Session Notes
Model Forest Caribou Workshop

MODEL FOREST NETWORK
RESEAU DE FORETS MODELES

April 26-27, 2005 Radisson Hotel, Winnipeg

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Introduction

The primary purpose of this workshop was to provide a forum for experts and experienced practitioners in caribou ecology and management to share their knowledge and experience. This sharing is part of a national dialogue on boreal caribou conservation. The focus of this session was to help participants understand and appreciate how other jurisdictions are interpreting science, applying science to both management and policy and, in particular, overcoming management challenges within the ecological and social context of their respective jurisdictions. These expert sessions sought convergence of opinions on issues and approaches where possible, and improved understanding of unique ecological conditions or management circumstances where they exist.

Background

Woodland Caribou in the boreal forest have been designated nationally threatened. In every jurisdiction where industrial development has encroached on caribou range, caribou populations have been placed under stress or have been eliminated. A wide array of management approaches to mitigate this impact have been proposed and have generated considerable debate. Caribou conservation has challenged resource managers and has attracted the attention of industrial users, non-government organizations and other stakeholder groups. Issues analysis by the Canadian Model Forest Network places caribou management as a high priority among clients. Resource managers are somewhat confused by the variety of approaches expressed in different jurisdictions. They wonder whether

these variations are the result of different science, a different application of science, different policies or a different ecological and social context. The Manitoba Model Forest, on behalf of the Canadian Model Forest Network, hosted this workshop to enhance understanding of the state of caribou management in the boreal forest and facilitate communication and understanding among resource managers. The mechanism was a limited discussion of selected concepts and issues in a workshop environment.

Workshop Design and Approach

The workshop emphasis was on technical dialogue and analysis among individuals invited for their experience and technical knowledge. A secondary emphasis is placed on dissemination of information to a wider audience. The workshop was held April 26 & 27 at the Radisson Hotel in Winnipeg Manitoba. The agenda (Appendix A) featured a series of presentations by invited speakers and five technical working sessions. The last session was not completed due to lack of time. Approximately 35 invited experts (Appendix B) participated in these sessions.

Working Session Summaries

At the completion of the working sessions there was a brief report-back to a plenary audience. Most of the notes were captured individually and on flip charts. Volunteers from among the participants took the flip-chart notes and briefly captured the major discussion points from the working sessions. These brief summaries have been compiled here as the written notes from the deliberations. These notes were subject to limited editing for consistency but main points including redundancies were retained. Between sessions two and three a diagrammatic representation (Appendix C) of factors that could affect the

population parameter lamda was generated and shared with the group in order to stimulate discussion of targets for mitigation in subsequent sessions.

A presentation by three participants of the expert session was prepared (Appendix D) and delivered to the Public Session held April 28, 2005 at the same location.

Caribou in Dynamic Landscapes (Sessions 1 & 2)

Factors affecting Caribou Habitat Selection and Movement

Collective input from participants suggested eight categories of factors influencing caribou habitat selection and movement. Common themes and generalizations about the significance of these factors and the scientific basis for our understanding was sought.

Caribou Use of a Dynamic Landscape

Caribou live on a dynamic landscape which must be able to provide for a sustainable habitat supply at appropriate temporal and spatial scales. There was strong convergence of thinking that:

Caribou distribute themselves across the landscape to reduce risk of predation and other threats. This tends to occur at large spatial scales consistent with the forest disturbance regime and the coarse patterns of surficial geology and topography. In terms of time, security provision may be measured in terms of many caribou generations or fire cycles where renewal of refuge habitats on a sustainable basis is required to ensure survival. This may mean planning horizons in the vicinity of 100 years or greater. In terms of space, it is imperative that alternate refuge habitats be available in case of catastrophic habitat loss (fire etc). The landscape must be a large enough area to allow for landscape dynamics and alternate habitat provision (in the case of habitat replacement or caribou displacement). Only in highly exceptional environments would we agree that habitat is forever and the values can be maintained in perpetuity without replacement or alternate habitats being required.

Within areas that meet their need for security, caribou select habitats for foraging based on relative abundance, quality and distribution of seasonal forage resources such as lichen in the winter and a wide variety of foods in the summer. In terms of time, lichen establishment, regeneration, and growth requires a minimum of 40 to 80 years depending on growth rates after fire. Relative growth

rates vary dramatically with substrate type, associated forest tree species and relative humanity. There may be an upper end to the lichen availability window but the duration of lichen availability may be quite site-dependent. Clustering or aggregation of the forage resource is best located within secure environments but may be successfully utilized in many different spatial arrangements.

This relationship between scale for security and scale for forage appears to hold across the country but with many local variations due to the unique expression of ecological context; topography, bedrock geology, hydrology, surficial geology and ecological parameters such as species, growth and succession rates, fire disturbance regime, non-fire disturbance regime and human disturbance regime.

Forage Resources (food)

- Quality and quantity during both winter and summer is a main factor influencing caribou distribution across ranges.
- There was general concurrence that the importance of winter diet, energetics and the importance of lichens is well established in the scientific literature. We have a reasonable understanding of lichen ecology and growth rates.
- There was agreement that our knowledge of summer diet and food quality is limited.
- There was some question as to whether you would find caribou where there was no lichen. We know we find caribou where there is extremely limited lichen resources on the Slate Islands but generally caribou aggregate where forage is most abundant and where security is provided at a larger spatial scale.

Natural Disturbance (e.g., fire, blow down)

- Fire frequency, extent and severity of wild fire affect caribou habitat selection and behaviour. These ultimately influence the abundance and interspersion (configuration) of age classes and size of area used by caribou (and the inherent connectivity). Caribou do not necessarily immediately move out of recently burned areas, but may have declining levels of use for several years after a burn.
- Fire may, over the long term be an important habitat renewal mechanism.
- Age class distribution of forests associated with the disturbance regime combines with the distribution and abundance of vegetation types associated with peatlands and droughty or impoverished soils to influence caribou habitat selection and movement.
- Storm damage and insects may also affect successional pathways resulting in less suitable forest types, as well as reduced visibility and caribou mobility, ultimately influencing caribou distribution and movement.
- The major impact of forest fire is the reduction in lichen availability, but some question how important lichen is to habitat selection. Many consider lichen availability to be secondary to security.

