cows and calves to helicopter on the Beverly Herd calving ground, Northwest Territories.

Smith, W. and Cameron, R. Factors affecting pipeline crossing success of caribou

Valkenburg, P. The reaction of caribou to aircraft: a comparison of two herds.

Abstracts

Curatolo, J. Caribou response to the pipeline-road complex in the Kuparuk Oilfield, Alaska.

Fancy, S. Movements and activities of caribou near oil drilling sites at the edge of an oilfield and near an isolated drilling operation.

Stelfox, G. Caribou behavior in relation to human-elk-wolf influence in Jasper National Park.

15. O'Neill, G. Access development in the Peace-Liard Sub-Region 1975-1992 and it's potential impacts on wildlife. Ministry of Environment, Fort St John, BC. Winter 1991.

This study was put together to look at the increase in access development over a 17-year period in the Peace-Liard sub-region. It uses road density to compare and contrast development and potential impacts. They looked at three study areas in various locations including one in the MK on the Sikanni Chief River and the other areas were on the Peace and Sukunka Rivers. These three locations were chosen to reflect current development conditions as well as the fact that they are home to a variety of species, have different habitats and represent different eco-sections in the region. In order to compare the development of access over time, all access routes were digitized for use with a GIS. The routes were divided into four categories based on their quality consisting of general-purpose roads, seismic lines, township (TWP) lines and trails.

The purpose of this study is to:

- document the increase in access over the past 20 years in the Peace-Liard sub-region,
- outline the possible impacts on the sub-region's wildlife populations, and
- to provide management direction for the protection of wildlife populations. It is necessary to address the issue of access in the region because the resources in the area such as timber, minerals and oil and gas will require an extensive access network to extract them which in turn means increased access and impacts to the area.

“BCE is concerned that these roads may be reaching densities which could be negatively impact the wildlife populations of the sub-region. Concerns over increased road densities include: 1) the removal of valuable habitat from production, 2) increased legal and illegal hunting pressure, 3) decreased hunt quality and 4) increased predation.”

Densities for ATV accessible road networks were calculated using the total kilometres of road (general-purpose roads + seismic lines + TWP lines + trails) per mapsheet, dividing by 909 km<sup>2</sup>, to get a density per km<sup>2</sup>. They also calculated 4x4 accessible road networks using a little different calculation. They had to account for the portion of seismic lines that were accessible by 4x4. Based on an assumption of 20%, they changed the total km calculation to (20% general-purpose roads + seismic lines + TWP lines + trails) per mapsheet. Results are summarized below.

**ATV accessible road networks km/ km<sup>2</sup>**

<u>STUDY AREA</u>	1975	1992
Area 1	.68	1.13
Area 2	.90	1.97
Area 3	.93	1.43

**4x4 accessible road networks km/ km<sup>2</sup>**

<u>STUDY AREA</u>	1975	1992
Area 1	.14	.30
Area 2	.25	.50
Area 3	.20	.41



area. Caribou can tolerate low levels of snowmobile use and, if they are not harassed by snowmobilers, their tolerance will probably increase.” In general, the recommendations provided indicate that use by humans and their associated activities should be reduced while caribou are on winter range for various reasons.

Keywords: effects, snowmobile, winter caribou

**20.** Smith, W. and Cameron, R. “Factors affecting pipeline crossing success of caribou.” Caribou and Human Activity. September 1983 pg 40-46.

Abstract: Early simulation studies on the Arctic Slope of Alaska showed that caribou would not pass freely beneath elevated pipelines. Our recent observations during summer indicate that crossing success varies with pipeline design, caribou group structure, and a number of environmental stimuli. Effective barriers to caribou movement exist where surface-to-pipe clearance is inadequate for physical passage, or when drifting snow along road/pipeline complexes reduces the effectiveness of clearance. Where pipeline elevation is sufficient, the outcome of an encounter is influenced by group size/composition, topography, insect activity, traffic level, and the intensity of local construction, as well as road and/or pipeline configuration. ... Crossing success on an individual and group basis decreased with increasing group size. Present studies describe local movements and evaluate the effectiveness of special pipeline crossing structures, but comparisons are difficult because different criteria for ‘success’ have been used. Maintaining caribou passage through oil fields requires careful planning based on an assessment of both local and regional movements.”

Keywords: pipeline, caribou

**21.** Sopuck, L. Movements and Distribution of Caribou in relation to the Quintette Coal Development. Renewable Resources Consulting Services Ltd. Sidney, BC. April 1985

Only part of this document was reviewed, but it was very informative. An important statement is made in the abstract, “High predation rates, increased hunting pressure and disturbance resulting from improved access to caribou range are the greatest threats to the population.” They discuss areas that are critical to caribou including alpine wintering areas, calving areas, rutting areas and mineral licks. The reason that wintering areas are so vital is because “...they are restricted in size and number.” It is stated that “Human access on development roads has potential disruptive effects in alpine habitats and must be monitored and minimized to avoid adverse impacts.” The paper concludes with five recommendations that aim to minimize impacts.

1. Destruction of alpine habitat for caribou should be minimized and altered habitat should be reclaimed as soon as possible after mining has been completed.
2. Human access by motorized vehicles to alpine and subalpine components of caribou range should be restricted during the periods 15 May – 30 June (calving) and 1-31 October (rutting).
3. Harvesting of caribou, if permitted, should be conservatively managed and monitored closely. Harvesting at current numbers and levels of recruitment is not recommended.
4. Illegal kill and collision mortality of caribou along roads should be monitored.

Abstract: Roads were grouped into three classifications based on their character and corresponding use. Big game distribution was measured by pellet group analysis and stratified by topographic and vegetative features of the landscape. Generally, roads reduce big game use of adjacent habitat located from road edge to more than one-half mile away. This impact was greatest along “main” roads and through open vegetation types, and diminished with reduced road quality and increasing vegetation density.

The purpose of the study was “...to establish guidelines for road construction in big game habitats...”. The study indicates that “...minimal impact on elk habitat from construction of new roads would result if roads were located in dense forests and on east facing slopes...[and that] construction of roads in elk habitat, without protective guidelines, can negatively impact elk habitat to a significant degree.”

This study area is similar to the MK, in topography and wildlife populations, and similar studies could be used to gather valuable information in the MK.

Keywords: impacts, roads, game, distribution

**18. Rost, G. and Bailey, J. “Distribution of Mule Deer and Elk in relation to roads.”**  
Journal of Wildlife Management vol 43, no 3 July 1979. pg 634-641.

Abstract: Responses of deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) to roads were assessed by counting fecal-pellet groups near roads on winter ranges. Data were obtained in Colorado in shrub and pine habitats adjacent paved, gravel and dirt roads east of the continental divide; and in shrub and juniper woodland habitats west of the divide. Deer and elk avoid roads, particularly areas within 200 m of a road. Road avoidance was greater (1) east, rather than west, of the continental divide, (2) along more heavily travelled roads, (3) by deer, when compared to elk, and (4) for deer in shrub habitats. Because of less snow accumulation, winter habitat is more to cervids east of the continental divide where more pronounced avoidance of roads presumably results from a greater availability of habitat away from roads.

The objective was to look at how mule deer and elk travel in relation to roads that are located within or near their winter habitat. The study demonstrates “...that an expanding roads system or an increasing traffic volume on roads will affect the distribution of deer and elk and may affect their welfare.”

