2009 Tåîchô Government and Government of Northwest Territories Joint Proposal on Caribou Management Actions in Wek'èezhìi: an independent technical review for the Wek'èezhìi Renewable Resource Board

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Executive summary

The Tåîchô Government's and Government of Northwest Territories submitted a Joint Proposal on Caribou Management Actions to the Wek'èezhìi Renewable Resource Board. As part of preparation for public hearings on the proposal, WRRB requested that I technically review the Joint Proposal. The joint proposal is a response to the recent and rapid decline of the Bathurst caribou herd. The proposal concludes that if hunting continued at 2008/09 levels, the herd may be eliminated in 4-5 years. The Joint Proposal's actions for recovery are focused on restricting hunting and re-evaluating caribou abundance in 3 years after a census in 2012.

The actions listed in the recovery plan are unlikely to be effective in meeting the proposal's goal "for the most rapid recovery" of the herd. The Department of Environment and Natural Resources (ENR) computer modeling acknowledges that restricting hunting alone is unlikely to lead to sufficient recovery to be detectable through a census of herd size by 2012. The reasons are two-fold. Firstly, the extent of recovery depends on other and interacting factors including how weather influences pregnancy rates and calf survival. Environmental trends on the Bathurst herd's range are likely to increase variability in, for example, pregnancy rates. Age structure and natural mortality especially predation are other factors that will likely reduce initial rates of recovery.

Secondly, a census is insensitive to small changes in herd size (10-15%). This means that reliance on a census in 3 years to re-evaluate herd abundance is risky as it may not discriminate between whether the herd is declining, stable or recovering.

The risk of failing to detect changes in herd size is accentuated as the Joint Proposal offers no proposed use of monitoring to index changes in herd size as 'an early warning' whether management actions are sufficient or need to be intensified. Unless criteria are established for annual monitoring to index likely direction of change in herd size, opportunities for timely intervention may be lost.

The Joint Proposal depends on restricting hunting to enable recovery for the Bathurst herd within only 3 years. But those actions restricting most of the hunting are unilateral which raises questions about their effectiveness. The Joint Proposal offers no flexibility or trade-offs to encourage collaboration for herd recovery in the context of co-management. Caribou and people have an age-old relationship and people have over time acquired knowledge and rules about living with changes in caribou abundance. Yet the Joint Proposal does not draw on this knowledge. Recovery and management planning that are not well-supported by the people most affected, are less likely to be successful.

The proposal lacks objectives with criteria to measure success or failure of the management actions. This in turn relates to how the monitoring actions measure the effectiveness of the hunting restrictions and the likelihood of recovery. The details for how some actions will be implemented is vague and the effects of shifting hunting to the neighbouring, and declining, Bluenose East and Ahiak herds are uncertain, especially in the absence of risk analyses.

Experience with other caribou herds underlines that more than one management action for reducing caribou deaths increases the probability of successful recovery. In the Fortymile caribou herd, for example, hunting restrictions did not increase herd size at the expected rate until predation and environmental variation were included. Relying on more than one approach to increase adult survival also opens the possibility for trade-offs – for example, accentuated hunting of wolves would offset a low level of harvesting and or to buffer possible effects of trends in the environment such as weather. An additional point about the recovery of the Fortymile herd is that recovery takes time (decades).

Introduction

The Tåîchô Government and Government of Northwest Territories submitted their 'Joint Proposal on Caribou Management Actions in Wek'èezhìi' to the Wek'èezhìi Renewable Resources Board on 5 November 2009. The proposal is a response to the recent (2006-09) and rapid decline of the Bathurst herd. The Joint Proposal lists nine management actions and monitoring for the Bathurst and its two neighbouring herds (Ahiak and Bluenose East).

Basis for technical review

WRRB requested that I act as an independent expert and critically review the management actions and monitoring outlined in the Joint Proposal[1]. For that review, I assessed whether the Joint Proposal clearly presented the recovery actions with supporting arguments from a technical/scientific standpoint.

As the proposal lacked technical details, I drafted Information Requests to Environment and Natural Resources, GNWT, on 3 December 2009. ENR's responses to the Information Requests were posted 5 January 2009. I have also referred to ENR's Technical Report[2] summarizing technical information which was placed on WRRB's public registry 18 December 2009.

The Joint Proposal is a recovery plan. If hunting continued at 2008/09 levels, the herd could be eliminated in 4-5 years[3]. The rate of decline of the Bathurst herd exceeds the Committee On the Status of Wildlife In Canada's criteria for "Endangered" (a decline >50% in 10 years). Those two points emphasis the risk to the herd and the heightened need for actions to stem the current rate of decline and promote recovery.

In reviewing the Joint Proposal, I looked at recent wildlife and fisheries management approaches to recovery planning. The practical understanding of recovery from fisheries management is that recovery depends on the extent of the decline, weather and working with fishermen (Appendix A). In wildlife management and conservation biology, contemporary attention is toward learning from management activities through monitoring and feedback (adaptive management) and toward a more collaborative approach (Appendix B).

This technical review refers to solutions used elsewhere in rebuilding caribou herds. The decline of the Bathurst and its neighbouring herds is part of a general circumpolar trend

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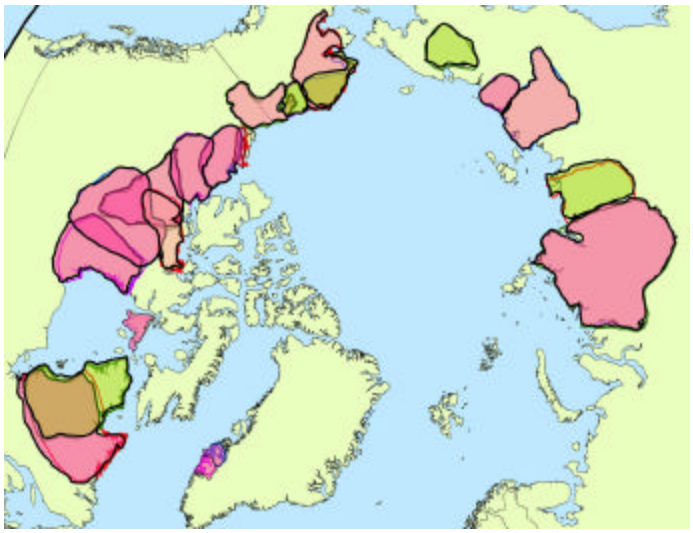
[1] wrrb.ca/public registry/WRRB Anne Gunn expert advisor 18 Nov 2009.pdf

[2] Adamczewski, J., J. Boulanger, B. Croft, D. Cluff, B. Elkin, J. Nishi, A. Kelly, A. D.'Hont, and C. Nicolson. 2009. Decline in the Bathurst caribou herd 2006-2009: a technical evaluation of field data and modeling. Department of Environment and Natural Resources, draft technical report

in migratory tundra caribou[3]. The map shows 19 major herds of barren-ground caribou in Russia, Canada, Alaska, Greenland. Most herds (colored in pink on the map) have declined since peaks in the 1990s. The 5 herds in green are increasing or their status is unknown.