- Recovery of abundant terrestrial lichens may be fairly rapid (50 years) but may be much longer depending on climate and local context (Alberta is generally longer; NFLD may be shorter). Arboreal lichen regeneration may take a longer period of tome to regenerate than terrestrial lichen.
- There was agreement that caribou re-colonize naturally disturbed areas when a stand reaches ~50 years of age (variable with the forest growth rates and ecology in different eco-climatic zones) but there is some debate and uncertainty as to why it may take ~50 years for caribou to re-colonize disturbed areas and why do caribou exhibit fidelity for disturbed areas for ~ 5 years following disturbance.
- Scientific understanding is acceptable for lichen re-colonization after disturbance and the effects of fire on forest condition. We do not understand why there is some fidelity to areas for up to 5 years and why it take 50 years for caribou to regenerate lichen – rich forest conditions that caribou will use for winter forage.

Human Activities

- There was agreement that caribou avoid areas of human activity beyond the physical extent of the activity. There is not adequate documentation of direct human activity impacts on caribou but a minimally acceptable evidence on indirect effects of human activity (cumulative impacts). Indirect impacts of roads, noise, vehicle traffic, air traffic and other summer and winter human activities needs further study.
- There are outstanding questions on 1) what level of human activity caribou can tolerate; 2) how long following human activity caribou will re-occupy an area (e.g. what is the temporal scale associated with the regeneration / restoration of seismic lines such that caribou re-occupy them) and 3) what is the longevity of cumulative effects with respect to caribou avoidance?

Predators/Alternate Prey

- All agreed that predators (density and distribution) affect the distribution and movement behaviour of caribou.
- Availability of security-providing habitats (forest types, physical features and scale dependent structure of the environment) also influence distribution and movement behaviour of caribou and facilitate resting and predator avoidance
- There is abundant scientific information on how predators affect occurrence and distribution of caribou, alternate prey hypothesis, low calf recruitment in areas of high predation and caribou being affected by predator densities.
- There is not enough hard evidence on alternate prey hypothesis, how predators affect habitat selection and the extent to which predators lead to extirpation. There are outstanding questions on how predators affect the selection of habitat (It is inferred that predators affect the habitat selection of caribou during the calving period, but there is little scientific evidence) and how caribou are influenced by predator densities.
- Alternate prey hypothesis may not work in all areas.

Landscape Characteristics

- Terrain features, spatial arrangement of habitat, soils texture, nutrient levels and forest land productivity influence the distribution and movement behaviour of caribou.
- All agreed in principle that caribou require connectedness between areas of use.
- There was disagreement that caribou need large, contiguous tracts of old-growth forest (forest of specific age or structural attributes?).
- There is abundant scientific information on the requirement for larger tracts of older forest or peatlands (agreement in principle).
- There is insufficient information to guide management of connectivity / corridor development between protected areas, thresholds to fragmentation and what constitutes a barrier.
- There is a need for additional science addressing the characteristics of barriers to movement or the connectivity / corridors that facilitate movement.

Forest harvesting

- Caribou avoid areas of harvest (exception may be peatland forestry such as in northeastern Ontario
- Techniques that reduce lichen availability likely reduce caribou use.
- Forest stand conversion to mixedwoods will ultimately lead to increased caribou mortality rates (increase in alternate prey abundance).
- Suspect prey abundance thresholds in areas with low ungulate densities.

Disease

- Uncertain to what extent disease influences caribou habitat selection and / or movement, but general recognition that it could influence caribou population densities.

Environmental Conditions (e.g., snow depth)

- Agreed that snow depth and crusting affect behaviour (cratering and foraging).

Factors Important for the Persistence of Caribou on a Dynamic Landscape (Sustainable Habitat Supply)

- Have to be able to maintain some designated (x%) of landscape in suitable condition such as older forests or peatlands. The X% depends on the local abiotic and biotic factors affecting habitat dynamics such as productivity and fire regime. The scale of management will depend upon the scale of the ecological context that determine the natural processes (such as fire regime etc).
- Have to be able to maintain functional connectivity to facilitate metapopulation dynamics.

- Forest dynamics influences significant functional relationships such as predator avoidance (proximity to disturbance) proximity to other caribou populations and alternate habitat availability.
- Ultimately, metapopulation dynamics is facilitated by regional connectivity, large blocks of habitat and proximity to source populations.
- Special features to be satisfied across a dynamic landscape:
    - Late winter habitat,
    - Older forest conditions,
    - Low diversity forest conditions,
    - Long time periods consistent with forest disturbance regime associated with forest type,
    - Large areas that can provide for refuge, forage and alternate habitats within the existing disturbance regime, and
    - Calving sites with low predator numbers or high escape values.

Time and Space

- Ecological functions important to caribou operate on different spatial and temporal scales. Security from predators as provided by the bio-physical attributes of the landscape tend to operate at large spatial and temporal scales as opposed to foraging which tends to operate a smaller spatial scales but possibly still long temporal scales (it takes a long time for lichen to become established after forest harvesting or fire). In terms of caribou biology habitat must be examined in terms of multiple generations.
- There is a need to ensure planning is contiguous for all habitat supply areas (forest dynamics consistent). May need a 2/3 rule (or some other prescribed proportion) where caribou habitat is kept in suitable condition across a range (to be defined based on desired spatial scale.
- The habitat time-window is determined by the natural processes and ecological context, particularly with the fire cycles, the successional pathways and the rates of establishment, growth, maturation and decline of lichen biomass in forest stands used for winter habitat.
- Appropriate time scale for management may be a minimum of 1 fire cycle in many areas but it might be measured by multiple generations of caribou in other areas with exceptionally long fire cycles such as the HBL.
- There are major differences across the country on the ecological context within which caribou exist. This includes more peat and less lakes in Alberta, less fire in Labrador and various balance between forest and peatland habitats. There is a substantial difference in vegetation growth forest.