Keywords: deer, elk, roads

**19. Simpson, K. The effects of snowmobiling on winter range use by Mountain Caribou.**  
Ministry of Environment, Lands & Parks, Wildlife Branch Nelson, BC Feb 1987.

This paper provides the details of a study done near Revelstoke, BC. It looks at the impacts created by human presence, use of snowmobiles and helicopters on local caribou herds during the winter season. In a general statement, the effect was that the caribou were displaced from their preferred habitat. The disruption also meant that the caribou used more energy to flee and since food sources are low in the winter, this energy loss was detrimental. The article concludes, “The aspects of snowmobiling most disrupting to caribou are human scent and large groups of machines moving rapidly around in an

area. Caribou can tolerate low levels of snowmobile use and, if they are not harassed by snowmobilers, their tolerance will probably increase.” In general, the recommendations provided indicate that use by humans and their associated activities should be reduced while caribou are on winter range for various reasons.

Keywords: effects, snowmobile, winter caribou

**20. Smith, W. and Cameron, R. “Factors affecting pipeline crossing success of caribou.” Caribou and Human Activity. September 1983 pg 40-46.**

Abstract: Early simulation studies on the Arctic Slope of Alaska showed that caribou would not pass freely beneath elevated pipelines. Our recent observations during summer indicate that crossing success varies with pipeline design, caribou group structure, and a number of environmental stimuli. Effective barriers to caribou movement exist where surface-to-pipe clearance is inadequate for physical passage, or when drifting snow along road/pipeline complexes reduces the effectiveness of clearance. Where pipeline elevation is sufficient, the outcome of an encounter is influenced by group size/composition, topography, insect activity, traffic level, and the intensity of local construction, as well as road and/or pipeline configuration. ... Crossing success on an individual and group basis decreased with increasing group size. Present studies describe local movements and evaluate the effectiveness of special pipeline crossing structures, but comparisons are difficult because different criteria for ‘success’ have been used. Maintaining caribou passage through oil fields requires careful planning based on an assessment of both local and regional movements.”

Keywords: pipeline, caribou

**21. Sopuck, L. Movements and Distribution of Caribou in relation to the Quintette Coal Development. Renewable Resources Consulting Services Ltd. Sidney, BC. April 1985**

Only part of this document was reviewed, but it was very informative. An important statement is made in the abstract, “High predation rates, increased hunting pressure and disturbance resulting from improved access to caribou range are the greatest threats to the population.” They discuss areas that are critical to caribou including alpine wintering areas, calving areas, rutting areas and mineral licks. The reason that wintering areas are so vital is because “...they are restricted in size and number.” It is stated that “Human access on development roads has potential disruptive effects in alpine habitats and must be monitored and minimized to avoid adverse impacts.” The paper concludes with five recommendations that aim to minimize impacts.

1. Destruction of alpine habitat for caribou should be minimized and altered habitat should be reclaimed as soon as possible after mining has been completed.
2. Human access by motorized vehicles to alpine and subalpine components of caribou range should be restricted during the periods 15 May – 30 June (calving) and 1-31 October (rutting).
3. Harvesting of caribou, if permitted, should be conservatively managed and monitored closely. Harvesting at current numbers and levels of recruitment is not recommended.
4. Illegal kill and collision mortality of caribou along roads should be monitored.

5. The population trend and productivity of the herd should be monitored over the long term

Keywords: caribou, development, movements, distribution

22. Sopuck, L. Movements and Distribution of Mountain Goats in relation to the Quintette Coal Development. Renewable Resources Consulting Services Ltd. Sidney, BC March 1985

Only part of this document was available to read on the impacts of mining on goats and the management recommendations. Statements are made that mining development impacts goats in two ways. First displacing them from natural habitat and secondly by providing access via roads for the mine, which increases hunting pressures. One good point that they recognize is that limited data was available on the pre-development status of the wildlife. The management recommendations are logical solutions to protecting the goats and include

- access to goat habitat for recreational purposes should be carefully controlled,
- unnecessary disturbance of goats, such as low level flights by aircraft over goat range, should be avoided where possible and future expansion of (the Frame Mountain)
- open-pit sites should be conducted on a manner that minimizes the destruction of alpine habitat goats (this could be expanded to all resource expansion and all species).

Keywords: goats, development, movements, distribution

23. Stelfox, J. and Bindernagel, J. Caribou behavior in relation to human - elk - wolf influences: Jasper National Park, 1971-1974. Parks Canada 1978.

Abstract: Caribou (*Rangifer tarandus*) behaviour in response to human, elk and wolf influences was observed on their mountainous ranges within Jasper National Park between 1971 and 1979. A pronounced decline in caribou numbers in the 1960s and early 1970s was associated with a 1271% increase in human use of alpine tundra ranges during a 7-year period. Caribou were most vulnerable to harassment from humans during the spring and summer seasons. Their tolerance to humans was low on alpine tundra ranges compared to moderate on low elevation ranges within or adjacent to coniferous forests. Cows with calves showed a stronger reaction to the scent, rather than the sight, of humans, when the humans were above rather than below, and during hot weather. Cows with calves flushed from humans at greater distances than did bulls. Elk also encroached on to these high elevation ranges during this same period and range overlaps existed above 1825m. Caribou were submissive to elk and relinquished their range to encroaching elk. There was no evidence of significant harassment from wolves except during the brief attack periods. The increased wolf predation on elk was beneficial to caribou as it lessened the increase in elk numbers. Park management recommendations are made for minimizing the impact of humans and elk and for ensuring the availability of critical habitats for caribou.

The recommendations clearly show the areas that need protection to ensure animals safety and preservation. Some of the relevant recommendations are listed below.

- 1) Human-caribou interactions should be minimized on prime caribou alpine- tundra ranges by placing hiking trails away from major summer caribou ranges where

possible and/or restricting hiker use during critical calving periods. Hiking trails should be placed below and within forest cover of these prime ranges where the number of caribou-human encounters will be reduced and the deleterious effects of these encounters minimized.

- 2) Increased human use of important caribou ranges should not be encouraged by increasing trails, overnight shelters, ski developments, etc.
- 3) All caribou calving and rearing ranges plus caribou licks should be delineated and plans made to protect these areas from detrimental activities of humans (and elk).

Keywords: caribou, elk, wolf

**24. Trombulak, S. and Frissell, C. Review of Ecological effects of Roads on Terrestrial and Aquatic Communities. Middlebury College and University of Montana. Conservation Biology. March 2000.**

**Abstract:** Roads are a widespread and increasing feature of most landscapes. We reviewed the scientific literature on the ecological effects of roads and found support for the general conclusion that they are associated with negative effects on biotic integrity in both terrestrial and aquatic ecosystems. Roads of all kinds have seven general effects: mortality from road construction, mortality from collision with vehicles, modification of animal behaviour, alteration of the physical environment, alteration of the chemical environment, spread of exotics, and increased use of areas by humans. Road construction kills sessile and slow-moving organisms, injures organisms adjacent to a road, and alters physical conditions beneath a road. Vehicle collisions affect the demography of many species, both vertebrates and invertebrates. Mitigation measures to reduce roadkill have been only partially successful. Roads alter animal behaviour by causing changes in home ranges, movement, reproductive success, escape response, and physiological state. Roads change soil density, temperature, soil water content, light levels, dust, surface waters, patterns of runoff and sedimentation as well as adding heavy metals (especially lead), salts, organic molecules, ozone and nutrients to roadside environments. Roads promote the dispersal of exotic species by altering habitats, stressing native species, and providing movement corridors. Roads also promote increased hunting, fishing, passive harassment of animals, and landscape modifications. Not all species and ecosystems are equally affected by roads, but the overall presence of roads, is highly correlated with changes in species composition, population, size and hydrologic and geomorphic processes that shape aquatic and riparian systems. More experimental research is needed to complement post-hoc correlative studies. This review underscores the importance to conservation of avoiding construction of new roads in presently roadless or sparsely-roaded areas and removal or restoration of existing roads to benefit both terrestrial and aquatic biota.

