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Northwest Territories Environment and Natural Resources

Mr. Jonas Lafferty
Interim Chair
Wek'èezhìi Renewable Resources Board
4504 49TH AVENUE
YELLOWKNIFE NT X1A 1A7

JAN 26 2016

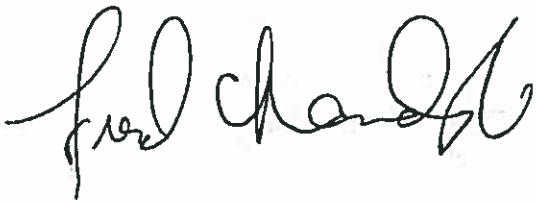
Dear Mr. Lafferty:

Responses to Information Request Round No. 1 – Bathurst Caribou Herd Joint Management Proposal

The Tłı̨chǫ Government (TG) and the Department of Environment and Natural Resources (ENR), Government of the Northwest Territories (GNWT) received a list of information requests from the Wek'èezhìi Renewable Resources Board (WRRB) on January 18, 2016 in regards to the "*Joint Proposal on Caribou Management Actions for the Bathurst Herd: 2016-2019*".

TG and ENR would like to provide the attached joint response to the WRRB's information request.

Sincerely,



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Attachment

c. Grand Chief Eddie Erasmus, TG

Ms. Laura Duncan, Tłı̨chǫ Executive Officer, TG

The Honourable Wally Schumann, Minister, ENR

Mr. Ernie Campbell, Deputy Minister, ENR

Ms. Lynda Yonge, Director of Wildlife, ENR

Ms. Jody Pellissey, Executive Director, WRRB

Bathurst Caribou Herd Joint Management Proposal
Information Requests Round No.1

Tłı̨chǫ Knowledge-related Information Requests (IRs); IRs #1-8:

Information Request #1: What observations in the past two years have the harvesters made in relation to the health and behaviour of barren ground caribou? Please provide the most recent documentation with relevant quotations attributed to the individual.

Response (TG): Attached we have included the most recent report by Petter Jacobsen, "*We Live Here for the Caribou*". In this report Jacobsen (2016) documents the most recent observations made by Tłı̨chǫ hunters and elders. The observations show that the Tłı̨chǫ people see deterioration in caribou health (see section 3.1 of report).

Information Request #2: The Tłı̨chǫ Government have agreed to no harvesting of the Bathurst herd, and limited harvesting of Bluenose East herd, how will traditional knowledge monitoring – harvesters watching caribou without input from biologist – be continued and funded to ensure their way of life and knowledge system remains intact (and that they can purchase healthy food).

Parties Responsible: Tłı̨chǫ Government

Response (TG): Over the past six years the Tłı̨chǫ Government has conducted the CIMP-funded TK research project, Tłı̨chǫ Ekwo Nàowo. The research focused on the traditional knowledge of Tłı̨chǫ harvesters, women and elders in Wekweètì, in order to ascertain cumulative impacts of natural and human made change on the Bathurst caribou. Due to the rapid decline of the Bathurst herd, the Tłı̨chǫ Government has chosen to no longer harvest the caribou. However, Tłı̨chǫ do not want to discontinue interaction between Tłı̨chǫ and the herd. To continue the TK project's original work—workshops, individual interviews and mapping—would produce little of value as there is no new information to record. Therefore, we are proposing to evolve the TK project and establish a boots-on-the-ground monitoring program.

Partnership:

The project is proposed to be a partnership between ENR-GNWT, WRRB, (Dominion Diamond Corporation (DDC) and the Tłı̨chǫ Government. The Tłı̨chǫ Government will oversee and run the project, assisted by ENR, and DDC will provide in-kind and/or financial support.

Boots-on-the-Ground Monitoring Program

Tłı̨chǫ harvesters will monitor, identify and document the conditions of: 1) Bathurst caribou in their current state; specifically with regard to health, behavior, population and migration, 2) the herd's current habitat; specifically looking at lichen/forage plants, predators, insects and climate, and 3) how the caribou relate to human-made factors on the land, such as mining and exploration activities, and other human activities. The monitors will be stationed at various locations along the summer/fall range of the herd. The time period from July to October is especially informative for our research, as the herd migrates from its calving grounds towards the Ekati area, and its winter range south of the tree line. Timing and placement of monitors will be decided collaboratively between Tłı̨chǫ Government and ENR-GNWT and will depend on the locations and movement patterns of collared Bathurst caribou. The monitors will record information in the field using GPS, field-notes and photographs, additionally a researcher will accompany the monitors to document their traditional knowledge in the field. Analysis will be completed by TK researchers, caribou biologists from ENR-

GNWT and assisted by WRRB, in order to understand the big-picture by combining the strengths from TK and science.

Results

Expected results from the boots-on-the-ground monitoring project are current information on the Bathurst caribou, such as habitat conditions and the impacts of human-made disturbances on the caribou range. Through this project, real-time knowledge will be communicated from local harvesters to decision-makers, such as the Tłı̨chǫ Government, other aboriginal groups, the mining industry, resource management boards and ENR-GNWT, who can make informed decisions and take actions based on Tłı̨chǫ traditional knowledge.

Rationale for IRs #1 and #2: The Tłı̨chǫ Land Claim and Self-Government Agreement (12.1.6) states that "the Parties and the Wek'èezhìı Renewable Resource Board shall take steps to acquire and use traditional knowledge as well as other types of scientific information and expert opinion." The proposals refer to one apparent traditional knowledge report—Garner 2014. The report is useful and should be referenced but not as a traditional knowledge report. Garner measured bull and cow fat to show fitness levels between 2010 and 2014, and showed changes to health and body conditions. The study used community-based scientific methods to collect and analyze data.