Major Assumptions about caribou persistence on a dynamic Landscape

- Caribou will return to areas that have been disturbed by fire or forestry operations when conditions are restored to “suitable” status.
- Habitat restoration and management must include forage, predators and predator prey relationships.
- Caribou are limited by predation almost everywhere.

- Caribou may occupy sub-optimal habitat.
- Development impacts caribou partly through influence on predator prey relationships. But we can sustain caribou and development together through aggressive alternate predator and prey management.
- Larger ranges are more stable; than smaller ranges (Alberta ?).

Session 3: Conserving Caribou on a Managed Land Base: Models of Mitigation

What are we trying to mitigate?

The discussion primarily focused on identifying the main causes of mortality for woodland caribou on managed landscapes across the boreal region. A number of direct threats to the animals were identified including direct mortality associated with legal and illegal harvests and the effects of anthropogenic activities on the animal's distribution, movement, reproduction and energetics. The group also recognized the importance of a number of indirect threats on the species including changes in habitat composition leading to reduced amount of high quality habitat, changes in abundance of ungulates and prey species, increased predation risk and overall community changes. Although indirect threats were considered to be significant, the group opted to focus the discussion on the direct causes of mortality and disturbance and associated mitigation measures.

Past research on woodland caribou has demonstrated that populations are limited by predators and significant research still focuses on the complex relationship between habitat changes, composition, size of ungulate populations, and predation rate on caribou. The group identified legal harvesting [subsistence, licensed and incidental] and poaching as important direct causes of mortality for woodland caribou. The number of animals harvested or poached from a given population varies across the country and can be significant (e.g. Red Wine Herd in Labrador). A number of factors contribute to the number of animals killed (by humans) including access to remote areas (roads, trails), increased visibility (cutovers) and better technology (snowmobiles, aircraft, GPS, telemetry, firearms). Other direct causes of mortality include road and railroad kills which are potentially more important during winter and are associated with road clearing and maintenance (the use of road salt). Finally, the capture and handling of animals associated with research activities were also identified as potential direct sources of mortality (see summary table below).

Among various sources of potential disruption, the group discussed the impact of aircraft, vehicles, hikers, skiers, as well as recreational, industrial and commercial development on the animal's distribution and movement on the landscape, on their energetics and food intake. Although the group discussed the potential impact of these anthropogenic activities on the animal's physiological / reproductive behavior and rates, it was concluded that these remained highly hypothetical.

What are the most desirable management/mitigation strategies?

A number of management and mitigation strategies have been put in place across the country to reduce direct mortality. The experience of the group led to the description of different management strategies and to an interesting discussion on their effectiveness (see summary table below).

For the direct mortality associated with legal harvesting practices, stewardship activities and management planning associated with some monitoring activities were seen as the most beneficial strategies. Stewardship activities have led to some great results in Labrador including a voluntary reduced subsistence harvest level on the Mealy Mountain herd. In other parts of the country, management (access or forestry) planning has led to better management of access roads and trails; sites retirement and rehabilitation immediately after logging. The group agreed that roads or access was highly detrimental to woodland caribou and fewer or no roads was highly desirable. The group also briefly discussed the influence of wildfire (both human and natural caused) and wildfire suppression on length of fire cycle, forest cover type, structure and distribution, as well as related access and potential fire salvage logging that may occur on portions of woodland caribou range.

For the direct mortality associated with poaching, stewardship activities and access and management planning activities didn't appear to be effective strategies. In some cases (with smaller herds), the poaching of only a few animals by one or a few individuals can be detrimental to the population and can only be stopped by legislated regulation measures, enforcement and compliance. Significant discussion ensued on the effectiveness of regulations vs stewardship, education and management planning strategies and examples were presented. The group concluded that although it is most favorable to develop strong relationships with users groups, and jointly develop land-use management strategies, sometimes these stewardship activities and shared management responsibilities over the resource aren't sufficient to protect the species. In such cases, stewardship activities need to be supported by strong enforcement measures. Many jurisdictions also control the release of telemetry data, they only release coarse data (imprecise locations) or simply don't release the information.

For animals killed on roads and railroads, access and management planning activities appear to be the most effective strategy to reduce the number of incidents. In cases where roads or railroads are not in place, planning contributes to decisions pertaining to the placement of such linear features and structures associated with the road construction. In cases of temporary roads,

the access plan often provides detailed information on the retirement and rehabilitation of these linear features. In cases where roads are already there, access planning is also important and contributes mitigation measures such as speed limit, road maintenance, clearing and traffic level. In cases where road mortality can be detrimental to the population (particularly with smaller herds), more aggressive measures can be put in place. The use of fences and travel conduits was mentioned as possible mitigation measures although none are in place or have been tested to date for woodland caribou.

For incidences of mortality associated with research activities, the group discussed different ways of minimizing animal's injuries or mortality primarily associated with the capture and handling. These include review of capture methods used by animal care committees and the use of trained capture teams. The use of non-invasive and less invasive techniques should be favourable where applicable.

Finally, for anthropogenic activities that lead to animal displacement and barriers to movement, planning can influence the location and timing of different activities on the landscape in order to minimize disturbances of the animals at a time of year when they are most sensitive to human activities (particularly winter range and calving sites).

Overall, the most important causes of direct mortality and disturbances revolved around access; the development of roads and trails in remote areas of the boreal landscape. The most effective management strategies appear to be the establishment of strong, local stewardship initiatives and the development of access management plan (providing the avoidance of certain areas, timing of activities and immediate site retirement and rehabilitation). There is no evidence that these strategies work, however, monitoring programs could be put in place to track mortality rates, changes in habitat use and population sizes. The management and mitigation strategies discussed by the group are direct and aim at effectively reducing direct mortality.

Since population data are not available for most woodland caribou herds across the country (except for Alberta), management and recovery actions are being applied with the full acknowledgement that the outcomes are totally uncertain. The group embraced the concept of adaptive management and the importance of a long-term vision for woodland caribou at the meta-population / landscape scale.