As demonstrated by the abstract, this is an excellent resource and addresses many, if not all the impacts created by roads. Each of the seven general effects are discussed in more detail in their own section. There is an extensive bibliography created from this paper that could be used to find more supporting material.

Keywords: ecological, roads

**25.** Valkenburg, P. "The reaction of caribou to aircraft: a comparison of two herds." Caribou and Human Activity. September 1983 pg 7-9.

Abstract: Aircraft overflight cause Western Arctic Herd *caribou (rangifer tarandus granti)* to flee more often and to continue running more than Delta Herd caribou. Delta caribou have apparently become more habituated to aircraft or never learned to fear them, whereas Western Arctic caribou have either had insufficient exposure to aircraft or, more likely, perceive them as a threat. Delta Herd caribou have been exposed to high levels of human activity including aircraft overflights, but they are not hunted directly from motor vehicles to any degree. Western Arctic caribou on the other hand, are probably less subject to human activity, but they are pursued from snowmobiles and to some extent, aircraft. The emphasis in disturbance studies should be changed from simply documenting overt reactions to determining predictable aspects of inherent and learned behaviour, and ultimately finding ways to promote habituation.

This study was done using radio-collared caribou that were monitored using light fix-winged aircraft. Five categories of responses were defined:

- 1) Panic response: animals were out of control; they stumbled, collided with one another and ran into obstacles such as willow patches or trees.
- 2) Strong escape response: animals trotted or ran and continued running after the aircraft had passed.
- 3) Mild escape response: animals moved away from the aircraft or from the original direction of movement on the case of travelling animals. This class included only animals that walked or trotted a short distance.
- 4) Stationary response: animals stopped feeding, rose from resting position, or assumed alarm posture.
- 5) No visible response: animals continued feeding or resting or, if moving, continued at the same pace in the same direction.

Keywords: caribou, aircraft

**26.** Ward, J and Toweill, D. Elk of North America Ecology and Management. Stackpole Books, USA. 1982 pg 453- 456.

This is a book that has a lot of good information about elk. Chapter ten on elk and land management that looked at access and roads was the only chapter that was reviewed. This section references many other studies. They summarized the conclusion of about a dozen authors and state that "The width of the area avoided by elk has been reported as 0.4 –2.9 kilometers (.25 – 1.8 miles), depending on the amount and kind of traffic, quality of the road, and density of cover adjacent to the road." They reference one of the author's previous works, that found "...elk prefer to be at least 0.8 kilometers (0.5 mile) from people in out-of-vehicle activities, and that elk tend to be undistributed by repeated events of predictable nature, such as vehicle traffic that does not stop." This section also references a paper that I reviewed by Jack Lyon. It talks about his habitat effectiveness model. They declare that based on Lyon calculations, "...a road density of 1.9 kilometers per 100 hectares (3 miles per section) would leave almost no effective habitat for elk [in Western Montana]." This section recognizes the fact that road design and traffic control are important for animal protection as well as preservation of travel routes and cover adjacent to roads.

Keywords: elk, management

**27. Webster, L. The Effects of Human Related Harassment on Caribou (*rangifer tarandus*). Ministry of Environment Williams Lakes BC. August 1997.**

This document was prepared to reveal the different types of harassment that caribou face when they encounter humans participating in various activities. Topics reviewed that reflect caribou harassment include snowmobiles, helicopter/fixed wing aircraft, all terrain vehicle, pedestrians, mining/seismic exploration and roads/traffic/pipelines.

Recommendations are made that attempt to reduce harassment and protect the animals including:

- limit general flight altitudes in caribou habitat to above 300 meters,
- restrict recreational access to alpine areas during calving (mid-May to June),
- zone snowmobile and ATV use away from core caribou winter range particularly where terrestrial lichen is essential to caribou winter survival,
- limit snowmobile and ATV use in areas that may stress animals,
- promote further study concerning long term effects of human related harassment,
- minimize visibility of area surrounding active roads to screen animals from vehicular disturbance and reduce hunter success.

This paper also contains a useful appendix that summarizes in point form the study topic and the disturbance type that was reviewed in each resource.

Keywords: effects, human, harassment, caribou

### Materials for Planning Access

**28. Access Near Aquatic Areas : A Guide to sensitive planning, design and management. The Stewardship Series. 1997**

This guide recognizes that planning and management play a key role in controlling public access. Although the examples pertain to aquatic areas, the same general principles can be used for all environmentally sensitive areas. The idea of barriers, trails and signage are discussed. This guide specifically states that livestock grazing, hunting, mountain biking, horse riding and motorcycle, ATV and snowmobile use is inappropriate near [aquatic] environmentally sensitive areas.

Keywords: access, planning, management

**29. Environmental Guidelines for Access Roads and Water Crossings. Ministry of Natural Resources, Ontario. 1988**

This guide helps point out the impacts of building access roads and how to minimize them using conscious environmental planning, good design and construction techniques.

Keywords: access, roads

**30. Forest Planning A Guide to Co-ordinated Access Management Planning. Ministry of Forests British Columbia January 1989**

This guide reviews the Co-ordinated Access Management Plans and explains how it should be implemented with examples of its use.

Key Words: access, management

**31. J.S. Peeper & Associates. Roadside Access for Recreational Activities Systems Planning Study. March 1988**

This study came up with a methodology for selecting where outdoor recreation sites should be located based on the public's supply and demand. All types of activities were include such as hunting, cultural sites, trails, boating, etc. This type of idea could be used within the Muskwa-Kechika in the future.

Key Words: access, recreation

**32. MacLeod, N. A Framework for Planning Access in the Flathead Cranbrook Forest District. 1983**

This document lays out plans used by the Cranbrook Forest District for dealing with access roads by proposing the idea of road classification. It documents the development of the plans and how the public was involved. This kind of concept could be used within the MK Special Management Area in the future.

Key Words: access, planning

### Material from the Internet

**33. Roads and Habitat Fragmentation By Chuck Cottrel**  
<http://www.wildrockies.org/WildCPR/bibliionotes/road-frags.html>

This piece refers to "...the fragmentation effects of roads and how the presence of roads adversely affects the integrity of habitat for interior dependent wildlife..."

Key points:

- roads change the predator-prey relationships of forest interiors by allowing predators and brood parasites to penetrate farther into patch and contiguous forest areas than would otherwise be possible.
- road obliteration and revegetation should become part of the overall [timber harvesting] process
- habitat fragmentation not only results in decreased habitat area and increased patchiness of the habitat, but also causes microclimatic changes along the patch perimeter that alters the vegetative structure of remnant forest.

Concluding statement is "When combined with other road issues such as poaching, soil erosion, noxious weeds, and pollution, habitat fragmentation offers a strong argument for closing and removing many existing roads and changing future road management practices."