The Tłı̨chǫ Government has a Research and Monitoring Program and Traditional Knowledge Research Program within their Culture and Land Protection Department. The Tłı̨chǫ harvesters observe and discuss caribou among themselves regularly. Furthermore, Petter Jacobsen has been reporting Tłı̨chǫ knowledge holders' information on caribou and the environment.

Information Request #3: How will male and female Tłı̨chǫ harvesters participate during the summer to examine barren-ground caribou winter habitat? Discuss how this can be incorporated into the traditional education program.

Parties Responsible: Tłı̨chǫ Government and Environment and Natural Resources

Rationale for IR #3: Tłı̨chǫ harvesters express the importance of knowing where the best "caribou food" is in the winter as well as the summer (Whàehdǫǫ̀ Nàowo Kǫ̀ 2014). Tłı̨chǫ also discuss the important of on-the-land programs for youth, elders and harvesters to learn traditional skills. Examining winter forage that the barren-ground caribou depend on during the summer is one of many traditional skills.

Response (TG and ENR): The Tłı̨chǫ Government understands the importance of knowing where the important winter feeding grounds (i.e., habitat) are for Barren-ground caribou. The IR assumes there will be such a program. We inform that such a TK-based program to examine winter habitat of the Bathurst herd in summer, has not been initiated, and as such it is premature to devote time and resources to issues like logistics and harvester participation.

That said, TG and ENR have committed in the proposal to a traditional education program. However, this program is still in its infancy. The traditional education program will involve input from experts of TK, education and biologists. This program cannot be created in the timeframe given so unfortunately it is not possible to supply the board with specific details at this time.

Information Request #4: Please explain why Tłı̨chǫ harvesters are being asked to harvest wolves rather than ENR staff killing the wolves in an efficient manner that will minimize the harm to both wolves and to Tłı̨chǫ people – especially women who interact with men whom ENR is targeting to harvest the wolves.

Parties Responsible: Tłı̨chǫ Government and Environment and Natural Resources

Response (TG and ENR): The IR assumed that there is a certain "pressure" to ask Tlicho harvesters to harvest wolves that is at odds with Tłı̨chǫ values. Tłı̨chǫ harvesters are not being asked to harvest wolves. Tłı̨chǫ harvesters are eager to help stop the declining herd numbers. The Tłı̨chǫ Government had several applications from Tłı̨chǫ People willing to go out on the land and harvest wolves. They are aware that they need guidance from elders. The TG, in an internal workshop, was informed that elders want something done about the wolf. Tłı̨chǫ elders want Tłı̨chǫ people to be a big part in the solution. ENR is not "targeting Tłı̨chǫ man to harvest wolves". Tłı̨chǫ harvesters are no longer willing to sit at home and not do anything to stop the decline of the Bathurst. Any suggestion that ENR might be asking Tłı̨chǫ people to harvest wolves for ENR is incorrect. The proposed wolf harvesting program will work out the logistics of timing and who harvests.

Information Request #5: Please provide how TG will ensure that traditional laws and rules with respect to wolves will be followed? How will the Tłı̨chǫ wolf harvester be selected?

Parties Responsible: Tłı̨chǫ Government

Response (TG): The WRRB "Rationale IRs #4 and #5" comments that the proposed wolf harvesting program approach appears "extremely disrespectful to Tłı̨chǫ and their values". That is not the intent of the wolf harvesting program; and in fact the proposed program is rooted in ongoing discussions between TG and Tlicho harvesters over the past several years, who recognize that recommended co-management actions for recovery of the Bathurst herd – including the management of aboriginal harvest and predators – requires support and participation of Tłı̨chǫ in order for those actions to be implemented and effective. Tłı̨chǫ have great respect for their traditional law and rules. The ongoing and high rate decline in the Bathurst herd is a management crisis that demands action. Tlicho harvesters have said that wolves are a problem. As harvesters of the Bathurst herd, TG asserts that Tłı̨chǫ need to be part of the solution and not leave management actions solely to others. We recognize the need to be sensitive to the views of people. No one will be forced to harvest wolves. The Joint Management Proposal at p. 13 states that:

Some believe that, from a cultural standpoint, Tłı̨chǫ people do not hunt wolves. By bringing in an Elder to explain to Tłı̨chǫ people that wolves are a problem and that Tłı̨chǫ should do something about it as long as one follows the traditional laws, more people will be motivated to go out on the land to harvest wolves.

The Tłı̨chǫ wolf harvester will be a person who is available, willing to participate and have the ability and interest to complete the harvesting task.

Rationale IRs #4 and #5: As the proposal states the harvesting of wolves program is at odds with Tłı̨chǫ values. Members of all the Tłı̨chǫ communities have said for years they will not kill

wolves because it is an animal with whom they have special spiritual relations. The proposed wolf harvesting approach appears extremely disrespectful to Tłı̨chǫ and their values. Over the years the elders have asked ENR biologists to harvest the wolves.

Information Request #6: How will the relationship Tłı̨chǫ have with caribou be incorporated into the management actions?

Parties Responsible: Tłı̨chǫ Government and Environment and Natural Resources

Response (TG and ENR): As the Tlicho really are the voices for the caribou, the management actions in the Joint Management Proposal are taken to protect the caribou for the future. The Tlicho Wenek'e (Land Use Plan) has the force of Tlicho law. We are so connected to the caribou that we could not think of creating land management zones that would not consider the caribou, their trails and our trails following the caribou as a critical part of setting out how Tlicho would deal with requests for development. At p. 29, the Tlicho Wenek'e states that:

Migratory Barren-ground Caribou
Migratory barren-ground caribou are a cultural keystone species; they have shaped the cultural identity of Tłı̨chǫ over millennia. They can also represent a meaningful indicator species for land use planning because of their important role in northern ecosystem processes. Barren-ground caribou affect the food chain of northern ecosystems through their simultaneous roles as large migratory grazers and primary prey for carnivores. There are two migratory barren-ground caribou herds that occupy on Tłı̨chǫ lands on a seasonal basis: the Bathurst herd and Bluenose East herd.