In response to declines of Cape Bathurst and Bluenose West herds, co-management boards (Wildlife Management Advisory Committee (NWT), the Gwich'in Renewable Resource Board and the Sahtu Renewable Resource Board) have recommended hunting restrictions as part of herd recovery[4]. The example of the Fortymile herd illustrates both stakeholder cooperative approach[5] and that recovery is complex. Alaska and Canada share the Fortymile herd which has increased over 30 years from about 5-8,000 to about 40,000 under restrictive hunting and varying levels of wolf management (Appendix C).

The Joint TG-GNWT lacked typical components of recovery or management proposals such as objectives, and alternate actions. Consequently, my approach to reviewing the proposal starts with the (1) proposed recovery actions and (2) monitoring and then as well, I have included comments on other elements of the proposal.

1. The proposed actions restricting hunting (Actions 1-5)

Five of nine recovery actions are hunting restrictions. Three restrictions (to eliminate commercial meat tags, outfitting and resident tags) are supported by the Tåîchô Government. The Tåîchô Government does not support the actions to eliminate all female caribou hunting from the Bathurst herd and restrict bull hunting to an unspecified number of antlerless bulls. The Joint Proposal does not address implications of unilateral action.

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[3] Map from carmanetwork.com

[4] Adamczewski, J., J. Boulanger, B. Croft, D. Cluff, B. Elkin, J. Nishi, A. Kelly, A. D.'Hont, and C. Nicolson. 2009. Decline in the Bathurst caribou herd 2006-2009: a technical evaluation of field data and modeling. Department of Environment and Natural Resources, draft technical report

[5] Gronquist, R. M., T. L. Haynes and C. L. Gardner. 2005. Rebuilding the Fortymile caribou herd: A model of cooperative management planning. Rangifer, Special Issue No. 16: 163-175

The over-riding question is whether restricting hunting will be enough to halt the Bathurst herd's decline and start the herd's recovery within the 3-year term of the recovery plan. For the reasons given in the following sections, recovery is unlikely to be distinguished from stability or continued decline within the proposal's 3 year timeframe.

1.1 Uncertainty, the Precautionary Principle and Adaptive Management

The proposal does not acknowledge uncertainties (incomplete information) underlying the management actions. Risk is a consequence of uncertainty: the greater the uncertainty, the greater the risk. Most management authorities including the Tlicho Agreement (Clause 12.1.5 (c)) refer to a precautionary approach, which requires an assessment of risk.

Assessing risk requires describing incomplete information and its influence on management decisions. The sources are fourfold[6]:

Process variability – natural variation among individuals and environmental (unpredictable) variation.
Observational errors – measurement errors including those from inaccuracy (bias) or sampling design (precision).
Model errors – computer models are incomplete pictures of the complexity of biological systems.
Implementation errors - includes delays or inadequate management actions.

In recovery planning, one approach to dealing with uncertainty is through Adaptive Management (Appendix B). Adaptive Management covers a variety of approaches which have in common, learning from management actions is involved. Adaptive management also can accommodate collaborator's knowledge and values. The intent is to use specified (and agreed) monitoring criteria to inform decisions for management actions.

ENR's Technical Report includes computer modeling which includes procedures to account for observational error (precision) and process variation for estimates of adult and calf survival. The Technical Report also acknowledges the potential for model error – the model projections are not exact predictions.

Implementation errors are often un-appreciated but can be significant. Management planning for the Bathurst herd has been under way since the 1980s (Appendix D) but for a variety of reasons, has not been implemented. As well as management planning specifically for the Bathurst herd, GNWT also recently hosted a 2007 Caribou Summit

[6] Harwood, J. and K. Stokes. 2003. Coping with uncertainty in ecologi cal advice: lessons from fisheries. Trends in Ecology and Evolution 18 :617-622.

and an overall 2005 Caribou Strategy but implementation is unfinished. More recently, it is prudent to note that it can take time for government to implement co-management board recommendations as regulations. For example, SRRB's December 2006 recommended hunting restrictions did not become operational as regulations until December 2009.

1.2 The likelihood of detecting recovery within 3 years

Although it is intuitive that reducing hunting eventually will assist recovery, measurable recovery is unlikely to be detectable within the 3-year timeframe of the proposal based on a census in 2012 census. Under good conditions, precision of the estimate is 10-15% of the mean estimate[3]. ENR does not address what change in the number of breeding females is detectable and what are the probabilities of detecting an increase relative to failing to detect a decline. However, elsewhere, ENR states (Responses to Information Request 2.5, 5 January 2010) that "Modeling carried out to date suggests that closure of female hunting would most likely result in an estimate of breeding females in 2012 similar to that recorded in 2009. It is unlikely that a statistical comparison of the two estimates would show a significant difference."

This response reveals uncertainty about either success or failure of the management actions, which is risky. The risk comes from difficulty in deciding whether to intensify or relax management actions, which depends on being able to credibly distinguish between a continued decline, numerical stability or recovery.

1.3 Hunting levels

The Joint Proposal does not specify the current hunting levels and how reducing those levels will adult survival for the Bathurst herd. This is obviously a key step in predicting herd recovery. The harvest information is insufficient to understand whether the accelerated decline (2006-09) is a consequence of an increase in hunting and or natural mortality.