**34. Land Use Impact Costs of Transportation** By Todd Litman,  
Victoria Transport Policy Institute 1998 [http://www.tlcnetwork.org/\\_Email/000000de.htm](http://www.tlcnetwork.org/_Email/000000de.htm)

This article was posted in response to a request for information on the impacts that highways have on ecosystems. The author makes several valid points including:

- “Vehicles that use roads will kill wildlife.”
- “Road surfaces alter hydrologic pathways and, when they intersect streams, affect the quality of water.”
- “Roads also provide pathways that accelerate the dispersal of pests.”
- “Roads, parking facilities, sidewalks and the development that they bring to an area displace and damage natural greenspace.”
- ” Ecological damage from roads and traffic is well documented. Impacts include the loss, isolation, and disturbance of wildlife habitat, hydrologic impacts, damage to unique physical features, road kills, and wildlife injuries.”
- “If just 5% of a watershed is covered by impervious surfaces, water quality is seriously degraded.”

All these points are backed up with references.

He makes a good statement in that “Some land use impacts such as loss of wetlands, impacts on historical sites, and threats to endangered species have received considerable attention, and occasionally affect transportation decisions. But it is inappropriate to address each of these impacts alone. Doing so implies that only a few types of land use impacts are significant. For example, it implies that building a road imposes no environmental costs if it avoids wetlands and old growth forest, even if it degrades a second growth forest or farmland. A better approach is to develop a general model for assessing the value of any type of land.” This is what we want to do and need to do in order to complete the mapping of access sensitivity in the MK.

The author makes reference to Dr. Reed Noss’s paper, *The Ecological Effects of Roads*, which I included below. He also references a statement made by W. Roley “The net effect on wildlife of automobile-dependent urban sprawl is the fragmentation of habitat and the isolation of these fragments and their wildlife populations from one another. The gravest threat to the survival of wildlife in developed areas around the world is the reduction of both habitat and mobility of wildlife. The automobile, in other words, has become the greatest predator of wildlife.”

**35. The Ecological Effects of Roads** By Reed Noss, PhD  
<http://www.eco-action.org/dt/roads.html>

This article discusses the definitive effects of roads on biological diversity. It is an extensive summary of the impacts that roads have in both direct and indirect ways. Direct effects that are discussed include roadkills, road aversion and other behavioural modifications, fragmentation and isolation of populations, pollution, impacts on terrestrial habitats, and impacts on hydrology and aquatic habitats. Two indirect effects are discussed including access and cumulative effects. Options for mitigation measures are reviewed. This article was put together using vast amounts of reference material; the bibliography contains many sources related to the impacts of roads.

**36. The Effect Of Noise On Wildlife: A Literature Review** By Autumn Lyn Radle  
<http://interact.uoregon.edu/MediaLit/FC/readings/radle.html>

**Abstract:**

“Noise pollution, as it effects humans, has been a recognized problem for decades, but the effect of noise on wildlife has only recently been considered a potential threat to animal health and long-term survival. Research into the effects of noise on wildlife, which has been growing rapidly since the 1970s, often presents conflicting results because of the variety of factors and variables that can effect and/or interfere with the determination of the actual effects that human-produced noise is having on any given creature. Both land and marine wildlife have been studied, especially in regards to noise in the National Parks System and the onslaught of human- made cacophony in the oceans from military, commercial and scientific endeavors.

Most researchers agree that noise can effect an animal's physiology and behavior, and if it becomes a chronic stress, noise can be injurious to an animal's energy budget, reproductive success and long-term survival. Armed with this understanding it should follow that humans would attempt to minimize the threat to wildlife by reducing the amount of noise that they are exposed to in natural areas; but this has not been the situation. Natural areas continue to be degraded by human-made noise, wildlife continues to suffer from these disturbances, and to date the majority of the debate revolves around the egocentric demands of people to either produce more noise in nature (through motorized recreation, scientific research, military exercises etc.) or experience natural areas in the absence of anthropogenic noise. Neither side has adequately addressed the issue from the biocentric view of wildlife and the known, or as yet undiscovered, damage that our increasingly noisy human-altered environment is inflicting upon them.”

The paper also includes the topics:

- Determining The Effects of Noise On Wildlife
- Research Into The Effect of Noise On Terrestrial Wildlife During The 1970's
- Research Into The Effects of Noise On Terrestrial Wildlife During The 1980's
- Research Into The Effect of Noise On Terrestrial Wildlife During the 1990's
- Noise In The National Parks

**37. Roads: A big impact on small mammals** By Diane Rangaard  
<http://www.wildrockies.org/WILDCPR/bibliionotes/roads-sm-mammals.html>

“Roads impact small mammal species in several ways. Roadside habitats often contain different small mammal species than habitats further from roads. Small mammals along roads may be exposed to increased predation and vehicular pollution. Roads also can be barriers for small mammals, resulting in reduced habitat connectivity. “ This paper examines topics such as alteration of habitat along roads, invasions of nonnative small mammals, increased predation along roads, pollution along roadways and roads as barriers.

The paper concludes with “With our incomplete understanding of the effects of roads on small mammals in ecological systems, it is evident that more research is needed. In the

mean time, we should err on the side of caution in road planning to preserve the integrity of those ecological systems.”

**38. The Environmental Impacts of Off-Road Vehicles: A Primer** Friends of the Environment Chapter 1 Environmental Concerns <http://www.foe.org/trails/ch1sec1.html>

“The explosive growth of off-road recreation in recent years has created new challenges to managers of public lands and habitat.” This article covers several topics related to the impacts created by off-road vehicles including soil displacement and compaction, pollution, vegetation damage, wildlife damage and fire.

**39. Snowmobile Position Paper** By Bluewater Network  
<http://www.earthisland.org/bw/snowpos.shtml>

This paper discusses negative effects of snowmobiles. Topics include air quality, wildlife impacts: disruption and displacement, hazards to public health, wildlife impacts, impacts on vegetation, disruption of natural peace and quiet and safety concerns. The paper offers some suggestions for solutions including restricting the use of two-stroke engines that cause excessive pollution. Motors in vehicles that are not up to standard with pollution regulations have been phased-out and so should snowmobiles. Although more costly, new technology is allowing better motors to be built that are quieter and less pollutant. Secondly, the paper suggests restricting the areas where snowmobiles can go. This restriction is due to the fact that most effects of snowmobiles are negative, and therefore incompatible with most park system regulations. In some parks in the States they have been regulated. In support of this regulatory reasoning, the paper states “The adverse impacts of snowmobiles on air, water, vegetation, wildlife, and public safety demonstrate that there are some areas in which snowmobiles do not belong.” This paper has an extensive bibliography, from which they referenced a variety of sources that can be used in support of the effects and impacts of snowmobiles.

Other interesting information can be found on the Bluewater Network Page regarding snowmobiles:

<http://www.earthisland.org/bw/snowfacts.shtml>

<http://www.earthisland.org/bw/snowmobilemyths.shtml>

### Special Reference

**40.** Olliff, T. K. Legg and B. Kaeding, editors. 1999. Effects of Winter Recreation on Wildlife of the Greater Yellowstone Area: a Literature Review and Assessment. Report to the Greater Yellowstone Co-ordinating Committee. Yellowstone National Park, Wyoming. 315 pages.