Session 3: Conserving Caribou on a Managed Land Base: Forestry

<u>What ecological impacts/pressures are you trying to mitigate?</u>

Woodland caribou are most often associated with large contiguous blocks of older coniferous forests and/or landscapes that have low suitability for alternate prey (moose, elk, deer). In most cases, forest harvest sets back forest succession in a manner that both eliminates lichens for a period of time (e.g. through clear cuts) and favors alternate prey. In turn, this is thought to increase

predator densities (particularly wolves). Consequently, the ecological impacts that managers must attempt to mitigate are:

1. The fragmentation of contiguous caribou habitat (older, intact coniferous forests).

2. The loss of high quality caribou patches (lichens).

3. The increase in habitat quality for alternate prey either on or adjacent to caribou habitat.

What are the most desirable strategies?

- Move the disturbance around in terms of time and space that provides for sufficient caribou habitat in the majority of their historic range at all times. This will often require that both the rotation age and the amount of timber extracted is significantly reduced over current practices.

- Lengthen the rotation age of the forest harvest. In many instances, the rotation age dictated by timber supply is too truncated to provide for good lichen recovery.

- If caribou habitat is to be logged, the general consensus is that it is better to log a few large patches, than to log many small ones. This strategy is directed at: minimizing fragmentation (should be fewer roads), minimizing the response by alternate prey (less “edge effect”) and once the block has grown back into caribou habitat (50 – 150 years depending on the ecosite), it will more closely resemble caribou habitat. Mimic the range of natural variation to a certain degree, but not in the extreme fire events. Set guidelines for the minimum amount of forest age and area required at any given time.

- Reduce that amount of time that logging is active in caribou range.

- Minimize roads – winter roads are best because of their short duration of use and minimal footprint. If all-season roads are necessary, access should be managed. Long-term access plans are desirable provided thresholds of road densities are established. Roads should avoid high caribou use areas; particularly those landscape features that are in short supply (e.g. eskers in large fen/bog complexes).

- Consideration must be given to providing an ample supply of lichens throughout caribou range so that they can move among patches and avoid predation. A long-term trajectory for lichen supply is required. High-value lichen areas must be remote from alternate prey habitat. [There was some discussion of managing for good lichen patches within a logged patchwork, but there is the concern that this could result in the establishment of population sink (i.e. an area where caribou still venture, but at a much increased risk to predation)].

- Use post-logging silviculture prescriptions that favor more rapid establishment of caribou habitat by: a) decreasing shrub response, b) speeding up succession and returning to a "caribou friendly" structural stage (not necessarily just forest age). However, it is recognized that this could have major ecologicial costs. All silviculture practices should be documented in order to be able to track those activities that are most productive for caribou.

What evidence do we have that these strategies might work?

Given how long it takes to regenerate woodland caribou habitat after disturbance, most of these strategies have not been tested. In general, we have a relatively good idea of what doesn't work. In Ontario, caribou are evenly distributed in those parts of the province where forest harvest hasn't occurred and they have been disappearing in those areas where logging is active. Woodland caribou avoided summer logging activity in Newfoundland (Chubbs et al. 1993). Likewise, migratory woodland caribou avoided both active and old cutblocks they encountered upon their return from alpine summer range to forested winter range in Alberta (Smith et a. 2001). Moreover, adult female woodland caribou survival in Alberta was negatively correlated with increasing densities of roads (both timber and oil and gas access) (Smith 2004). Most recently, forest management guidelines developed in Quebec recommend an ecosystem approach based on the protection of large forested blocks, the concentration of forest harvesting in large management blocks and the maintenance of habitat connectivity (Courtois et al. 2004). The majority of the strategies proposed have not been tested over a meaningful time period. Consequently, it must be understood that these are based on our understanding of the biology of woodland caribou and have a very high risk of failing, since no meaningful examples of success are available to date. The precautionary principle is paramount.

What is the appropriate scale to be applying this strategy?

As with the other workshop sessions, we recommend that the minimum planning area appropriate is at the woodland caribou herd range. An area larger than this is preferable and planning should occur for an entire forest rotation or fire cycle.

How do you evaluate success?

The most meaningful measurement of success is at the caribou population level. It is not sufficient to simply document changes in distribution, since caribou may continue to use an area after extensive disturbance, but suffer very high mortality. An annual total count of the population would be ideal; however, this is very difficult (or impossible) to achieve given the dense forest often inhabited by this species. Consequently, comparing recruitment with adult survival (though a minimum sample of 20 radio collared females) to track rate of increase or "lambda", is the next best population metric. Long-term monitoring is necessary to document success. Fecal DNA holds promise as a means of measuring population change without handling animals. Additionally, measuring alternate prey and predator population and distributional changes would be ideal (but an additional added expense).

At the larger scale**,** monitoring movements between herds is desirable. Combined with between herd measurements of genetic variability, this would provide a good measurement of corridor design (size and configuration). Most studies have concentrated collaring activity on females; however, young males are probably most likely to disperse, so increasing the sample of collared males would provide a better measure of between herd movements. Sustaining the current range of occupancy is one of the major goals in Ontario.

The maintenance of genetically viable populations would also provide a major cornerstone of success. This would require information from all herds within a population.

In the absence of any measurement of woodland caribou population response, measuring successional trajectories of the forest can provide some short-term assessment for portions of strategies.

Finally, it is important to mention that most jurisdictions subscribe to the notion of adaptive management, but few actually measure woodland caribou response to validate if strategies are working and to make further changes and re-test, if they are not. The cost of actually practicing adaptive management is not cheap, but the rewards are substantial.

Session 4: Conserving Caribou on a Managed Land Base: Maintenance of Genetic Connectivity

What are the best bets for maintaining connectivity on a dynamic, managed landscape?

Populations separated from continuous range may be reproductively isolated and generally occur in areas heavily fragmentation by human disturbance. While small populations may continue to exist in some areas, their long-term viability is questionable and management efforts are required to

strengthen the genetic connectivity between isolated range and more continuous range.