The Technical Report has 1988-1993 information (Table 5.11) from the Dogrib harvest study and 2007/08 and 2008/09 harvest information from interviews and check stations although apparently not include the data from the 2004 – 2006 check stations (posted in WRRB's Public Registry) or details for the 2007-09 interviews. The report has a comment that the Dogrib harvest study is a substantial over-estimate but no explanation as to the basis for this comment . ENR's technical report[2] notes that estimates of 5,000 cows in the annual harvest are uncertain as they are a back calculation from the computer model rather than an empirical measurement.

1.4 Natural mortality especially predation rates

Natural mortality (predation, accidents and disease) for adult caribou is difficult to measure although it one of the drivers of caribou abundance. Predation is typically a large component of natural mortality. For a declining herd, a key question is whether predator numbers have declined in response to the caribou decline or whether a delay

in predators declining increases the relative rates of predation. Experience elsewhere is that there is a time lag in the response of wolf numbers to declining prey and that the decline in wolves is not evident until prey number are low[7]. ENR's Technical Report summarizes four indices that may relate to wolf abundance. Two indices (number of adult wolves at den site and August number of occupied dens) show a decline since 1996. The decline in active dens in August suggests entire litters are lost. The loss of the wolf pups during the summer may be due to caribou unavailability or diseases such as rabies and parvo-virus. ENR has not apparently used the summer locations of collared caribou cows relative to den locations to determine the level of evidence supporting the availability of caribou.

The other two indices that ENR uses for wolf population size do not reveal clear trends. . The surveys in June reveal that the number of active wolf dens and the average number of pups per den is annually variable with no trends. The number of dens is dependent on a standardized sampling design. Elsewhere, wolf pregnancy rates and litter size decline when prey numbers are low, which suggests that wolves are not nutritionally stressed during winter[7]. This raises a possibility that winter predation rates have not decreased.

The Technical Report notes an absence of any trend in wolf sightings during late winter caribou surveys although the report expresses doubt about the validity of the index. No data are presented on wolf and grizzly bear sightings during calving ground surveys. In other words, it is uncertain how wolf abundance has changed relative to the decline in caribou abundance.

Natural mortality also includes calf deaths as well as adult caribou. Recovery will also depend on rates of calf survival. ENR's response to Information Request 2.7 and the Technical Report's use of modeling suggests that increase in adult female survival to 86% (which is the estimated 1985 level) would allow the herd to stabilize with calf survival levels of 50%. Unless calf survival exceeds 30%, the computer model projects that the herd will not increase regardless of increases in adult female survival.

Calf survival is difficult to predict and manage as it depends on both environmental trends and predation. For example, calf survival (and pregnancy rates) are influenced by summer weather through the effect of summer temperatures and wind speed the severity of warble fly harassment. The Technical Report describes an increase in calf survival in the Bathurst herd 2006-09 which was when the index to warble fly harassment was lower.

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[7] Boertje., D., and Stephenson, R. 0. 1992. Effects of ungulate availability on wolf reproductive potential in Alaska. Can. J. Zool. **70:** 2441 -2443.

Experience elsewhere in caribou recovery, reducing natural mortality through predator removal can accentuate the recovery based on restricting hunting. The Fortymile caribou herd shared between the Yukon and Alaska did not recover as rapidly as expected when hunting levels were reduced to a bull-only harvest. The reasons were high predation rates compounded by 2 years when severe weather decreased calf survival and increased predation rates (Appendix C). To be effective, at least ¾ of the wolves have to be removed. Wolf numbers recovered within a few years through immigration and productivity. Monitoring wolf abundance and caribou survival would be mandatory if wolf removal is applied as a recovery action. However, as a short-term measure given the high rate of caribou decline and as a trade-off with restrictions on hunting, accentuated hunting of wolves (fur harvest) has advantages despite being controversial[8].

1.5 Restricting male hunting levels

Uncertainties reduce confidence in how restricted harvesting of bulls will contribute to recovery. This is because although the Joint Proposal states that the male hunting will be limited to antlerless bulls in winter, it does not include details. It is unclear about the number of bulls, the mechanism other than a tag system or how mobile zones based on collared caribou will operate especially as only a few bulls will be collared.

An Information Request (2.12, 6 January 2010) suggested that the hunting would be limited to 4% of the 2009 population estimate of males and that ENR's preference would be for young (small) bulls. But those young bulls retain their antlers during the winter which would contradict the Joint Proposal (antlerless bulls) and possibly increase the risk of wastage. In the 2001-06 management plan for the Fortymile caribou herd, concerns were expressed about a bull-only hunting increasing wastage as cows were mistaken for antlered bulls.

1.6 Age structure and recovery

The Joint Proposal does not acknowledge that the herd's age structure will influence the rate of recovery. ENR's response to Information Request 2.8 and the Technical Report note that the age structure of the Bathurst herd has shifted from middle-aged cows. Such an age structure can, especially if environment conditions are severe, influence the rate of recovery. A large representation of older cows contributes to declines because older cows tend to have lower fecundity and higher natural mortality rates. Given the likely lag in recovery from increased calf survival to be recruited as breeders and age structure shift, 2012 (census timing) not likely to be most suitable timeframe to measure

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[8] Nie, M. 2003. Beyond Wolves: the politics of wolf recovery and management. University of Minnesota Press. Regelin, W.L., P. Valkenburg, and R.D. Boertje. 2005. Management of large predators in Alaska. Wildl. Biol. Pract., 1: 77-85.

recovery. Experience with other herds such as the Nelchina herd in Alaska also draws attention to the role of weak year classes in declines and recoveries[9] .

1.7 Risks to hunting neighbouring herds

The Joint Proposal mentions a decline in the Bathurst herd's neighbouring herds - Ahiak and Bluenose East herds. The Joint Proposal states that "careful and limited hunting of caribou females may also be considered on those two adjacent herds until a photo census and new population estimates are obtained for those two herds which are scheduled for the summer of 2010". There are no details specifying how the 'limited' hunt will be determined and implemented. Information Response 2.9 from ENR still left open the scale of the limited hunt or how it will affect the hunting levels for the Bluenose East and Ahiak herds. The proposal does not address the risk of hunting from those two declining herds or how this relates to management planning for those herds.

1.8 Overlapping winter distribution between neighbouring herds

The Joint Proposal states that "No hunting of females is to take place when caribou of different herds are mixed together in the winter time to avoid accidental hunt of Bathurst cows. When this situation occurs, it is recommended that males only be hunted (ENR's position)." But the Joint Proposal offers no guidance on the practicality of this such as defining in an operational sense what is meant by 'mixed'.