This resource was completed in late 1999 and contains up to date issues, concepts and techniques. It references impacts that occur during the winter season as a result of

recreational activities. This document mainly looks at the impacts on wildlife and more specifically those that call the 'Greater Yellowstone Area' home. Some of the species discussed in depth include bison, elk, and moose to mention a few. The birds that are talked about include the bald eagle and trumpeter swan. A different author writes about each species in its own individual section, which makes for easy reading and concise review. In many, if not all, the individual sections topics such as habitat, life history human activities and their potential effects are discussed. There is also very brief section on habitat and the impacts on vegetation from winter recreation. To close out the document several issues are examined, including the effects of development on wildlife, energetic costs of displacement, and habituated wildlife, as well as a few others. There is an extensive bibliography accompanying this document that could be a valuable tool in finding other sources related to this topic. This document is very useful for three reasons: 1- very recent material 2- similar species as in the MK and 3- same issues of winter recreation, access and development.

Summarized below is a quick list of Management guidelines that were presented in this document. Please keep in mind that this information is based on the impacts of winter recreation activities but could be expanded to include access and future development. Also although the species may not be of the same sub species (example thin horn sheep versus big horn sheep), the same general characteristics and impacts will apply.

### **Big Horn Sheep**

- Human approach to the critical areas of bighorn habitat should be limited. A buffer zone should be established around bighorn sheep escape terrain.
- Human activities should be limited to roads or trails to minimize disturbance to bighorn sheep.
- Dogs should not be prohibited on any bighorn sheep winter range.
- The remaining bighorn sheep habitat should be protected to ensure that migration corridors will remain intact and that traditional ranges are maintained.
- Special protection measures should be enforced during brief periods such as breeding, lambing and severe winter weather.

### **Bison**

- Where possible, consider rerouting snowmobile trails so that they are located outside of critical bison winter ranges and bison concentration areas.
- Where major bison migration routes intersect groomed snowmobile trails or snowmobile-use routes, consider relocating snowmobile trails and user routes.
- If bison are travelling plowed highways that have berms, plow frequent "pull-outs" where bison can escape from vehicular traffic.
- Consider restricting human use in areas of critical wildlife winter range.

### **Elk**

- Avoid construction of new facilities in elk winter range and place any necessary construction in or adjacent to already disturbed areas
- Regulate human activities so that they occur in defined areas in as predictable a fashion as possible
- Structure areas of human use and development so that there are buffer zones between humans and elk-use areas. Create or maintain sight barriers (brushy forested areas)

adjacent to human-use areas, thereby reducing the distance elk must flee to find hiding cover.

- Avoid placing transportation and motorized routes in low-elevation, low-snow, riparian and open habitat favored by elk. When this is necessary, attempt to occasionally move the route away from those areas and through denser timber or areas with adequate cover. Avoid creating roadside barriers that may prevent elk from crossing roads or trails or that may trap animals along the route.
- Limit human activity in low-snow winter range areas. Where it occurs, keep activity concentrated in established areas.
- Carefully research elk use of particular areas before creating new human activity zones. Avoid creating new developments or disturbances in areas where elk have no alternative winter ranges to use or where impacts cannot be adequately mitigated.

### **Gray Wolves**

- New winter recreational developments should not be built near ungulate winter ranges or where they would impede wolf movements between high-quality habitats. Moreover, existing destination areas should be closed by April 1 to prevent the displacement of wolves during critical denning periods.
- Wildlife managers should immediately remove road-killed animals from roadsides to prevent foraging wolves from being hit by vehicles.
- New groomed motorized routes should be located in areas that are not classified as ungulate winter range or important wolf habitat. Grooming and use of snowmobile roads and trails should end between March 15 and April 1, allowing wolves to use spring denning sites without harassment.
- Dispersed motorized use should not occur on or near ungulate winter range or on spring range after wolf denning begins, usually between March 15 and April 1,

### **Moose**

- Avoid building winter recreation facilities in moose winter range. This will prevent a loss of habitat and reduce encounters that elicit energetically expensive flight responses. As stated moose winter range is not difficult to identify. All components of the wintering area should be considered, including foraging areas, cover and travel corridors.
- Where human use does occur in moose winter range, regulate activities to make them as predictable as possible. This can be accomplished by restricting them spatially and temporarily.
- Where plowed roads exist in moose winter range, reduce the risk of collisions by plowing escape corridors in roadside snow berms, reducing speed limits, alerting motorists to the risk by signing and other educational efforts, providing roadside lighting, restricting travel to daylight hours, fencing road corridors, providing underpasses for moose to cross the road and removing roadside barriers that limit visibility.
- Educate the public so that they can take appropriate measure to avoid impacting moose. They should understand the impacts of chasing or approaching moose the importance of controlling the movement of dogs.

## **Mountain Goats**

There is a key quote in this section, referenced by another author Joslin (1986), who claims that "Motorized access in or near mountain goat habitat is probably the single biggest threat to goat herds throughout North America."

"Throughout their ranges, mountain goats inhabit steep, rocky terrain during all seasons of the year. No other feature of preferred habitat is more apparent than the rugged inclines to which goats are adapted. They are often found on slopes between 20 and 60 degrees with little vegetative cover. They use cliff ledges for all activities including resting, feeding and playing. They also use the slide-rock, talus and turf meadows adjacent to ledges, though they rarely stray far from the safety of cliff habitat." Therefore we can see why these areas need to be protected.

## **Bald Eagle**

Three critical habitats for the bald eagle were identified in the section. They included wintering, nesting and roosting habitat. During winter the eagle will stay close to major rivers and large lakes, where fish and waterfowl may still be available. For nesting and roosting sites, mature or old growth forests provide the best habitat because of the protective nature of the forest. The trees are often large and there are snags to provide perching and nesting sites. It was noted that "Bald eagles display strong fidelity to a breeding areas and often to a specific nest site." This means that sites could be located and mapped for protective measures. Some recommendations were made to support management decisions:

- Establish buffer zones of 1,300 feet around high-use foraging areas with temporal restrictions from sunset to 10:00am in areas of high human use or establish site-specific modifications based on research findings,
- Diurnal perching areas may not always be associated with primary foraging area. If separate, buffer zones of 650 to 1,300 feet around concentrated or high-use perches should be imposed, depending on existing vegetative screening. Temporal restrictions should be consistent with seasonal residency. Removal of trees, especially snags greater than 2 feet in diameter that are within 100 horizontal feet or 1,300 feet in elevation rise of greater than 30 degrees from shoreline should be discouraged....,
- Areas of winter and early spring waterfowl concentrations are important to wintering and migrating eagles. Efforts to enhance existing wetlands and development of new ones should be supported.

They have identified three important zones for the eagle

### **Zone 1- Nesting Site Area**

The area within a ¼ mile radius of active nest sites should be maintained to protect nest site characteristics, including snags, nest trees, perch trees, roost trees and vegetative screening. Any disturbances should be eliminated.

### **ZONE 2- Primary Use Area**

This zone includes the areas ¼ to ½ mile from active nest sites in the breeding area where it is assumed that 75 percent of activities (foraging, loafing, bathing, etc.) of a bald eagle breeding pair occur.

### **ZONE 3- Home Range**

This areas includes all suitable foraging habitat within 2.5 miles of active nest sites. Areas within the 2.5 mile radius of the nest that do not include potential foraging

habitat may be excluded. However, the zone will include a 1,300 foot buffer along foraging habitat where the zone has been reduced.”

### **Trumpter Swan**

Three helpful management guidelines given regarding the swan are:

- Designating snowmobile and ski trails away from open waters used as winter habitat by swans can mitigate winter recreational impacts on the birds.
- Special restrictions may need to be implemented on open-water snowmobiling in areas that swans routinely use for feeding. These measures would reduce the energetic expenditures resulting from disturbance.
- Some concern has been raised about the effects of snowmobile noise on swans. At this time, no information is available on this subject.