Our limited understanding of gene flow within and between populations represents an important knowledge gap requiring further research. Collaboration between scientists and managers to delineate populations and meta-populations, based on gene pool and movement patterns, would help identify geographic linkages and barriers between populations.

In developing management actions managers should distinguish between range with little or no fragmentation and range with relatively high fragmentation. An important initial action should be to assess the extent of connectivity both within and between ranges. Delineation of corridors should consider known distributions of caribou, critical habitat, and disturbances (harvesting, roads, etc). This will require identifying seasonal movement patterns of animals within home ranges, including evidence of association or common use of corridors by multiple animals. Identifying movement of animals between populations may require tracking males in regions where males more commonly disperse between populations or sub-groups. Definitions and delineation of corridors should reflect the nature of habitat selection observed in relevant scale domains.

The extent of fragmentation will limit availability of suitable corridors and long-term land use planning in an area should be complemented with corridor development. Potential corridors should be prioritized based on animal distribution and movement patterns, size of available corridors, magnitude of disturbance, and population viability. The potential for success of any strategy needs to be weighted against costs as corridor development may require extensive changes to land use planning.

Within Range Strategies

Seasonal movement of caribou within annual ranges may facilitate reproduction, predator avoidance and access to forage. Priority should be given to caribou corridor development in a landscape context and large protected areas are generally more favorable than small corridors. Consideration of current parks or protected areas overlapping or adjacent to caribou range would complement corridor development and help harmonize land use planning at a landscape scale.

Concentrating disturbances both spatially and temporally would help minimize barriers to movement induced by the cumulative effects of disturbance. Requirements to constrain disturbance events would partly depend on the degree of connectivity within ranges, population viability, and factors limiting to caribou in the area.

Roads are an important source of fragmentation, creating direct barriers, as well as, habitat loss due to land conversion. The development of long-term road management strategies is highly recommended, with consideration given to road density, primary access road location, and road access control or decommissioning. Permanent all season roads are of greater long-term impact than winter roads.

Where available, telemetry data should be used to identify movement corridors, as well as, to aid in the development of predictive models for delineating habitat that facilitates movement.

Knowledge Gaps:

Our understanding of the importance of male caribou movement to gene flow is limited and further research in this area is recommended. Further research is required to apply the concept of minimum dynamic areas to caribou management. development and validation of habitat supply and cumulative effects models would aid in defining threshold disturbance levels and identification of the necessary size of protected areas.

Among Range Strategies

Generally, the greater the distance between ranges, the greater the width of corridor needed to facilitate movement between populations. Habitat structural attributes are an important aspect of corridor delineation. Small caribou populations are particularly vulnerable to extirpation if large distances separate ranges and fragmentation is extensive. It is recognized that effective management of a group of ranges over the long term may require a comprehensive approach to risk management across the habitat matrix including the area between and within ranges.

Corridor development to improve connectivity among adjacent populations (meta-populations) should be complemented with efforts to increase population size. Population viability analysis should be considered. It is recommended that managers evaluate the use of translocation as a means for population re-establishment or augmentation (“Holiday Rut”). Potential benefits include increases to both genetic diversity and reproductive rates. The role of predator control for isolated populations in sever risk of extirpation should be considered. Managers should attempt to reduce mortality rate (predation risk) in corridors connecting populations. Habitat management and minimizing predators and alternate prey would facilitate maintenance of effective corridor structure/function between populations.

Where appropriate data exists (e.g. telemetry data/habitat inventory), predictive models should be developed to rank and map potential corridors. Large protected areas should be identified, corresponding to minimum dynamic areas required to facilitate movement between ranges. Dynamic simulation modeling could be used to explore different scenarios and the potential effects of different corridor widths.

Knowledge Gaps

Knowledge of gene flow between populations is limited and requires further research. The importance of predation on male caribou in movement corridors between populations is unknown.

Session 4: Conserving Caribou on a Managed Land Base: Linear Features

Causes of Potential Impacts

Linear features have the potential to reduce caribou survival and recruitment, thereby reducing population growth rates in a variety of ways. Linear features can increase predation on caribou by: 1) increasing predator efficiency, through improved access, and 2) producing vegetation and access conducive to deer and moose which could increase predator numbers. The construction of linear features can reduce habitat directly through the removal of lichen supporting trees and indirectly by causing caribou to avoid disturbances from machinery and people. Access created by linear features can increase human caused caribou kills though hunting (legal and illegal) and vehicle collisions. This access can also lead the way for other resource developments which may be detrimental to caribou, e.g., logging.

Mitigation

Access Management

Given the difficulty in returning linear features to their pre-disturbed structure, reducing the number and intrusiveness of the linear features is the first step in caribou conservation. This would involve coordination between resources users that require linear features. Multiple groups would use as many of the same features as possible rather than each group building several linear features in the same general area. The linear features should be less intrusive, e.g., winter roads rather than permanent roads. When these features are no longer required, efforts should be made to return them to their pre-disturbed structure through planting and prohibiting human access as much as possible.

This planning should be conducted at large spatial scales, at least the size of the population range with a buffer. Broad planning must be done on a long temporal scale, e.g., 20 years, but updated with specific plans on shorter time frames, e.g., yearly.

Alternate Prey Management

Reducing vegetation structures (e.g., early successional hardwoods) required by alternate prey (e.g., moose and deer), should prevent caribou predator densities from increasing to an unnatural level. A second option would be to increase hunting pressure on the alternate prey. Given that the number of people participating in hunting varies regionally and appears to be declining in recent years, the effectiveness of this option may be questionable. Both options should be done before predator numbers increase, if not the reduction in alternate prey may increase predation on caribou. Otherwise this should be done in conjunction with predator management. It is important that the effectiveness of these methods be heavily monitored.

This planning should be conducted at spatial scales similar to that of predator movements and commence as soon as possible after linear features are no longer required.

Reducing human hunting

In addition to limiting human access described above, human hunting on endangered herds should be reduced primarily though education and stewardship but also through appropriate legislation and enforcement. This planning should be conducted at large spatial scales, at least the size of the population range. Education, stewardship and legislation should be commenced prior to developments.