Bathurst Herd
The Bathurst herd is of significant importance to Tłı̨chǫ language, culture and way of life. The Tłı̨chǫ are still largely dependent upon barren-ground caribou for food and clothing, and crafts in modern era.

TG fully expects that the relationship it has with the caribou will be incorporated into the management actions:

a) Hunter Harvest: The development of subzones is intended to maximize the allowance for continued Tlicho harvest of Bluenose East caribou that might otherwise be commingled with Bathurst caribou in a "mobile conservation area". Respect for caribou will be promoted and hunter education is part of that. Tlicho will be involved in obtaining reliable harvest reporting as well as status and management of the herd.
b) Predator Management: The wolf management approach will be developed with Tlicho hunters and communities. Rationales for this have been provided in responses to IRs 4 and 5.
c) Monitoring: There will be increased Tlicho community based monitoring.

TG agrees that Tlicho culture and nature and intertwined as are our relations with animals. WRRB has heard this before. It will hear it again at the public hearings. With the greatest of respect, might it be that the WRRB is conflating the pragmatism that must come with a short term joint management proposal with being "one-sided". The issues facing Tlicho are stark. Caribou numbers are in crisis. Short term management levers are proposed to deal with that, which include but are not limited to:

1. Hunter Harvest;
2. Monitoring; and

3. Predator Management.

If the Joint Management Proposal was the only point of comment for Tlicho, the criticism would be even more pointed. However, the Joint Management Proposal is but one document contributing the entire process as contemplated in the Tlicho Agreement.

The public hearings will be Tlicho Government's opportunity to present its perspective on the management actions and as well as to have Tlicho citizens inform on their perspectives as Tlicho. The statement in the WRRB's "Rationale IR6" that there is a lot of literature on the indigenous perspective is of course correct. WRRB can use that literature as part of its deliberations and recommendations. Our perspective will be most evident in the upcoming public hearings and we welcome the opportunity to provide it.

The Tlicho perspective looks to the future as well as having to deal with the present crisis. In our letter to you dated August 25, 2015, we also look to WRRB leadership in assisting us in halting the decline of the herd and to medium and longer term solutions as well. We stated that:

Both GNWT and Tlicho Government have been in "reaction" mode as the decline of Caribou takes effect. "Emergency measures" and other approaches in this time of herd decline deal with trying to stop the decline and stabilize the herds through reductions in hunting only. But let's not fool ourselves here. We're dealing with the symptoms of the decline, not necessarily the reasons for it. Tlicho Government needs WRRB to engage seriously in the development of planning that maximizes the recovery of the herd and study carefully how predation [i.e. natural mortality], industrial development, roads, loss of habitat, etc. are contributing to herd decline. This year we are once all again dealing with measures [via hunting restrictions] to halt the decline of the herds, but everyone, including the WRRB, need to be focused on the causes of the decline and looking to a longer-term plan. To that end, Tlicho Government wants WRRB to recommend on management action planning that emphasizes addressing the multiple causes of the decline and a long term plan that includes all harvesters of these herds throughout the range of these herds.

Rationale IR #6: The proposals should better represent the Indigenous perspective and relationships that are relevant to successful management actions. The proposals should clearly outline how Indigenous and Western perspectives can work together and complement each other. This is a very one sided document that builds on the western ideology that nature and culture are separate; that humans and animals are separate. This is not the ideology of most Indigenous peoples. Tłı̨chǫ culture and nature are intertwined as are their relations with animals.

Although the proposals do mention 'respect', they ignore the relationship that comes with the perspective that nature and culture are bound, and caribou and Tłı̨chǫ are intimately related, as John B Zoe (*Rangifer:* 2012:21-22) clearly stated when he said,

> *"One of the things that I heard from elders is that we've been living with the caribou for centuries and we have stories of how animals and people emerged from one another. So we as traditional knowledge holders are really the voices for the caribou.*

There is extensive traditional knowledge literature on human-animal relations. Much of this literature discusses this. See for example the special issue of Rangifer (2012) that includes

articles by Walter Bayha, John B Zoe, Danny Beaulieu, Joseph Judas, Fred Sangris, Gabriel Nirlungayuk, and Devalynn Pokiak; Ingold (2000); and Tłı̨chǫ Government (2008). There is also literature on workable management solutions.

Information Request #7: What logistical support will be made available for communities and schools to hire Elders to work alongside the aboriginal teachers to teach Tłı̨chǫ practices and laws associated with caribou? See also #3.

Information Request #8: What logistical support will be made available for communities to bring Elders and harvesters together with their families to discuss and maintain traditional practices? See also #3.

Parties Responsible: Tłı̨chǫ Government and Environment and Natural Resources

Response (TG and ENR): The WRRB's Rationale for IRs #7 and #8 stated that the description of the hunter education program could be interpreted that ENR staff will oversee the teaching of traditional practices. We assume this comes from the statement in the Joint Management Proposal at page 11 that:

In response to community demands, ENR is currently developing a Hunter Education program. A working group developed materials which are currently out for review with individuals, boards, agencies and organizations involved in the Wildlife Act creation. There are 8 sections in the program (the responsible hunter, ecology and wildlife management, hunting laws, firearm safety, hunting skills, planning and preparation, the hunt and survival skills).

Tłı̨chǫ Government and GNWT welcome the opportunity to clarify. ENR will not oversee the teaching of traditional practices. The Hunter Education program is one instrument in sharing knowledge about hunting practices.