### **Summarized Points**

Development should occur with respect to species sensitive life cycle.

Winter is a more critical time! The reason that impacts and effects during the winter are so important is to do with the fact that animals are extra stressed during this period and need extra protection!! Summer requires less protection because the animals have more range and food to eat and thus can tolerate some disturbance.

However, if it can be stated that winter recreation impacts wildlife AND that access development creates a greater impact than recreation THEN similar, if not worse, impacts will result from access development. So the impacts mentioned here can be applied to but more likely intensified by access development.

Human use and disturbance will cause displacement from high quality habitats. This should be avoided because it will be detrimental to the fish and wildlife population of the MK.

### **General Management Guidelines/ Mapping Factors**

- Protect critical habitat with a buffer. This should be determined by the species vulnerability to impacts. The critical habitat areas include winter range, travel/migration corridors, rutting/calving grounds, denning sites, mineral licks, nesting areas, spawning areas, escape terrain, etc.
- Restrict use or activities during critical periods such as rutting, calving, migration to different habitats, spawning, etc.
- Avoid placing roads in locations that will fragment or separate primary habitat. This causes problems for wildlife, especially when migration routes are impeded. This is the animals easiest way to travel between habitats and usually a traditional route.

## **Key Words**

access  
aircraft  
canoe  
caribou  
deer  
development  
distribution  
ecology (ecological)  
effect(s)  
elk  
environment(al)  
fisheries  
forest  
game  
grizzly bear  
habitat  
harassment  
human  
impact(s)  
management  
moose  
motorized  
Mountain goat movements  
off-road vehicles  
packstock  
pipeline  
planning  
recreation  
road(s)  
Stone's Sheep  
snowmobile  
ungulates  
value(s)  
wilderness  
wildlife  
winter  
wolves



Appendix 2

**Interview Response Summary Sheet**  
Compiled by Stephanie Beitel  
March 2000

# Interview Response Summary Sheet



MK Access Sensitivity

## Interview Questions

### **SECTION I -Personal Information**

- |   |  |
|---|--|
| <input type="checkbox"/> 6 Ministry of Environment, Lands and Parks | <input type="checkbox"/> 1 Guide Outfitter     |
| <input type="checkbox"/> Ministry of Forests                        | <input type="checkbox"/> Hunter                |
| <input type="checkbox"/> Ministry of Energy and Mines               | <input type="checkbox"/> Fisher                |
| <input type="checkbox"/> 1 Oil & Gas Commission                     | <input type="checkbox"/> Trapper               |
| <input type="checkbox"/> Private sector- Oil & Gas                  | <input type="checkbox"/> First Nations         |
| <input type="checkbox"/> Private sector- Forestry                   | <input type="checkbox"/> 1 Personal Recreation |
| <input type="checkbox"/> Non-government Organization                | <input type="checkbox"/> Horse Rider           |
| <input type="checkbox"/> Aircraft Operator                          | <input type="checkbox"/> River Boater          |
| <input type="checkbox"/> Other 3 BCAL 1 Tourism                     | <input type="checkbox"/> Lodging/Accommodation |

What is your personal experience/background with the MK Management Area?

- Work related -inventory, planning, burning, parks related work, current related projects, interagency work regarding MK
- Personal recreation –camping, fishing, hiking, boating, hunting
- LRMP Table member
- Access Management Planning
- Work and Recreational Use before designation of MK
- Guideoutfitter and family territory
- Tourism – promotion of MK

When travelling within the MK Management Area what type(s) of transportation do you use?

Foot 9 Horse 4 Mountain Bike 0 Vehicle 5 Quad/ATV 3 Snowmobile 3  
Snowshoe 0 Skies 0 Motor Bike 1 Helicopter 8 Airplane 6 Floatplane 2  
Canoe 0 Jet boat 4 Kayak 0 Other \_\_\_\_\_

\*It should be noted that all the types of access are used to some extent even though the interviewees did not use all of them. The majority of the responses related to air access are related to work experience rather than personal recreation.

*How long are your visits to the MK Management Area?*

1 to 3 days- 6 3 to 5 days- 5 5 to 10 days- 1 10 days or more Live OR Work there-1

### **SECTION II- Access**

1. *Why do you visit/use the MK Management Area?*

- Work related – Wildlife and habitat enhancement and management
  - OGC: review developments and assess impacts

- Enforcement: ensure compliance with laws and regulations
- Personal Recreation- hunting, hiking, fishing, camping, scenery tours
- Can't afford to access MK for personal recreation ie) too expensive: planes, snowmobile, atv, boats.

2. *What changes in the type of access have you observed in recent years and what were the impacts that you observed?*

- Impacts from roads, river access and ATV access
- More roads = more accessible = more damage
- Increased river boat use into streams and lakes impacts spawning fish and creates bank erosion. ie)Kechika, Muskwa, Tochodi, Sikanni, Halfway \*smaller waterways feel the effect more
- Increased snowmobile use in the Sikanni- access to winter ranges
- Increase in air access, in particular by private companies, includes floatplanes. There are 45 airstrips in the parks alone
- Increased technology !! ie) better machines = go faster, farther, easier into areas not previously accessed
- More horses used by packers
- Increase in all forms creates more pressure ie West Coast Trail
- Increase in oil & gas development ie) well sites, drilling
- AMA has limited access
- ATV use off trails creates damage to watershed, soil, etc
- Horses ruins camp areas from killing vegetation

3. *Please rank what type of access you think creates the most impact and why?*

1 = High impact

3 = Low impact

2 = Medium impact

4 = No impact

	AVG	(Score were added together then averaged.)		AVG
Walking/Hiking	3.43		Snowmobile	2.50
Horseback	2.56		Canoe/Kayak	3.75
Mountain Bike	3.17		Jet Boat	1.55
Motor Bike	2.21		Helicopter	2.65
All-terrain-vehicle	1.83		Airplane	2.65
Vehicle (car/truck)	1.67		Floatplane	2.65

4. *What impacts does your type of access have on the MK Management Area?*

In general, most people believe that their type of access caused little damage. As seen in these comments, people thought that as long as they were complying with the AMA regulations, they did not think they were damaging the environment (although they still were creating an impact).

- Harvest impacts from hunting
- Aircraft creates noise that may disturb wildlife. Especially high elevation species like sheep and goat.
- Aircraft's provide access to inaccessible places
- Campsite use including wood, fire pits and water
- Jet boat use on major lakes and rivers is OK
- ATV on trails is OK
- When not landing with aircraft no impact

- Foot access causes little damage and if you use multiple trails you lessen the impact.
- Horses do little damage when kept on trails
- Vehicle access on highways/designated routes cause no damage

5. *What impacts do you see resulting from other types of access in the MK Management Area?*

In general, most people believe that other types of access cause more damage than theirs.

- Loss of habitat, movement and undue stress to fish and wildlife and decline of populations
- Loss of pristine wilderness and environmental degradation; cluttered with garbage and waste (fuel drums)
- Horse use is damaging – education is needed as to the impacts they create
- Jet boat use on small sensitive lakes and rivers is very damaging to aquatic species
- Oil and gas development and road building from industry causes the greatest impact. Especially the roads because they are usually not closed after resource extraction and then used by the public.
- Horse use and ATVs ruin trails because they chew them up
- Hunting and fishing harvest impact the fish and wildlife populations (especially if it is not done lawfully)
- With better transportation methods, there is an increase in the ability to carry more equipment and people will be more likely to leave it there
- Impacts are concentrated by using only one type of access.
- Crowding from increased access by river boat
- If access is not controlled, it will have a greater impact!!