The proposal also notes that "Consultation between Industry, Tourism and Investment (ITI) and ENR will take place to explore avenues to provide financial support to hunters to access new hunting areas". This is vague and fails to address the cumulative risk of moving hunting effort to adjacent herds that are declining.

[9] Eberhardt, L. L. and K. W. Pitcher. 1992. A further analysis of the Nelchina caribou and wolf data. Wildlife Society Bulletin 20: 385-395

2. Other proposed actions (Actions 6-9)

The Joint Proposal has four actions, supported by both governments, that do not relate directly over the short-term to recovery (in the sense of not reducing caribou deaths). The proposal does not specify how those four actions (education, compliance, calving ground protection and mandatory hunting reporting) relate to the proposal's goal of "most rapid" recovery as they are longer-term and supporting actions. It is not clear how monitoring will measure their success or failure.

2.1 Education (Action 6)

"Public and Hunters Education" is listed as an action but details are lacking except for the possibility of producing a DVD production on traditional and ethical hunting practices. The need for education was identified in management planning for the Bathurst herd since the 1980s, which thus emphasizes its importance.

2.2 Compliance (Action 7)

Action 7 is about compliance with the hunting restrictions and was provided for information as no direction is required from the Board. However, there is no indication whether ENR considered alternative methods for compliance or any linkage between education and compliance. Alternative methods would include community-based monitoring based on directions from elders.

2.3 Calving ground protection (Action 8)

The Action for Calving Ground Protection refers to consultation and collaboration between GNWT and Nunavut to ensure current level of protection is maintained although without mentioning how limited is the current level of protection. The Joint Proposal does not make the link between calving ground protection and recovery of the herd which includes dependence of recovery on calf survival.

ENR's response to Information Request 2.15 gave more detail about current protection. ENR referred to discussions between GNWT and GN about increasing protection of calving grounds for those herds with calving grounds in Nunavut. However that does not mention the role of Indian and Northern Affairs Canada and Inuit organizations that are the land managers for Crown and Inuit Owned Lands, respectively. The Information Request does not clearly identify the lack of effective protection especially for the Bathurst Herd's calving ground. ENR's information does not refer to alternative and additional measures such as mobile protection measures which have been recommended[10] but still not implemented.

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[10] Weihs, F.H., and P.J. Usher. 2001. Towards the development of a policy on the management of human activities in caribou calving and post-calving grounds. Contract # 00-0210 for Department of Indian Affairs and Northern Development, Ottawa.

2.4 Mandatory reporting for hunting levels (Action 9)

Mandatory reporting of hunting for Aboriginal hunters is one of the proposed actions. But the Joint Proposal only mentions monthly interviews and a harvest calendar for Tlicho hunters. The Joint Proposal does not specify any details how the reporting will work in conjunction with the tag system for bull hunting. No reference is made to alternative approaches such as providing a tag in a sampling kit to collect information on condition as ENR has done in Inuvik[11]. The proposal does not indicate the likelihood of compliance with mandatory reporting or why a voluntary system of community-based reporting was not considered. Nor does the proposal indicate what information will be collected during the interviews.

3. Monitoring actions

The Joint Proposal lists 11 proposed monitoring actions as for the Bathurst, Bluenose East and Ahiak. The following comments are for the Bathurst herd as management objectives and actions for the Bluenose East and Ahiak herds are not included in the Joint Proposal. The type and intensity of monitoring for those herds will depend on their herd-specific management planning (goals, objectives and actions).

Within a management (or recovery plan), monitoring is to inform about how effectively the management actions contribute to recovery. To be effective, monitoring requires selecting indicators relative to the proposal's objectives and agreeing on criteria or thresholds for the feedback to assess effectiveness of the actions. There are three types of indicators which clarifies their role in providing feedback on the management actions:

(1) The direct effect of a recovery action (such as restricting hunting or removing predators). A harvest study is an example.

[11] www.srrb.nt.ca/registry/Draft%207%20FINAL%20REPORT.pdf

(2) The response of the caribou herd to the recovery action(s) such as trend in breeding female numbers, or mortality. Those indicators have under-lying mechanisms such as changes in pregnancy rates or calf survival which are measured through a third set of indicators.
(3) Explanatory Indicators: caribou demographic indicators include direct measures (pregnancy rates, spring and fall health and condition) or indirect measures based on ratios. The ratios include birth rates, fall and spring calf survival, and adult sex ratio. Ratios have to be cautiously interpreted as they are composite (for example, calf cow ratios reflect pregnancy rates, adult and calf survival).
The caribou responses to management activities is integrated with their responses to other influences such as weather. So there are indicators (explanatory) used to measure environmental influences such as insect abundance, plant greening and wolf condition and productivity; and how winter range status affects movement, distribution and condition of caribou.

A well-designed link between actions and monitoring avoids further uncertainties. For example, when the Sahtu Renewable Resource Board recommended a Total Allowable Harvest for the Bluenose West herd (4% of the 2006 population estimate) they also recommended a harvest study. The harvest study would have directly measured the effect of the TAH and thus contributed to determining how the hunting restrictions were effective in the Bluenose West herd's recovery. However, the harvest study did not happen and by 2009, it is uncertain whether the Bluenose West herd stabilized because hunting was reduced, the 2006-09 winter distribution decreased access to hunting or other factors such as predation or weather were involved.

The Joint Proposal states that it based the proposed monitoring actions on the 2004 Bathurst caribou herd plan. However, as the Joint Proposal is a recovery plan, actions should be more stringently monitored given the risks of failing to detect responses could lead to missing a continued decline. An additional reason for enhanced monitoring is that the Joint Proposal's monitoring is similar to that which occurred during the 2006-09 accelerated decline. Only the trend of breeding females based on a 3 year census detected the 2006-09 accelerated decline while monitoring of other indicators did not indicate continuation or acceleration of the decline.