IR#7: Tłı̨chǫ Elders will continue to be involved in community meetings, presentations and the schools on traditional practices. As for logistical support, Tłı̨chǫ Government and GNWT will work together to ensure that the communities and schools will have the access they need to Elders work alongside aboriginal teachers.

IR#8: Tłı̨chǫ Government expects to be involved in ensuring that Elders and harvesters are brought together with their families to discuss and maintain traditional practices. Meetings will have to be organized and Tłı̨chǫ Government can provide that logistical support. Tłı̨chǫ people will also tell their government what kind of support they will need for the discussion and maintaining of traditional practices and Tłı̨chǫ Government will respond.

Rationale for IRs #7 and #8: The proposals recommend a hunter education program, with emphasize on traditional practices. At the moment the description of this program is vague and could be interpreted that ENR staff will oversee the teaching of traditional practices.

References Tłı̨chǫ Knowledge-related IRs:

Garner, K. 2014. *Tłı̨chǫ Caribou Health and Condition Monitoring Program*. Final Report. Behchokǫ̀: Department of Culture and Lands Protection, Tłı̨chǫ Government.

Haugerud, Rolf Egil (ed). 2012. *Rangifer: Proceedings of the 13th North American Caribou Workshop*. Norway: Nordic Council for Reindeer Husbandry Research. Special Issues No 20. (Includes articles by Walter Bayha, John B Zoe, Danny Beaulieu, Joseph Judas, Fred Sangris, Gabriel Nirlungayuk, and Devalynn Pokiak)

Ingold, Tim. 2000.*The Perception of the Environment: Essays in Livelihood, Dwelling and Skill*. London: Routledge.

Tłı̨chǫ Government, 2008. *Monitoring the Relationship between People and Caribou*. Yellowknife: West Kitikmeot Slave Study Society.

Whàehdǫǫ̀ Nàowo Kǫ̀ 2014. *Caribou Migration and the State of Their Habitat*. Behchokǫ̀: Tłı̨chǫ Traditional Knowledge Reports: Series 2 (originally published in 2001 by West Kitikmeot Slave Study Society).

Science-related Information Requests; IRs #9-18

Information Request #9: Please provide measurable objectives and criteria to measure success or failure for the proposed actions (a zero harvest and community wolf removal on the winter ranges).

Parties Responsible: Tłı̨chǫ Government and Environment and Natural Resources

Rationale IR #9: Specific objectives and criteria to measure their success or failure are essential for the proposal to be accountable and are typically required for management proposals. WRRB management proposal format specifically requires the desired outcomes of the proposed management action. The objectives could include projected changes in adult survival rates; an estimation of caribou that will be added annually to the herd and the number of predators removed.

The proposal does not describe the likelihood of success of the Tłı̨chǫ camp-based removal which has an initial "goal' of removing 100 wolves although it is not specified the removal is through trapping or shooting. The proposal describes annually evaluating the project but not the basis for the annual evaluation. Reviews of wolf management emphasize the need to remove entire packs rather than fragment them so this should be included as criteria for success. The existing monitoring information should be presented to evaluate the likely success relative to the availability of wolves such as the wolf sighting rate: for example, during 2009-2012 late winter composition surveys, only 10-20 wolves were sighted in packs averaging 2-4 wolves (averages 1 wolf/flying hour).

Response (TG): Relative to ENR's recent data on adult female survival and abundance of breeding females in the Bathurst herd, TG does not expect to see a measurable response in the caribou population that could be attributed directly to implementing a zero harvest of caribou for the Bathurst herd. The reason for not expecting a measurable response to a zero TAH (total allowable harvest) is that a harvest closure only provides a small incremental reduction of the Bathurst caribou harvest from levels that have been substantially reduced since 2009/2010 (see Summary Table below).

The apparent stability observed between the 2009 and 2013 estimates of breeding females (r = -0.015) suggested a measurable benefit of harvest management actions since 2009 (i.e., emergency harvest closure in 2009, recommended harvest targets from 2010 – 2014, followed by emergency measures in 2015 – see Summary Table below), when compared to the previous high rate of decline in breeding females observed between 2006 and 2009 (r = -0.402). However, with the 2015 calving ground survey results showing a population trend with a halving time of ~3 years (r = -0.227) relative to the 2013 survey, it is unlikely that reducing a reported harvest of less than 250 to zero will elicit a measurable population level response. For example, even under a scenario where the average annual harvest were 250 with 40% females, the number of cows harvested annually (250 x 40% = 100 caribou) would represent ~1.2% of the 8,075 breeding females estimated on the Bathurst calving ground in June 2015. Thus, even if hunting mortality were completely additive to natural mortality, the expected benefit in this example would be an increase in annual adult female survival on the order of 1-2%. This amount of change in survival is not detectable with current methods.

Summary Table of annual reported Bathurst caribou harvest 2006 – present.