Predator Management

In severe cases where caribou densities are extremely low and their predator numbers are quite healthy, a final option may be to actively reduce predator numbers principally through hunting and trapping. This planning should be conducted at spatial scales that of predator movements and only as a last resort.

Education

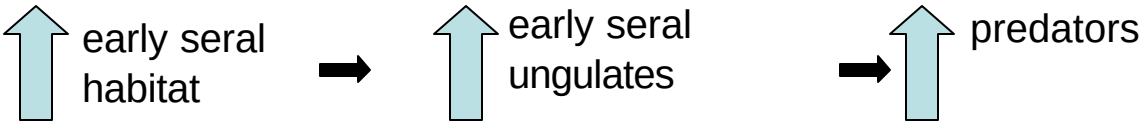
Public education is an important tool in implementing these strategies. With an educated public that understands the current status of caribou and their importance, it would be easier to have coordination between resource users to reduce linear features, to rehabilitate roads once finished and to effect alternate prey and predator management.

<u>How do you evaluate success?</u>

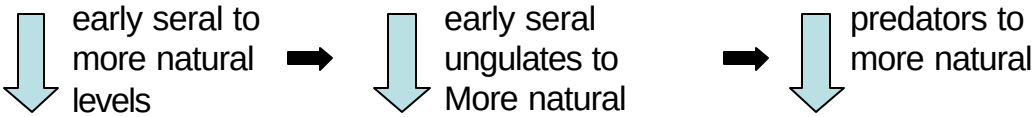
Although the ultimate measure of success is population size and rate of increase, these measures may be affected by factors other than those caused by linear features. Further, it may take some time before effects of our management can been seen at this level. Therefore, it is important to also monitor short-term, more localized goals. Examples include, the number of linear features per development, rate of regeneration on linear features, number of caribou kills (human and nonhuman), and alternate prey and predator densities.

Session 4: Conserving Caribou on a Managed Land Base: Predator Management

Human alteration of habitat has resulted in an increased predator response negatively impacting woodland caribou. The following graphic describes a simplistic interpretation of how this works:



The group agreed that the first approach to reducing the impact of predation on caribou is to deal with the habitat issue first.



More intensive silviculture practices may be required in some locales to manage the species composition, structure and successional trajectory of early seral habitats. Practices may be expected to vary due to caribou population status or management concerns. Stand conversion may not be as much an issue in some jurisdictions (NE Ontario peatland complexes) as in other jurisdictions where the forested landscape may provide a wider variety of response options (Manitoba, Alberta and Northwestern Ontario). Silviculture may be a valuable tool in managing the quality and quantity and distribution of habitats preferred by other ungulate species.

There is a need to ensure the recovery of linear corridors such as seismic lines and roadways. Examples include physical removal of roads, tree planting in seismic corridors or on roads, etc. The establishment of new linear corridors (eg. transmission lines) will require serious review to prevent them from being located near critical caribou habitats (eg. calving and wintering areas). Current maintenance along transmission line corridors includes spraying or bulldozing (during winter) to remove tree and shrub growth. Perhaps alternative methods are required to allow the growth of plants to reduce the line of sight for predators.

The group discussed the management of predators under two themes – managing predators directly and managing alternative prey species.

<u>Predator Management</u>

Published data does exist to confirm predator impacts on caribou – B.C., Alta, Ont and Qué. However, the extent of the impacts of some predators (eg. black bear) is less known. Predators include wolves, coyotes, bear (black, grizzly), cougar, lynx, wolverine and eagles (bald, golden).

It was agreed that predator control should only be considered as a last resort and only as an interim measure until woodland caribou habitat has been recovered or restored. Predator control may be lethal or non-lethal. Direct predator management should only be considered on a site-specific basis and not broadly applied across a broad landscape. Therefore, it may be most appropriate when dealing with small herds (100 animals or less) and / or declining populations. Predator management may be important in situations where calves are the prime predator target causing reduced recruitment. Under such circumstances one available technique is to drive pregnant females into pens prior to calving and then release them once the calves are strong enough and have a greater chance of survival.

Predator control may also be accomplished through increased trapping or hunting opportunities as opposed to direct elimination. It was suggested that the imposition of bounties was not a preferred option (unless the situation was dire) as this might lead to unwarranted alteration of predator populations and extreme public opposition.

We urge caution that the use of predator control as a management tool could lead to requests for further predator control. The group stressed that prior to the implementation of any predator management there was a need to obtain the scientific data to ensure that predators were indeed the problem and that there was sufficient justification to carry out some form of predator control. Questions about implementation of predator management include:

- What would be the time frame for implementation?
- How would political approval be obtained to even consider this as a tool?

National, provincial or territorial recovery strategies may provide the mechanism by which predator control could be an option.

Other forms of predator management may be to reduce alternate forage options. For example, dumps (which are used by wolves and bears) should be reduced and established away from critical caribou habitats. Commercial fish operations can also have an impact as waste fish remains attract scavenging predators. On the other hand, there is evidence that a fish parasite may cause a reduction in wolf numbers.

Alternate Prey Species Management

In most jurisdictions, the decline of caribou can be attributed to an increase in the population of alternate prey species, primarily other ungulates (moose, deer, elk) that prefer early seral habitats. This in turn has resulted in an increase in predation on caribou. On the other hand, there are examples (i.e. Yukon) where an increase in ungulates (eg. moose) has resulted in a decrease in caribou predation. Increased numbers of beaver may result in increased numbers of predators which can be negative to caribou. This can be alleviated by

promoting an increased trapping effort but this appears to be a problem in most jurisdictions because of low pelt prices and the effort required to trap beaver.

In some jurisdictions, Newfoundland/Labrador, NE Manitoba and Northwest Territories, the large herds of transient caribou are the alternative prey species which can result in increased predation on local sedentary populations. Increased hunting effort on these larger herds can result in incidental hunting mortality of animals from the local sedentary herds.