The Joint Proposal does not include a commitment to or schedule for annual analyses of the monitoring and annual reporting to WRRB as well as other stakeholders . The need for annual assessments of the monitoring could provide for supplementary management actions rather than the risk of total reliance on a photographic census in 3 years. The question of the availability of monitoring data is an issue raised elsewhere in caribou co-management. For

example, the Hunting Fishing and Trapping Coordinating Committee is the consultative committee representing Northern Québec Inuit, James Bay Cree and the Naskapi Nation of Kawawachikamach on wildlife including the George River and Leaf River herds. In a review of the co-management committee[12], the comment was made " For the committee to function efficiently it has to be fed information on a continuous basis and it must spend the necessary time analyzing the said information".

3.1 Monitoring direct effects of recovery actions (reduced hunting)

Five of the nine recovery actions relate to reduced hunting but only two of those five actions require monitoring (commercial, resident and outfitting are dependents on tags). The required monitoring (stated in the Joint Proposal as a recovery action; see comments in Section 2.4) is mandatory reporting through monthly interviews and harvest calendars. The proposal does not provide any indication of how mandatory monitoring will be more effective than previous monitoring of harvest levels (also using calendars and interviews) and whether a measure of hunting effort will be included.

3.2 Monitoring the response of caribou (changes in abundance; trend in breeding females) to recovery actions

The Joint Proposal relies on monitoring the trend in breeding females in 3 years to determine the response of the caribou herd to the restricted hunting. This has two limitations. Firstly, there is no feedback on the effectiveness of the recovery actions for 3 years (and the feedback depends on success of the census). Secondly, the census is relatively insensitive to small changes in abundance and a non-significant result runs the risk of missing a continued decline relative to missing an increase or stability.

Increasing the frequency of calving ground census is not practical (cost and sensitivity of the technique – it needs changes in abundance of >10-15%). However measuring the density of breeding cows on the calving ground (and extrapolating to estimates of numbers on the calving ground can be used as an indicator of relative change, which would provide feedback on the response of the cows to the hunting restrictions (as well as predation, disease and environmental conditions).

3.3 Monitoring the response of caribou (mortality) to recovery actions

The only direct measure of the effects of the hunting restrictions is a change in adult mortality (besides monitoring hunting levels). Although monitoring adult survival is not specifically listed, the Joint Proposal's monitoring action 11 is a statement about increasing the number of satellite-collared cows from 20 to 50 to "better assess" cow

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[12] Dion, R. Twenty-five years of co-management of caribou in northern Québec. 2003. Rangifer, Special Issue No. 14: 307-311

survival. However, this is not supported by TG and without a power analysis, it is uncertain how many collars are necessary to detect the mean annual level of natural mortality. In the Alaskan/Yukon Fortymile caribou herd, 50-80 and 50-90 collars for calves and adults, respectively, were not enough to determine if survival increased[13].

The Joint Proposal does not acknowledge that it is also important to be able to partition mortality into causes such as predation, accidents and diseases. This would require field investigations of deaths.

3.4a Explanatory caribou demographic indicators: Calf survival; Health and condition; Birth rate; Adult sex ratio

The Joint Proposal provides almost no details on monitoring caribou demographic indicators. Especially missing is how the measured values will be used to inform about the effectiveness of management actions.

The survival of calves to 10 months of age is a composite indicator as pregnancy rates and cow survival are factored into estimating calf survival from the field measurement (calves:100 cows). The Technical Report describes threshold values which will could be required for recovery based on the computer models. Those values, such as 32-35% calf survival, can be used as thresholds to estimate the likelihood of recovery, which could be used as criteria – however it needs to be specified if and how cow survival and pregnancy rates will be factored into those criteria.

The Joint Proposal provides few details on how monitoring health and condition information will be used or collected – the proposal refers to community hunts with the emphasis on bulls. Action #4 states that a "limited low number of breeding females may be allowed to be hunted from the Bathurst herd in the winter months for scientific purposes (health and condition and assessment of pregnancy rate)." The proposal specifies that a collection limited to 20 cows will be used to assess pregnancy rates. However a sample size of 20 likely will lack statistical power to detect annual changes and trends, especially given changes in age structure. The Joint Proposal does not explain why it needs to monitor pregnancy rates from a small sample of harvested cows as well as birth rate. Birth rate is an acceptable indicator for pregnancy rate as intra-uterine losses are usually low. Monitoring birth rate will be likely more valid as an indicator of pregnancy rates rather than a small sample of cows. The key to measuring birth rate on the calving ground from surveying the status of cows is it depends on

[13] Boertje, R. D. & Gardner, C. L. 2003. Reducing mortality on the Fortymile caribou herd, 1 July 1997–30 June 2003. – In: Healy, C. (ed.). Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Performance Report. Grant W-27-1 through W-33-1. Study 3.43. Juneau, Alaska, USA.

ascertaining the peak of calving. A sampling protocol needs to be clarified to reduce bias caused by early calf deaths.

The Joint Proposal does not explain why it is necessary to annually monitor adult sex ratio. Neither the proposal nor the Technical report assess the likelihood that measuring the adult sex ratio will be sensitive to any changes in the proportion of the two sexes during the 3-year recovery plan period.

The Joint Proposal supplies no explanation for how monitoring wolf den occupancy will contribute to monitoring for caribou recovery (feedback on management actions). In the Technical report, early pup survival is annually variable and no trend was apparent (although sample size and sample effort is unclear). It is unknown how well den occupancy, adults at den sites and pup survival index wolf abundance and the relationship between trend of wolf abundance and predation levels on caribou is also unknown. The Joint Proposal does not include a relatively simple index which is a standardized reporting of predators seen during caribou aerial surveys (e.g., number of wolves/100 hrs).

The Joint Proposal describes setting out remote weather stations to collect weather data, which is used to calculate an index to warble, black fly and mosquito potential harassment levels. The proposal does not explain why existing weather stations are inadequate or how the indexes will be used relative to other monitoring indicators (pregnancy rates, calf survival). The Joint Proposal supplies no details for how monitoring summer range condition will contribute to monitoring for caribou recovery or why for example winter snow and ice conditions or the extent of forest fires are also not included and related to demographic indicators.

4. Additional comments on TG-GNWT proposal

The Joint Proposal lacked details that would have secured the context of the proposed recovery actions. Key points for success of the proposed recovery actions are firstly cooperation and support from people. Secondly, the ability to measure success (or failure) of the recovery actions requires clearly stated objectives.