6. *What types of access do you feel are appropriate in the MK?*

- Non motorized because you have no way to control access
- Walking/hiking, horseback, mountain bike, canoe/kayak
- Limited snowmobile, jet boat, helicopter, fixed wing
- Very limited ATV
- ‘Traditional’ access should be allowed
- designated routes are good but not the 10 meter limit, should be increased
- a reasonable amount of access that the public will support because they are the ones who have to comply
- all water methods are OK
- ATV are OK with controlled use and restrictions ie) size of tire, type of tread
- No motor bikes or mountain bikes in the Parks
- All methods should be allowed as long as they are regulated, designated to certain areas and respect the environment
- Good network of trails for hiking
- Restriction on numbers and motorized
- ‘muscle power’ ie) foot, horse

7. *What impacts do you see with regards to the amount and types of access at different times of year the MK Management Area?*

- Most popular use times for recreational use – fall, summer, spring, winter
- Motorized access has a bigger impact in the summer – vehicle, atv, boats
- Winter access impacts are focused on animal winter range – snowmobile
- Winter access by snowmobile to lakes where damage and pollution may occur
- Fall access relates to hunting (Aug – Sept) – river boat- creates bank erosion, garbage, noise
- Chasing of animals, soil compaction, trails through wildlife habitat

- Concentrated impacts in short time periods ie) hunting, snowmobiling
- Concentrated impacts in several small areas ie) camps and trails

8. *Due to the fact that future resource development may occur within the MK, this will lead to an increase in the number of access routes. What do you think will be the positive and/or negative results?*

- Positive economic and Negative environmental
- Any access whether signed or gated will create new access that will be illegally used therefore negative impact
- Resource extraction = jobs and \$ (however the money doesn't go back into the area anyhow)
- Loss of wilderness area
- Once an area is open with easy access (roads) damage will be done
- Different levels of development will create different impacts
- Positive – pre-tenure plans will allow inventory to be done which will provide more information
- Increases options to spread out and reduce crowding
- More people = more disturbance = environmental degradation
- More people see the area = more appreciation = desire to protect
- No positive results from a wilderness/ environment perspective
- Negative impacts to wildlife populations and habitat
- Impacts of damage, pollution
- Impacts recreational values positive = more opportunity negative = more people therefore different experience
- Impacts can be restricted through management practices
- Potential over harvest of natural resources – all of them timber, wildlife, etc.
- Increased roads, pipelines, seismic lines = destroys habitat
- Should use alternate ways to access and build in MK ie) heliport
- All season roads create easier access for hunters, fishers
- Increased ATV use = degradation
- Roads should be considered for both resource and recreation use

9. *What type of suitable access management strategies would you suggest for the MK Management Area in the future?*

- Controlled access through regulations like distances, identifiable geographical boundaries (AMA is good but needs to be kept up to date)
- Signed and gated access
- Limited access depending on the time of year (seasonal access)
- Limit party size and number of trips
- Trails must be stayed on may horses, atv and hikers
- Restrict flight routes to avoid winter range
- River boat time, number and distance restrictions
- Roads restricted to industrial use only not the public
- MORE ENFORCEMENT (AMA seems to be adequate on paper)
- Winter area restrictions to minimize impacts
- Designated routes and speed limits
- Year to year changes to reflect conditions of environment (wildlife, land, weather)
- Deactivation of unused roads
- Have our laws reflect what we want for the future

10. *Do you think the current Access Management Area legislation is effective? If not, why? Suggestions.*

- Yes it is effective
- Not stringent enough
- Enforcement is not good enough need more staff and money
- No people want more access
- Current regulations address issues of the past, mainly vehicles and ATV but it doesn't address planes, boats, snowmobiles or horse use

### **SECTION III- Wildlife**

1. *Which animals in the MK do you utilize and for what?*

- Recreation
  - ~consumptive -- Hunting- bison, sheep, moose, elk, caribou, grizzly
  - Fishing
  - ~non-consumptive --Wildlife viewing
- They are all connected and rare and can be affected very easily and quickly
- No preference all are important and create balance

2. *What animals do you feel are impacted by different types of access in the MK? How are they impacted?*

- All
- They are impacted by loss of habitat, pressured into unknown movement patterns, creation of new access leading to ease of hunting
- Impacted from access including pressure from humans, cutting up of habitats, noise and loss of critical habitat leads to movement to new habitat that may not be of as good of quality
- Most impacts take place in the fall, but substantial impacts can occur in the winter and areas of winter range
- All are impacted by oil & gas development
- Habitat fragmentation and loss from roads impacts all species
- Goats/sheep – jump off cliffs from harassment like helicopters and mines especially during winter when animals are extra stressed
- Fish- riverboats ruin fish habitat, disturb during spawning season
- Duck on the river will be affected by boating activity during their nesting season
- Aquatic life is impacted by barriers such as culvert and bridges
- All species are impacted by snowmobiles infringe on winter range
- Big game species impacted by Treaty 8 Natives (territory includes all the MK) who have unlimited hunting access but vehicle restrictions
- Animals are habituated from the many activities that occur in the MK
- All are effected because more access = more people = more damage
- Access allows more hunters into the area which will directly impact big game and indirectly impact other species
- All species will be impacted by increased access
- Access routes near mineral licks is BAD for species dependent on this source because this will increase mortality potential.
- Extreme impacts to goats, evident because they had to create goat exclusion areas for their protection.
- Loss of riparian area impacts hydrology and therefore many species

- When species are disturbed their behaviour will change and they may avoid high quality habitat (this has many effects)

#### **SECTION IV- Personal Input**

1. *What value(s) do you associate with the MK and how important are they to you? If you are unclear about what the value includes see definitions below.*

<b>VALUES</b>	<b>Very Important</b>	<b>Somewhat Important</b>	<b>Not Important</b>	<b>Not Sure</b>
Recreational	9	1	0	0
Educational	8	2	0	0
Historical	5	4	0	1
Cultural	2	5	0	0
Hunting	5	4	1	0
Fishing	5	5	0	0
Economic	4	3	3	0
Wilderness	7	3	0	0
Biological	9	1	0	0
Environmental	7	3	0	0
Aesthetic	7	3	0	0
Spiritual	2	6	1	1
Wildlife/ Habitat	10	0	0	0
Hydrologic	7	3	0	0
Other _____				

Recreational- includes all outdoor such as hiking, photography, boating, camping

Educational- includes opportunities for people to learn about nature and scientific research to be done

Historical- the area/site has past time importance

Cultural- the area has important values to a certain group

Hunting- the area has hunting significance

Fishing- the area has fishing significance

Economic- includes all economic opportunities such as logging, energy production, tourism, commercial

Wilderness- an area essentially undisturbed by human activity together with its naturally developed life community where you seek solitude and recreate outdoors

Biological- ecosystems and all its components in a natural state

Environmental- pollution free, wilderness area

Aesthetic- the area is pleasing in appearance and pleasurable to the senses

Spiritual- the area has spiritual significance to an individual or group and may be concerned with religious values

Wildlife/Habitat- Animals and their natural habitat

Hydrologic- clean water and natural watersheds

4. *What kind of information/factors would you use to create a map that showed how sensitive an area is to access?*