Increased hunting effort on alternate prey species may result in a reduction of numbers but the group cautioned that there may be some time lag where reduced numbers of other ungulates may result in increased predation on caribou. In addition, an increase in caribou density as other ungulate densities decrease may also result in increased predation. Restricting caribou populations to smaller ranges may also increase the chances of predation. This complex interaction among species and predation relationships suggests a rigorous analysis is in order prior to direct management of alternate prey species to achieve desirable caribou population responses.

It is imperative to understand the underlying cause of the reduction in caribou numbers before either option of predator control or alternate prey species management can be considered. There is the social issue of valuing one species over another. There is no one solution that can be applied across caribou range but it is apparent that habitat management should be the main focus to ensure the survival of local caribou herds.

Appendix A: Expert Session Agenda

April 25
20:00 – 22:00 Registration and ice breaker for Expert Sessions:

April 26

07:30 Coffee

Opening Plenary
8:00 – 08:30 Opening comments, overview of workshop objectives, introduction of participants, introduction to the case studies which collectively address the translation of science and policy into management actions. Case studies are approximately 45 min including a minimum of 10 minutes for questions. (Mike Waldrum & Gerry Racey

08:30 – 09:15 Case study 1: Alberta: taking a broad view: cumulative impacts and the footprint model (Troy Sorensen)

09:15 – 10:00 Case study 2: Ontario: applying general forest landscape guidelines to forest management planning (Glen Hooper and Gerry Racey)

10:00 - 10:30 Coffee Break

10:30 – 11:15 Case study 3: Labrador (Robert Otto)

11:15 – 12:00 Overview to the National Caribou Recovery Strategy and emerging issues and challenges (Mary Rothfels).

12:00 – 13:00 Lunch

13:00 – 13:15 Introduction to Working Groups: Breakout sessions will be assigned and more than one group may be dealing with each topic but each group may only deal with a subset of topics. Topics are progressive with the results of earlier sessions influencing following sessions. Time lines are deliberately tight to force advancement through topics.

13:15 – 14:45 Working Session # 1: Caribou habitat on a dynamic landscape (anticipate discussions around caribou response to disturbance regimes, connectivity, productivity and succession)

14:45 – 15:00 Break

15:00 – 16:30 Working Session # 2: Dealing with space and time in defining conservation strategies. Many biologists would suggest that space is one of the most

important components of habitat. If this is true then how do we use the concept of space and time in a defining, describing or managing habitat for boreal caribou?

16:30-17:00 Plenary Session: Feedback from working sessions 1 & 2

17:00 Adjourn for Supper

19:30 – 21:00 Evening show and tell session: This is an opportunity to provide brief (10 minute) presentations or updates on caribou conservation related items biology, management, issues etc.) Notify organizers if there is something you would like to show or present.

April 27

07:45 Coffee

08:00 – 08:15 Introduction to morning sessions (recap major findings from previous day)

08:15 – 09:45 Working Session # 3: Conserving caribou on a managed land base (1) Models of Mitigation: ecological perspectives on mitigating industrial or recreational activities (forest harvest and regeneration, roads, seismic lines, hydro corridors, human activity centres (drilling sites, mine sites, etc).

09:45 – 10:00 Break

10:00 – 11:30 Working Session # 4: Conserving caribou on a managed land base (2) Specific management issues and caribou conservation.

11:30- 12:00 Plenary Session: Receive and review feedback from working sessions 3 & 4

12:00 – 13:00 Lunch

13:00 – 14:30 Working Session # 5: The big picture: cumulative effects, evaluating effectiveness and working with insufficient information.

14:30 – 14:45 Break

14:45 - 16:30 Closing Plenary: Presentation by session representatives on common areas of agreement or recognized challenges identified in the expert working sessions.
Recap of workshop results. Recommendation on what components should be shared with the public session.

Appendix B: Participant List

Brown, Glen	Tembec, Timmons
Biasutti, Marina	Innu Nation Environment Office
Boutin, Stan	U of A
Collins, Gene	MB Conservation
Crichton, Vince	MB Conservation
Cross, Dale	MB Conservation
Doucet, Christine	NL Govt
Frandsen, Dan	Prince Albert National Park
Gauthier, Mick	ON Ministry of Nat. Res.
Hagglund, Brian	Oak Hammock Marsh
Hatter, Ian	Govt of BC
Hedman, Darryll	MB Conservation
Hooper, Glen	Ontario Government
Johnson, Deborah	Govt of North West Territories
Jones, Elena	U of Northern BC
Leavesley, Kelly	MB Conservation
Manseau, Micheline	Parks Canada
Mitchell, Greg	Labrador Metis Nation
Moreland, Fiona	Prince Albert National Park
Morgantini, Luigi	Weyerhauser
McNay, Scott	Wildlife Infometrics Inc
Phillips, Frank	Govt of Labrador
Prior, Kent	Parks Canada
Racey, Gerry	Ministry of Natural Resources
Reynolds, Hal	Can Wildlife Service
Rodgers, Arthur	On Ministry of Natural Resources
Rothfels, Mary	CWS
Schaefer, Jim	Dept of Biology, Trent University
Schindler, Doug	U of W
Schmiegelow, Fiona	U of A
Seip, Dale	Northern Interior Forest Region
Simon, Neal	Dept of Natural Resources
Sorensen, Troy	Fish & Wildlife, AB Govt
Smith, Kirby	AB Fisheries & Wildlife
Taylor, Mark	Amec Earth & Environmental
Trottier, Tim	Sask Govt - SERM
Waldram, J Mike	MBMF
Whaley, Kent	MB Conservation

<u>Appendix D</u>: Summary presentation delivered April 28, 2005

Report from the Caribou Workshops

April 26 & 27 2005

Gerry Racey
Ian Hatter
Kent Whaley

Expert Workshops

- 39 participants
  - Government (policy, science and management)
  - Academia
  - Industry biologists
  - Consultants
  - Members of the Boreal Caribou Technical Advisory Committee
- National Representation
  - Newfoundland
  - Ontario
  - Manitoba
  - Saskatchewan
  - Alberta
  - British Columbia
  - Northwest Territories

Workshop Objectives

- Share knowledge and experience between jurisdictions
  - Interpreting the science
  - Application of policy and management
  - Ecological and social context of caribou conservation
- Convergence and consensus where possible
- Understanding of unique ecological conditions and circumstances where they exist.