4.1. Traditional Knowledge

Traditional Knowledge and Tåîchô elder's advice is not included in the Joint Proposal, despite reference to an elder's meeting in Gamèti. Nor does the proposal offer a mechanism to include elder's advice in developing actions and, if necessary, to reconcile any differences in approaches. Traditional practices and rules are part of caribou stewardship. The Joint Proposal does not include an action as to how traditional rules can be revitalized. A parallel that may be useful and innovative is from rights-based fisheries when individual (and transferable) allocation rules are the approach to sustainability. Success of small-scale fisheries has depended on community-based management when local communities develop context-dependent solutions for matching fishing rates to the productivity of the local fisheries[14].

Although the Joint Proposal refers to the January 2007 GNWT Caribou Summit (Inuvik) in the context of protecting calving grounds, it does not refer to the other two issues that Summit participants scored the highest. One of those issues was to bring traditional knowledge into decision making; the other was to develop a code of conduct for hunting. The proposal does include an action for education but the only specific is "Funding might be made available from ENR to the TG and/or WRRB to develop a DVD production on traditional and ethical hunting practices. " (Action #6, page 7). This is not the same as including Traditional Knowledge and values into decision-making, specific actions and monitoring.

4.2 Objectives

The Joint Proposal does not use its two goals to develop objectives. Conventionally in wildlife management, goals are stated in broad terms while objectives are technical, detailed, and attainable within a stated timeframe. Objectives need criteria of success and failure (performance measures). Given that some of the proposed actions require people to change their behaviour, people will need assurance that action worked or did not. A contemporary approach to wildlife management increasingly recognizes the value of a more structured approach to defining objectives, especially desired stakeholder-

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[14] Worm, B., R. Hilborn, J. K. Baum, T. A. Branch, J. S. Collie, C. Costello, M. J. Fogarty, E. A. Fulton, J. A. Hutchings, S. Jennings, O. P. Jensen, H. K. Lotze, P. M. Mace, T. R. McClanahan, C. Minto, S. R. Palumbi, A. M. Parma, D. Ricard, A. A. Rosenberg, R. Watson, D. Zeller. 2009. Rebuilding global fisheries. Science 325:580-585.

identified interests[15]. These objectives provide performance measures of subsequent management. This will focus the process on what is important to people and shared learning among scientists, managers, and stakeholders.

The objectives should specify criteria for what constitutes recovery – whether it is a rate of increase in breeding females, or estimated herd size and or a specific number of breeding females. Assessing the likelihood of recovery needs pre-determined criteria for success and failure, which in turn determines monitoring design. The objectives should acknowledge first with stopping the decline, then recovery which may require different actions and their criteria for success or failure.

4.3 Alternate management actions

The Joint Proposal does not offer alternatives to the listed management actions. There are two reasons for alternatives. Firstly, the proposal is to a co-management board, choices within and among possible actions would have been helpful. Secondly, the variable likelihood of success for reducing hunting to lead to recovery within 3 years indicates a need to examine trade-offs and assessment of the risks and benefits from alternative management strategies.

The list of actions is narrow as five of the nine actions relate to hunting restrictions. However, a range of hunting restrictions is not offered as alternatives. For example, the difference between restricting hunting of cows to zero or, for example, 250-500 is likely undetectable at the scale of resolution of the monitoring. But even a low level of hunt (for cows) would address inadvertent wastage (if a hunter mistook a young bull for a cow and did not want to risk enforcement actions). A reduced hunt would be a means to adequately sample pregnancy, health and age structure[16], and might partially increase support for the actions, the trade-off being a slightly lower rate of recovery.

The Joint Proposal does not describe alternative or additional actions, at least to the extent of arguing why those actions are not being proposed. Given the unpredictability of a changing environment and uncertainty about natural mortality, relying on harvest restrictions alone is risky. To build in a safety margin for herd recovery, criteria to intensify management (implement alternative or intensify actions) are needed. For example, predator management was listed in the 2004 ENR management plan and 2006 ENR proposal (if wolf predation is a key factor, support for hunters to take more wolves). During the Whati TG caribou workshop, the need to look for solutions to curb

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[15] Riley, S. F., W. F. Siemer, D. J. Decker, L. H. Carpenter, J. F. Organ, And L. T. Berchielli. 2003. Adaptive Impact Management: An Integrative Approach to Wildlife Management. Human Dimensions of Wildlife, 8:81–95.

[16] ENR (Inuvik) uses tags supplied in a small sampling kit to monitor restricted hunting.

wolf numbers was mentioned[17]. A suggestion was made for ENR to issue more tags to outfitters for wolves and bears. The question of predator management was raised at SRRB 2007 public hearings (but not answered).

The Joint Proposal does not list as a task but mentions for monitoring to ensure that unexpected cumulative effects of mine activities are not missed. This is vague and needs to be more specific actions. The Joint Proposal also does not raise the question of access as a cumulative effect and the need to link road access and hunting restrictions and monitoring.

4.4 Additional comments

Given it is a Joint Proposal between two governments, it would have been useful to refer to their respective mandates either in the body of the text or as an appendix. Identifying the different mandates could have clarified the support for some management actions such as enforcement.

The Joint Proposal's overall approach is a recovery plan for 3 years, to be followed by an estimate of herd size in 2012 and then a revised management plan. The proposal does not specify differences between a recovery plan and a management plan. The Joint Proposal does not clarify the relationship of the recovery plan or the subsequent revised management plan to the Tåîchô Agreement (Clauses 12.11.2) which requires the Tåîchô Government, Canada and Government of Northwest Territories to prepare a comprehensive proposal to manage the Bathurst caribou herd within 3 years of the effective date (2005) or another agreed upon date. Nor does the Joint Proposal acknowledge ENR's 2006 proposal to WRRB or the 2004 ENR Bathurst management plan or earlier planning (Appendix D). During 2008, discussions between WRRB and the Parties referred to the need to agree on and consult to obtain aboriginal and stakeholder input for a management framework (process). The framework would lead to a comprehensive co-management proposal. The Joint Proposal does acknowledge that in July 2009, the WRRB sent a letter to the Tåîchô Government and ENR encouraging both governments to engage in a new round of discussions to generate a comprehensive management proposal for barren-ground caribou.

The point about acknowledging the earlier planning for the Bathurst herd is two-fold. First, the people consulted about the earlier planning will be the same as for the Joint-Proposal and will see their contributions acknowledged rather than ignored The second point is that the history of the planning reinforces the need to ensure that plans are implemented – delays in implementing the earlier planning have lead to the need for the current recovery plan.