Hunting Season	Bathurst Caribou Herd - Reported Harvest: Northwest Territories	Nunavut	Total	% Cows Estimated in NWT	Reference / Notes
2015/2016	~20	70	90	?	Caribou shot outside the mobile area (see below) around Wekweeti. Zero harvest recommended by TG and GNWT in joint management proposal to WRRB (2015)
2014/2015	0	70	70	0%	GNWT established Mobile Core Bathurst Caribou Conservation Area (Jan. 2015); TG and YKDFN allocated 15 ceremonial harvest tags respectively but no caribou were hunted. An annual allotment of 70 commercial tags for Bathurst caribou are provided to Adventure Northwest from the Government of Nunavut.
2013/2014	167	67	234	37%	http://wrrb.ca/sites/default/files/2013-2014%20BGC%20Harvest%20Summary%20Report%20_%20FINAL_Oct15_2015.pdf
2012/2013	166	36	202	32%	http://wrrb.ca/sites/default/files/2012-2013%20Harvest%20%20Monitoring%20Summary%20Report-FINAL_Oct28.pdf
2011/2012	135	70	205	19%	http://wrrb.ca/sites/default/files/2011-2012%20Harvest%20Monitoring%20Summary%20Report_FINAL_04July2014_1.pdf
2010/2011	213	?	213	44%	BGTWG Barren-Ground Caribou Harvest Summary Winter 2011 (Draft 25 July 2011)
2009/2010	300	?	300	65%	TG and GNWT (2010) Revised Joint Proposal on Management Actions in Wek'èezhìı: Appendix 4.
2006 - 2009 (average)	4000-7000	?	5000+	67-71%	Boulanger et al. 2010; p. 890 ("*…, we used an estimate of 3,000 – 5,000 cows and 1,000 – 2,000 bulls/yr as the likely range of harvest totals from the Bathurst herd in recent years.* ")

Indeed, the TG's rationale for recommending and supporting a harvest closure for the Bathurst herd is not specifically to expect an immediate and measurable population response, but is based on i) the precautionary principle, which applied in this management situation, seeks to eliminate any direct and additive sources of mortality to Bathurst caribou caused by people, and ii) the rationale that a harvest closure will encourage co-management partners to actively support and implement additional recovery management and monitoring actions that will focus on reducing predation and disturbance to caribou and habitat.

The proposed community-based winter wolf hunting program is envisioned as a pilot program that will be implemented by TG, but with strong support and collaboration from GNWT. The pilot phase of the community-based program is intended to build capacity within Tlicho communities by training, supporting, and coordinating Tlicho hunters to become effective wolf hunters and trappers, with a strong foundation in Tlicho knowledge and respectful practices, combined with current skinning and hide preparation practices that are used and recommended by taxidermists and fur auction houses. The specific objectives of the pilot for this coming winter are to train at least 4-6 Tlicho harvesters to become proficient wolf hunters and trappers, with a focus on the community of Wekweeti.

The focus of the pilot is to build capacity for Tlicho to become effective wolf hunters and trappers; the next phase will focus on achieving numerical objectives for wolf removals. TG anticipates that the potential benefit of the community-based wolf hunting pilot program to the Bathurst herd will be dependent on the number of wolves that are removed from within the Mobile Core Bathurst Caribou Conservation Area during winter because those are the wolves that are preying on Bathurst caribou.

Response (ENR): Table 1 in the joint management proposal for the Bathurst herd included monitoring criteria and levels in the monitoring that would be consistent with objectives being met or not met. Adaptive change options are also listed in the table. This table is appended below.

The proposed wolf harvest pilot program has an initial objective of harvesting 100 wolves from the Bathurst winter range by Tlicho hunters. Wolf harvest and effort by hunters will be monitored, as well as subsequent caribou calf and cow survival rates. After the first winter, the relative success of the program will be assessed and the objectives and methods will be re-considered. In order to review the pilot program, TG and ENR will define a basic framework and initial assumptions that will be used to evaluate potential effectiveness of wolf removals on the Bathurst herd. Thus depending on the number of wolves removed, assumptions will be developed on i) age-sex composition of the herd, ii) proportion of age-sex classes in average individual wolf diet, and iii) average kill rates of wolves to explore plausible changes in adult female and calf survival. TG and ENR anticipate that this simplistic approach will support the feasibility assessment to be undertaken by ENR, and may be integrated in to program rationale and design of a larger scale wolf management proposal to be jointly developed by TG and ENR and submitted to the WRRB.

Results of the feasibility assessment ENR will lead may provide better insights into the estimated wolf population associated with the Bathurst herd and the number of wolves that might need to be removed to have substantive effects on caribou survival rates.