Synopsis

- Caribou have lived on the Canadian landscape for thousands of years
- Decline is related to human activity
- Conservation of boreal caribou will require us to modify our expectations in the use of our boreal landscape and it's resources

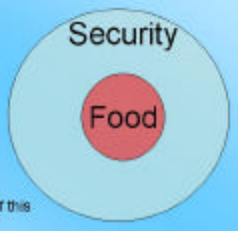
Synopsis

Security is provided at a broad landscape scale

Major factor determining caribou distribution

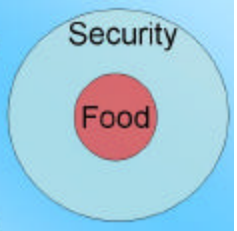
Caribou have behavioural adaptations to use this landscape efficiently

Foraging habitat is a subset of this landscape



Synopsis

- This relationship holds across Canada
- Expression of this relationship depends on the ecological context of specific herds:
  - Topography
  - Geology
  - Hydrology
  - Ecoregional forest parameters such as:
    - Species composition
    - Growth rates
    - Disturbance regime
- Appropriate management approaches are constructed within this context.



Sustainable Habitat Supply

- Spatial scale large enough to account for
  - Forest landscape dynamics
  - Alternate habitats
- Temporal scale long enough to account for
  - Disturbance regime
  - Successional changes and
  - Multiple generations of caribou
- Management is at the population level and measures of success must reflect population health

Importance of Monitoring

- Endorse an adaptive approach
- Recognize the importance of monitoring
  - Population health
  - Factors expected to directly affect population health
  - Effectiveness of management actions

Decisions are made in presence of the best information available

Human Impacts

Direct and Indirect Influences

- Mortality, reproduction, displacement, energetics and behavioural effects
  - Hunting
  - Road and Rail Kills
  - Industrial Development
    - Habitat Fragmentation
    - Alteration of predator-prey dynamics
  - Recreational Use
  - Research

Human Impacts

Key Messages

1. Humans have both subtle and overt impacts on energetics, behaviour and habitat that place caribou at risk.
2. Need for an educated and involved public to minimize risk e.g. avoidance of snowmobile trails through critical winter habitat.
3. Human impacts and access are related.

Habitat Connectivity

- Ecological role is access to important habitats and "space" to avoid predators.
- Need to ensure connectivity between seasonal ranges of a herd as well as between herds (genetic integrity).
- Best bet for ensuring connectivity is maintenance of functional caribou habitat across large landscapes (measures could include PA's, harvest deferrals)

Habitat Connectivity

Key Messages

1. Before Fragmented Landscape
   - Basic Research – core habitats, seasonal movements, predictive habitat maps
   - Habitat Planning – identify and protect movement corridors and core ranges
2. After Landscape Fragmented
   - Habitat Restoration
     - Linear features
     - Silvicultural techniques
     - Monitoring to ensure connectivity

Habitat Connectivity

Key Messages (cont'd)

3. Caribou require large intact areas both between season ranges (matrix habitat) and between herds (dispersal corridors).
4. Connectivity is essential to ensure gene flow, and to avoid inbreeding.
5. Movement routes must provide suitable habitat that reduces predation risk.

Linear Features

- Includes roads, seismic lines, oil wells, power lines, pipelines, etc.
- Direct and Indirect Influences, e.g.
  - Roads increase predator efficiency, poaching
  - Habitat avoidance and habitat loss from seismic lines.
  - Alteration of natural predator-prey relationships

Linear Features

Key Messages:

1. Recognize there is no "natural" analogy to roads.
2. There is likely a threshold of linear disturbance (density), above which caribou can no longer compensate, and herds decline.
3. Essential to have a long term access management plan for the development of industrial linear features.

Linear Features

Key Messages (Cont'd)

4. Consolidate footprint of industrial activities on landscape (e.g. mining/forestry roads)
5. Use low impact technology, e.g. seismic.
6. Reduce permanency of linear features (e.g. winter roads, deactivate and rehab roads, removal of culverts, etc.)

Forestry

- Forest harvesting can alter large portions of caribou habitat.
- Logging fragments caribou range and displaces caribou.
- Experience by managers indicates that caribou do not persist in logged forests.
- Large home ranges and low caribou densities requires management at large landscape scale.

Forestry

Key Messages

1. Minimize conversion of caribou habitat into early seral habitat: leads to more ungulate prey and predator numbers.
2. Cumulative disturbance of forest harvesting and fire should not exceed levels of natural disturbance across caribou range.
3. Successional cycling of habitat is required for caribou persistence on landscape.
4. Lichen habitat embedded in large landscape

Protected Areas

- Protected areas can include designated lands, i.e. fed. and prov. parks, park reserves, ASI, ecological reserves, etc., and temporary reserves or deferred harvest areas.
- Protected area initiatives occur in many jurisdictions across the boreal forest – provides opportunity to incorporate PA's into caribou management strategies.

Protected Areas

Key Messages

1. PA's have role in caribou conservation, but requires collaboration and strategic analysis.
2. PA network should consider connectivity in order to aid caribou conservation.
3. Organizations involved in PA establishment should consider caribou habitat requirements as part of their selection criteria.
4. If PA's are established specifically for caribou, conservation is provided by combination of PA's and managed landbase.

Predation

- Predation is the major cause of caribou mortality, due largely to human alteration of habitat (early seral) that changes predator-prey relationships.
- Clear understanding that predator control as a management tool is highly controversial
- Predation risk is presumed to increase with habitat loss, and increased linear features.

Predation

Key Messages

1. Use of predator control employed as last resort to save critically endangered populations.
2. Must show all other efforts including habitat mgmt, control of alternate prey species and habitat recovery efforts have proven inadequate.
3. Predator control employed only as an interim measure.
4. Practiced in very few jurisdictions as a recovery tool.
5. Huge public sensitivity and go/no-go decision never undertaken without public vetting and political support.

Questions?