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[17] Day 2; page 17 and page 21. TG caribou workshop transcripts, WRRB public registry.

APPENDIX A. Lessons from recovery planning for fisheries

Although fisheries and caribou recovery are two different disciplines, examination of success in fisheries recovery may hold lessons for caribou recovery. Hutchings and Reynolds (2004) assessed ability of fisheries to recover after declining. They generalized first that the rate of population decline is an defendable predictor of population recovery. Second, populations that have declined more than 60% over 15 years exhibit little or no recovery as much as 15 years later, even when fishing mortality has been reduced following collapse. With 15 year declines of 70-90%, only about 1/10th of fisheries recovered to 50% of prior abundance. Correlates of recovery included that reductions in fishing are necessary, but not always sufficient, for recovery. Other factors included habitat changes, Allee effects and food web changes.

Recovery also depends on how societies and governments respond to population collapses. This usually become political with decision makers struggling between scientific assessments and short-term economic pressures to avoid reductions in fishing. The speed with which managerial action is taken to halt population decline will influence the age structure of the population at the time of collapse, which can significantly influence recovery. Hutchings and Reynolds (2004) comment that "It is not always recognized that collapsed marine fishes are at risk of extinction because even relatively small catches can limit the recovery of depleted populations. More troublesome is the reality that closed fisheries tend to be reopened at the first sign of population increase, rather than after the attainment of some target level for recovery."

Besides technical information from fisheries, there are parallels and lessons to be learnt from co-management in fisheries. Pinkerton (1999) wrote that "A key premise emerging from the study of fisheries co-management arrangements around the world is that participants in locally based institutions that have a significant decision-making role have the potential to devise regulations that are more flexible, adaptable, and appropriate to specific situations than are those more generic ones crafted by centralized agencies. Working in tandem with central agencies, local bodies may be successful at devising sustainable harvest levels and promoting stewardship at the local level". Pinkerton (1999) describes options for over-coming barriers to co-management.

Beddington, J. R., D. J. Agnew and C. W. Clark. 2007. Current Problems in the Management of Marine Fisheries. Science 316, 1713-1716.

Hutchings, J. A. and J. D. Reynolds. 2004. Marine Fish Population Collapses: Consequences for Recovery and Extinction Risk. BioScience 54: 297-309.

Pinkerton, E. 1999. Factors in overcoming barriers to implementing co-management in British Columbia salmon fisheries. Conservation Ecology 3(2): 2. [online] URL: http://www.consecol.org/vol3/iss2/art2/

Worm, B., R. Hilborn, J. K. Baum, T. A. Branch, J. S. Collie, C. Costello, M. J. Fogarty, E. A. Fulton, J. A. Hutchings, S. Jennings, O. P. Jensen, H. K. Lotze, P. M. Mace, T. R. McClanahan, C. Minto, S. R. Palumbi, A. M. Parma, D. Ricard, A. A. Rosenberg, R. Watson, D. Zeller. 2009. Rebuilding global fisheries. Science 325:580-585.

APPENDIX B. Adaptive Management

Adaptive management comes in various forms and its underlying rationale is that it accelerates and enhances learning about management. It is typically more disciplined than simply learning by trial and error because it uses measurable criteria to assess management actions. An important point is, also, that " An inclusive approach is required not only to build understanding, support, credibility, and trust among constituent groups (Van Cleve et al. 2003, MacKay et al. 2003), but also to ensure adequate problem-framing and access to the knowledge, experience, and skills held by these groups." (Stankey et al. 2005 page 57). The point is that adaptive management approach would serve to build collaboration as well as technical needs to deal with environmental uncertainty and complex ecological systems. There are parallels between traditional knowledge approaches to resource management and adaptive management (Berkes et al. 2000).

Stankey et al. (2005) offer a concise description of adaptive management and while Sit and Taylor (1998) offer a more detailed technical guidelines and Johnson (1999) offers guidance in the context of resource management.

Sit, V. and B. Taylor (editors). 1998. Statistical Methods for Adaptive Management Studies. Res. Br.,B.C. Min. For., Res. Br., Victoria, BC, Land Manage. Handbook No. 42.

Berkes, F., J. Colding, C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10:1251-1262.

Johnson, B. L. 1999. The role of adaptive management as an operational approach for resource management agencies. Conservation Ecology 3(2): 8. [online] URL: http://www.consecol.org/vol3/iss2/art8/

Stankey, G. H.; Clark, R. N.; Bormann, B. T. 2005. Adaptive management of natural resources: theory, concepts, and management institutions. Gen. Tech. Rep. PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 73 p.

APPENDIX C Fortymile Caribou Herd recovery

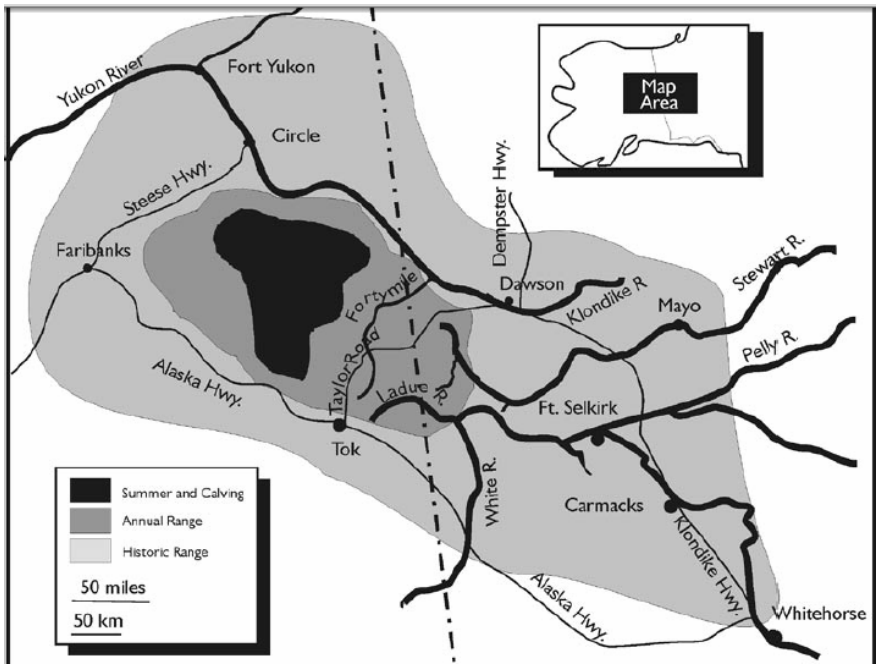
The Fortymile is a medium-sized caribou herd (2009: 46,510 caribou R. Boertje Pers. Comm.. 2010) whose seasonal ranges are shared between Alaska and Yukon. Managing recovery of the Fortymile herd illustrate four points:

1) A grassroots approach rather than government driven management planning was more successful (as measured by hunter compliance and support)

2) Recovery based on hunting restrictions is less effective unless predation and weather are taken into account

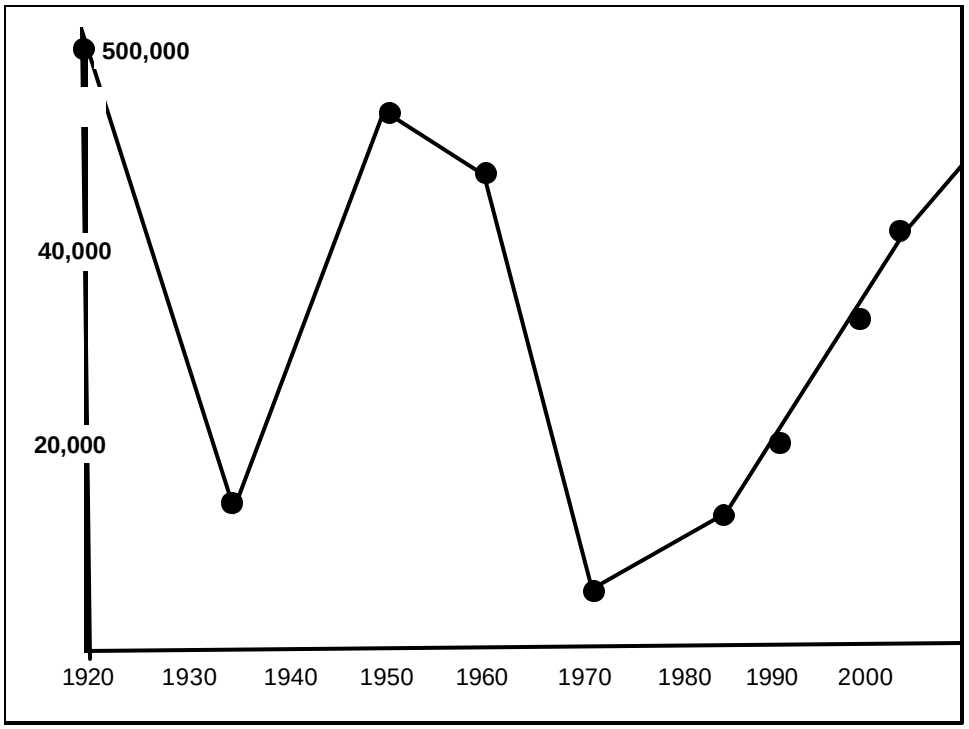
3) Wolf removal as a measurable contributor to caribou recovery has to be intensive and will be controversial as experienced in Alaska. The key messages are for public involvement and that localized wolf control can be effective.

4) Recovery was slow: the mid-1970s saw the herd reduced to <10,000 and it did not double in size until late 1980s (despite restricted hunting and wolf control).



In the three consecutive management plans (1996-2012), harvest is annually reviewed and is based on trend in herd size. The 1995-2000 plan included non-lethal wolf removal for dominant packs - and the harvest was reduced to 150 bulls to increase acceptability. In the 2001-2006 Plan, the harvest increased from 150 bulls to 2-3% herd size – target figure of 850 caribou +/- 15% and <25% are cows Concern was that bull-only harvest could lead to wastage (mistaken bulls for cows; reliance on education to keep cow harvest <25%). The harvest is regulated by season and zone (rather than road corridors which were considered difficult to enforce).The 3rd and most recent Management Plan

(2006-2012) has as objectives, annual growth 5-10% herd size and a harvest of 1000-15,000 and the adult sex of at least 35:100 and viewing opportunities. The Trondek Hwechin have not used their quota in the interests of conservation (http://trondekheritage.com/images/pdfs/forty_mile_caribou_0411.pdf).



Boertje, R. D. & Gardner, C. L. 2003. Reducing mortality on the Fortymile caribou herd, 1 July 1997–30 June 2003. – In: Healy, C. (ed.). Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Performance Report. Grant W-27-1 through W-33-1. Study 3.43. Juneau, Alaska, USA.

Gronquist, R. M., T. L. Haynes and C. L. Gardner. 2005. Rebuilding the Fortymile caribou herd: A model of cooperative management Planning. Rangifer, Special Issue No. 16: 163-175.

Regelin, W.L., P. Valkenburg, and R.D. Boertje. 2005. Management of large predators in Alaska. Wildl. Biol. Pract., 1: 77-85.)

APPENDIX D. Chronology of management planning for the Bathurst herd

1987-91	Denendeh Conservation Board
1988	DCB considers GNWT application for Ingraham Trail corridor to protect Bathurst herd caribou
1988-93	Consultation meetings on draft Bathurst Caribou management Plan
1994	GNWT publishes Bathurst Caribou Management Plan
2000	Bathurst Barren Ground Caribou Management Planning Agreement established Planning Committee
2000-03	Committee has community meetings to draft issue papers and plan
2003-04	Consultations on draft plan lead to final plan The consultation included all the Parties to the Agreement, mining and recreational industries, non government organizations such as IEMA, EMAB, CPAWS – NWT, CARC, WWF – Canada and the NWT Wildlife Federation.
2005	Tlicho Agreement establishes WRRB with powers to review any wildlife management plan (Clause 12.5.1); plans for migratory species (12.11.1) and a comprehensive proposal for the Bathurst caribou herd (12.11.2 and 12.11.3).
2006	GNWT submits a management proposal to WRRB for specific management actions
2007	WRRB extends time for ENR to consult. Tåîchô hold a regional workshop in Gamètì to get input from elders on the draft joint proposal
2009	November TG and ENR submit recovery joint proposal to WRRB