Table 1, Part 1. Biological monitoring of Bathurst herd

Indicator(s)	Rationale	Desired Response	Adaptive Management Options	How Often	Notes
1. Numbers (density) of 1+ year old caribou on calving ground from reconnaissance surveys	Provides index of number of breeding cows on calving grounds; number of 1+ year old caribou correlated with number of breeding females.	Increasing trend in numbers of 1+ year old caribou on annual calving ground.	If trend in 1+ year old caribou is increasing, continue as before; if trend stable-negative, re-consider management.	Annual (between photo-surveys)	Precision improved 2013 using 5-km spacing between flight lines.
2. Estimate of breeding cows from calving ground photo survey	Most reliable estimate for abundance of breeding cows & can be extrapolated to herd size based on pregnancy rate and sex ratio.	Increasing trend in numbers of breeding cows by 2018.	If trend in breeding cows increasing, continue as before; if trend stable-negative, re-consider management.	Every 3 years	Last surveys 2009, 2012, 2015, next in 2018. Trend in breeding females is most important for herd trend.
3. Cow productivity; composition survey on calving ground in spring (June)	Relatively low calf:cow ratio in June 2009 – many sub-adult cows not yet breeding; establishes basis for potential calf recruitment through fall & winter.	High calf:cow ratio (80-90 calves:100 cows).	Low ratio indicates poor fecundity and poor nutrition in previous summer; survey data integrates fecundity & neonatal survival.	Every 3 years	Essential component of calving ground photographic survey.
4. Fall sex ratio; composition survey (October)	Tracks bull:cow ratio; Bathurst ratio increased from 31-38 bulls/100 cows 2004-2009 to 57-58/100 in 2011-2012; prime bulls key for genetics, migration.	Maintain bull:cow ratio above 30:100.	If bull:cow ratio below target, consider reducing bull harvest. Fall calf:cow ratios indicate spring & summer calf mortality relative to June ratios.	Every 2-3 years	Needed for June calving ground photographic survey – extrapolation to herd size. Provides fall estimate for calf:cow ratio.
5. Calf:cow ratio in late winter (March-April); composition survey	Herd can only grow if enough calves are born and survive to one year, i.e., calf recruitment is greater than mortality.	>40 calves:100 cows on average.	If average calf:cow ratio ≥ 40:100, continue as before; if average ratio ≤ 20:100, herd likely declining; re-evaluate management.	Annual	Calf productivity & survival vary widely year-to-year, affected by several variables, including weather.
6. Cow survival rate (estimated from OLS model, including collar data)	Cow survival estimated 67% in 2009, 78% in 2012 (from model). Need survival of 83-86% for stable herd.	Increase to 83-86% by 2018	If cow survival increases to 83-86%, continue as before; if survival stays below 80%, re-assess harvest & wolf management.	Regular (every 3 years)	Population trend highly sensitive to cow survival rate; recovery will depend on increased cow survival.
7. Maintain 50 collars on Bathurst herd (30 cows & 20 bulls, with annual increments)	Reduce uncertainty in defining winter herd distribution; improve confidence in assigning herd identity to hunter-kills and improve overall harvest management; provide a direct & more precise estimate of adult female survival	More reliable harvest management & improve datasets for OLS model analysis of demography.	Develop options for implementing new management zones with Tłı̨chǫ̨ communities; has potential for improved zoning strategies that permit more flexible and effective harvest management.	Annual deployment of collars to maintain 50 on the herd	Tracking movements and locations of collared bulls (n=20) would assist in directing hunters to areas with bulls.
8. Monitor annual indices of environmental conditions	Indices of range condition, drought index, warble fly index may help explain trends in calf:cow ratios, pregnancy rates	Indices positive for herd, but focus is explanatory.	Adaptive management does not apply but indicators may help explain and predict possible herd responses	Annual	Trends in environmental indices may help explain underlying drivers of change in herd trend.

Table 1, Part 2: Harvest monitoring of Bathurst herd & monitoring of wolves and wolf harvest

Indicator(s)	Rationale	Desired Response	Adaptive Management Options	How Often	Notes
9. (Harvest) Numbers of cows and bulls taken by all hunters	Cannot assess effectiveness of management if harvest is poorly tracked; harvest well over target could lead to further decline.	Compliance with 0 harvest of Bathurst herd	If unplanned harvest occurs, review/revise harvest reporting & management immediately	Annual	As recommended harvest will be 0, frequent monitoring by ground patrols and aerial patrols will be needed to ensure compliance.
9. Numbers of wolves killed/year	Wolves are main non-human predator on caribou; natural cow and calf survival rates should increase at low wolf numbers.	Increasing # of breeding caribou cows, increased cow survival. Annual wolf harvest increased to 80-100.	If cow numbers, survival increasing, continue as before; if trend stable-negative, re-assess management.	Annual	Experience in Alaska & elsewhere indicates need to remove significant numbers of wolves for several years to affect caribou survival rates.
10. Wolf abundance	Index of relative wolf abundance	Declining trend in wolf abundance		Regular, pending wolf monitoring review	ENR to review methods of monitoring wolf abundance. Input & collaboration from Dean Cluff, other biologists.

Information Request #10: Please outline additional management actions and criteria for their rapid implementation if the proposed zero harvest and community wolf removal do not increase adult survival in 2016.

Parties Responsible: Tłı̨chǫ Government and Environment and Natural Resources

Rationale IR #10: Losing about a quarter of breeding females each year without the ability to take immediate and effective actions to increase adult survival leads to a high likelihood for loss of the Bathurst herd within a few years. The 2016 Joint proposal is similar to the 2010 proposal in limiting harvesting and a community-based wolf removal which did not halt the current high rate of loss of breeding females.

The proposal should outline additional management actions so they can be implemented swiftly given the accelerated rate of decline of breeding females. More use should be made of existing monitoring information rather than deferring actions to undertake reviews for possible monitoring. For example, in 2013, 15 occupied dens were recorded (Klaczek 2015) which, if removed, at a rate of 30 wolves and 20-25 caribou/wolf/year would increase the number of caribou to 600-900 caribou/year.

Response (TG): TG considers harvest and predator management as two wildlife management levers that can be applied to initiate and support recovery of the Bathurst herd. Monitoring of management actions and response indicators is required to evaluate whether actions were implemented (what was done) and the effectiveness of those actions (was the desired result achieved).
With respect to harvest management, the recommendation for harvest closure will require ongoing community-based monitoring to establish compliance and minimization of any unintended harvest of Bathurst caribou.

With respect to predator management, the community-based winter wolf hunting pilot program is intended to be expanded in geographic scope and number of wolves removed, with increased hunter and Tlicho community participation within Wekeezhi. A TG workshop in late 2015 held with community members and elders led, in part, to the inclusion of the pilot wolf harvest program in the joint management proposal, and included a recommendation that an aerial wolf cull led by government was not an appropriate way to increase wolf kill rates. The initial pilot program is focussed in the community of Wekweeti. However, implementation of more extensive predator management actions in Wekeezhi will require a full and detailed joint management proposal to the WRRB, which TG anticipates will occur in 2016/2017 following the ENR technical review; additional support and partnership from other aboriginal organizations will also be sought out. To consider a broader scope of predator management actions across the annual range of the Bathurst herd, it is necessary to engage the Government of Nunavut (GN), Inuit organizations and respective wildlife management authorities in Nunavut.