- Depends on the type of access
- Water- lakes bigger than 5 ha and watershed stream order greater than 2 should have a 500 meter buffer
- No development close to major rivers to protect aquatic species
- River corridors and valley bottoms are highly sensitive
- Wildlife -use indicator species since all species can not be included  
-use provincially noted species

- critical habitat
- travel corridors
- winter ranges
- mineral licks

- Vegetation: what types are most sensitive to access (damage) and what's there recovery potential
- Elevation, Slope and Soils
- Weather – snowfall data
- Extractable resource values
- Existing recreational uses – campsites
- All values mentioned above should be considered
- Levels of use and types of activities occurring need to be collected
- Road density – use to judge impact because activity will be concentrated in these areas
- Find out where activities are occurring because the areas being used only represent a small area compared to the whole MK.
- Levels and time of river activity
- Sensitive terrain and land forms such as cliffs, marshes, hot springs
- Designated routes and type of access being used
- SOIL, VEG, SLOPE, WATER will influence all factors  
(ie) historic settlements, wildlife habitat, where roads can be built, water is necessary for wildlife, soil dictates where things will grow and thus what species will come to feed there.

#### Comments/Suggestions

- Limited access will keep the MK remote
- Concern about boats bring in ATV and horses to new areas
- Adjacency to parks will create issues and impacts
- Industry will have the greatest impact if not regulated
- What are the impacts of noise disturbance
- Money gained from the resources is NOT put back into the area!
- There is a lack of information for this area. Inventories should be done based on priority and need. More research needs to be done before development begins
- Indicators from all important aspects should be integrated into plans for access and resource use
- Look for US examples
- Different types of access need to be dealt with in different ways
- Access connects everything making more areas accessible which means more damage could occur.
- Major concerns for fish with regards to disturbances from motorized boats
- No campsites should be located on or near rivers or lakes
- As few bridges as possible! And no roads close to water

#### CONTACTS

Chris Wagner at OGC, he did paper on access management  
Pierre Barrett Trappers Association  
Martin and Sharon Lamoreux Trappers  
Gerry Wald Archaeologist  
April Moi Tourism Manager



## Appendix 3

### **Similar Projects Samples**

#### **I - Mapping the Scientific Panel's Watershed-based Recommendations**

*Project done by ECOTRUST CANADA*

*Project posted on Aboriginal Mapping Network webpage*

*<http://www.nativemaps.org/Methods/science.htm>*

#### **II - Using GIS to select Protected Areas in the NWT**

**An example from the Slave Geological Province**

Northwest Territories Resources, Wildlife and Economic Development.

September 1999.

## Appendix 3

### **I - Mapping the Scientific Panel's Watershed-based Recommendations**

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## Appendix 3

### **II - Using GIS to select Protected Areas in the NWT**

#### **An example from the Slave Geological Province**

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September 1999.

Appendix 4

**Key Data Summary Information**

Compiled by Stephanie Beitel and Michael Wood  
March 2000

Existing Data

<b>Datasets</b>	<b>Description</b>	<b>Scale</b>	<b>Date</b>	<b>Comments</b>
<b>Muskwa Kechika Data</b>				
MK Boundary	Special Management Area designated in 1997 under LRMP Process	250,000	1998	
AMA Boundary	Access Management Area created in 1997 to legislated access	250,000	1999	
MK Designated Access Routes	The MK falls within the AMA, which designates specific routes for travel. Vehicles and ATVs have maximum distances that can travel away from the routes and weight restrictions.	GPS	1999	
RMZ Boundaries	Resource Management Zones Boundaries, Fort St John LRMP (2) & Fort Nelson LRMP (16)	250,000	1998	
Toad River Exemption Area	The area surrounding Toad River is exempt from AMA regulations		1999	
<b>Cadastral Data</b>				
CDMS	Cadastral Data Management System - Data Custodian is Crown Lands Registry Service (CLRS) : Roads, legal boundaries, townships	20,000		
<b>Water Data</b>				
Waterways, rivers, lakes, etc.	All water features	20,000 50,000		
Watershed Atlas	Streams networks of the Province produced by Ministry of Fisheries based on federal information	50,000	1998	
<b>Wildlife Data</b>				
Red and Blue Listed species	BC Conservation Data Center is responsible for this data, they produce tracking lists of the species. Documented occurrence information is available for the MK		2000	
Biophysical Habitat Mapping	Data is available for the following species: Bay Breasted Warbler, Beaver, Black Throated Green Warbler, Cape May Warbler, Caribou, Connecticut Warbler, Fisher, Elk, General Warblers, Grizzly Bear, Marten, Moose, Mountain Goat, Mule Deer, Philadelphia Vireo, Stone Sheep, White Tailed Deer	20,000, 50,000 and 250,000		For more details on this type of mapping see Appendix A at the end of this section
Canadian Land Inventory	Assessment of the lands limitations to the production of ungulates and waterfowl	250,000	1975	Data exists for the southern portion of the MK.

Existing Data

mineral licks and berry areas	These are natural sites where mineral deposits have surfaced. This sites help supplement the diet and often wildlife will gather here.			Some data has been recorded but more is needed.
Exclusion Areas	1999 mountain goat exclusion areas			Closed by Wildlife Branch
<b>Vegetation Data</b>				
Forest Cover	Identifies primary species, stand age and Crown Closure	20,000		Ministry of Forests in the Data Custodian
Terrestrial Ecosystem Mapping (TEM)	Ecosystem mapping is the stratification of a landscape into map units, according to a combination of ecological features, primarily climate, physiography, surficial material, bedrock geology, soil, and vegetation			This has been done for the Upper Sikanni and Besa-Prophet
Broad Ecosystem Mapping				
Biogeoclimatic Zones (BEC)	A hierarchical classification scheme having three levels of integration - regional, local, and chronological - and combining three classifications - climatic, vegetation, and site.	250,000	1997	
<b>Cultural Data</b>				
Archaeological Sites	The province has a branch devoted to discovering and mapping this type of information. The Archaeology Branch maintains the Provincial Heritage Register Database (PHRD), a database that incorporates all heritage sites and objects recorded in the province	150,000		
First Nations Reserves	The Kaska Dena and Treaty 8 Land Reserves coincide with the MK.	20,000		
<b>Recreational Data</b>				
Visual Quality	Ministry of Forests			
Recreation Opportunity Spectrum	Ministry of Forests			
Personal recreation	Includes campsite data. Data collected for MK Recreation Plan	GPS	various	
Commercial recreation	Includes data based on applications for commercial sites. Data collected by BC Assets and Land Corp.	GPS	various	
<b>Parks and Protected Areas</b>				
	Designated Provincial Parks and Ecological Reserves	20,000	1999	

Existing Data

<b>Topography</b>				
TRIM data	Elevation, slope, aspect	20,000		
<b>Guideoutfitter Data</b>				
Territory Boundaries	Ministry of Environment, Wildlife Branch	250,000		
Camps & Tenured sites		GPS	1999	
<b>Transportation</b>				
Powerlines and waterlines				
Access roads	Access roads for oil & gas and forestry operations			
Pipelines	BCAL and OGC hav this data (not necessarily in GIS format)			
Seismic lines	OGC			
<b>Miscellaneous</b>				
Trapper Boundaries	Ministry of Environment			
Old mine sites	Ministry of Energy and Mines is the Data Custodian for this information			
Documented mineral occurrence	Ministry of Energy and Mines is the Data Custodian for this information			