As part of the implementation and review of its community-based winter wolf hunting pilot program, Tlicho Government will communicate with the Government of Nunavut and respective Inuit organizations and wildlife management authorities to encourage active participation of Inuit communities in management and monitoring of predators on the Bathurst range. TG will also engage the ENR Minister and recommend collaboration with GN on the ENR-led predator management technical review, with a goal for implementation of predator management across the Bathurst Range,

with support, collaboration, and coordination with communities and respective wildlife management authorities in the Northwest Territories and Nunavut.

Tłı̨chǫ Government has called for more planning that maximizes the recovery of the herd and study carefully how predation [i.e. natural mortality], industrial development, roads, loss of habitat, and environmental conditions may be contributing to herd decline. This integrated approach to planning and monitoring is required in order to understand the relative influences of potentially multiple factors that are influencing the population health of Bathurst caribou through vital rates of survival and reproduction.

Response (ENR): Management actions taken in 2010, particularly the 95% reduction in harvest, were effective in shifting the Bathurst herd from rapid decline 2006-2009 to an approximately stable trend 2009-2012. Increased calf recruitment and possibly an increase in natural survival rates of adults also contributed substantially to the abrupt shift in population trend.

It is important to keep in mind that humans have a limited control of the population trend of a migratory caribou herd like the Bathurst. Recent information and studies about increasing drought conditions on the herd's summer range suggest that the recent declining trend is in part driven by poor environmental conditions; these are not subject to management. Active management options that could reverse the herd's current declining trend in the short-term are limited. Harvest has essentially been reduced to 0, except for the harvest of about 70 bulls in Nunavut; the only remaining option that could substantially alter caribou calf and adult survival rates in the short-term is large-scale reduction of predators.

ENR has committed to leading a full review and feasibility assessment of predator management options to address declining trends in barren-ground caribou herds. This review and assessment will be conducted in 2016 to inform decisions on ongoing and future actions. It is important to bear in mind that views about appropriate methods of increasing wolf harvest are diverse within the NWT, as they are elsewhere in North America. A TG workshop in late 2015 held with community members and elders led, in part, to the pilot wolf harvest program included in the joint proposal intended to increase wolf harvest in a culturally appropriate and acceptable manner. Discussion with Alaska Fish and Game biologists about wolf control programs in that state have provided insight into the criteria used to assess when intensive wolf management will be implemented to support ungulate populations. In general, intensive wolf management is only considered when wolf predation is considered to be a significant or limiting factor for caribou populations, and wolf management actions are expected to result in increased calf and/or adult survival rates by reducing the impacts of predation. More intensive wolf reduction options should be considered, given the herd's size and trend, but will need to be assessed carefully before any more intensive actions are taken. The WRRB has indicated in correspondence 2015-2016 that any more intensive wolf or predator reduction programs would need a separate management proposal to be considered by the board.

Information Request #11: Please provide annual 2009-2015 harvests including the possible range of inadvertent harvests (based on analysis of winter distribution).

Parties Responsible: Tłı̨chǫ Government and Environment and Natural Resources

Rationale IR #11: Information on the likely range of annual harvests could determine the extent that harvesting or other sources of mortality have contributed to the annual rate of decline. An analysis of winter collar distribution of neighbouring herds could be used to describe the likelihood of inadvertent harvesting which is necessary to determine the effectiveness of proposed management actions. The proposal contends that management zones "were generally

effective at limiting Bathurst harvest, but in some winters (e.g. 2013) Bathurst collared cows were found west and east of these 2 zones and may have experienced additional harvest pressure in those areas (ENR 2014a). The reference gives the harvest for 3 winters (2010-11:213 caribou; 2011-12: 87 caribou, 2012-2013: 166 caribou) but not more recent winters. There is no analysis of harvest levels based on the number of collars in and out of the two management zones and relating them to the approximate harvest levels.

Response (TG): As highlighted in IR #10 above, TG considers compliance with a zero TAH for Bathurst caribou to be very important, and will support the recommended harvest management strategy through ongoing community engagement and education with its communities. TG will also continue to support community-based monitoring of the Bluenose East caribou harvest in order to provide the relevant information (i.e., harvest dates and locations) that will minimize the possibility for any unintended harvest of Bathurst caribou.

Response (ENR): Updated estimates of Bathurst harvest, including fall and winter in RBC02 and RBC03 and Nunavut harvests where available, are 2010:300, 2011:213, 2012:205, 2013:202, 2014:234, and 2015:70 (the 70 assumes that all Bathurst Inlet tags were used on sports hunts). The average for 2010-2014 is 231 caribou/year. Sex ratio has not always been recorded accurately but the sex ratio of the harvest has varied and sometimes was unknown, with about a 60% bull harvest overall when the Nunavut harvest is included (all bulls).

Assessing the possible level of additional Bathurst harvest in zones outside RBC02 and RBC03 is difficult, particularly as the number of Bathurst collars has not exceeded 20 at any time. When dispersed over several management zones, 12-15 collars provide a sense of the herd's distribution but not a precise estimate of the numbers of caribou in each zone. Analysis by J. Boulanger in the past has indicated that at least 20 collars per management zone would be needed to define the herd's distribution and relative abundance; the example that follows is based on much lower collar numbers. An example of possible harvest of the Bathurst herd in 2013 is provided here, but the results should be considered approximations only, given the multiple untested assumptions involved.

In 2013 BNE winter collar locations included 9,494 in total and 3,528 in RBC01 (all numbers from ENR2014a). The herd was estimated at about 68,000 caribou in 2013. If those locations are proportionate to the herd's numbers, then 3528/9494 x 68,000 or 25,269 BNE caribou were in RBC01. In 2013, 501 of 2114 total Ba winter locations were in RBC01. If the herd was 30,000 in 2013 (35,000 in 2012 and 20,000 in 2015), then 501/2114 x 30,000 or 7110 Ba caribou were in RBC01. RBC01 was generally the site of the main harvest of BNE caribou. In winters 2010-2014, the estimated BNE harvest averaged 2700 caribou, although the true harvest was likely higher. If a harvest of 2700 occurred in RBC01 in proportion to BNE and Ba caribou found there, then 640 Ba caribou and 2060 BNE caribou could have been taken, a high proportion of them cows. Based on collar maps, 2013 was a year of widespread Ba collar distribution; in other winters 2010-2014, Ba collar distribution in RBC01 was limited and inadvertent Ba harvest was likely much less. It is possible that the inadvertent Ba harvest outside zones RBC02 and RBC03 exceeded the harvest in those 2 zones in 2013.

Information Request #12: Please provide annual estimates of adult survival from 2009 to 2015 and an analysis relating the level of harvesting to the rate of decline.

Parties Responsible: Environment and Natural Resources

Rationale IR #12: The proposal does not provide a mechanism for the decline of breeding

females at a rate of about 23% per year since 2012 despite harvest restrictions. Adult survival increased 2009 to 2012 from 67% to 78% but the 2012-2015 levels are not presented. Table 1.2 in the proposal states survival needs to be 83-86% for a stable herd size but it is unclear as to the extent to which adult survival has to be increased to reach the threshold for stability or how it will vary with calf survival. The calf cow ratios are high even in 2012 which suggests that adult mortality must be high to be driving the observed rate of decline. Calf:cow ratios were high 2009-2011 (45±0.03 SE) then decreased for 2012 (25:100) and 2014 (32:100) - the 2015 results should be provided.

Response (ENR): ENR will provide a draft report on the Bathurst June 2015 calving photo survey in the near future, which will include an updated demographic analysis and evaluation of factors contributing to the decline. Population trend in barren-ground caribou is most sensitive to adult cow survival rates and analyses by Boulanger et al. (2011) and Crete et al. (1996) demonstrated that herds are likely to be declining if cow survival is below 83-86%, as noted in the question. ENR's demographic analyses have generally been carried out at intervals of 3 years because of the population surveys carried out at those intervals. Annual estimates of cow survival are feasible with herds where there are 100 or more collared caribou (e.g. Western Artic Herd, Porcupine Herd), which provides a strong data-base for annual estimation of cow survival rates, but is difficult with the much lower numbers of collars on the Bathurst herd. Previous estimates of Bathurst cow survival were 86% in 1985, 76% in 2006 and a low of 67% in 2009 (Boulanger et al. 2011). These analyses were updated in 2016 by J. Boulanger and indicate a recent cow survival rate of 78% for 2012 and 77% for 2015 (Boulanger et al. 2016, preliminary estimate). The most recent analyses suggest that a continuing low cow survival rate and low calf recruitment since 2012 have both contributed substantially to the Bathurst herd's most recent decline (Boulanger et al. 2016). The late-winter 2015 calf:cow ratio was 24 calves:100 cows. Although a spring calf:cow ratio was not recorded in 2013, a fall composition survey in 2012 provided a calf:cow ratio of 24:100; based on past experience, this would translate to a spring calf:cow ratio of at most 24:100 and likely less. Thus 2015 marks the 4th consecutive year of low recruitment in the Bathurst herd.

Information Request #13: Please provide the seasonal rate of collar loss as an indicator for adult survival rates.

Parties Responsible: Environment and Natural Resources

Rationale IR #13: In other jurisdictions, the timing and rate of collar loss is used as an indicator for adult survival. Knowing the relative seasonal and spatial patterns will inform the proposal on possible causes of mortality and consequent management actions. For example, collar loss on the post-calving and fall ranges may reveal predation.

Response (ENR): ENR has contracted statistician/modeler John Boulanger to analyse the locations and season of collared caribou mortality for a number of NWT herds to identify periods and areas in which collared caribou have died. This analysis and report are expected in 2016 and will be provided when a completed report is available. Initial review of timing of Bathurst collared caribou mortalities in recent years by ENR staff has suggested that mortalities happen throughout the year but appear to be most common in the late summer or early fall. ENR has also increased its efforts in recent years to check on mortality of collared caribou when the collars become stationary; however collared caribou are often in very remote areas and are rapidly scavenged making it difficult to identify cause of death with confidence.

The number of collars on the Bathurst herd is 30 or less on females (20 on bulls), but only as of

March 2015. Previously there had been a maximum of 20 collared cows in the Bathurst herd. This limits the confidence on survival estimation from collared caribou. In Alaskan herds like the Porcupine and Western Arctic Herd, and the George River Herd in Quebec/Labrador, there are often 100 or more collared caribou, which provides a much stronger data-base for annual estimation of cow survival rates. A key demographic parameter for population trend is the adult cow survival rate; several studies have shown that adult cow survival needs to be at minimum 80-85% for a herd to be stable (e.g. Crete et al. 1996, Boulanger et al. 2011). Analyses of cow survival rate in the Bathurst herd have been carried out using a population model that uses all sources of demographic information for the herd, including collar-based information. Previous estimates of cow survival were 86% in 1985, 76% in 2006 and a low of 67% in 2009 (Boulanger et al. 2011). These analyses were updated in 2016 by J. Boulanger and indicate an estimated cow survival rate of 78% in 2012 and 77% in 2015 (Boulanger et al. 2016, preliminary estimate). The most recent analyses suggest that a low cow survival rate and low calf recruitment have both contributed to the Bathurst herd's most recent decline (Boulanger et al. 2016).

Information Request #14: Please provide rates of change in the number of breeding females when environmental variability is included. The analyses will reveal the annual range of outcomes depending on environmental variability for the increase in the numbers of breeding females resulting from the zero harvest and community wolf removal.

Parties Responsible: Environment and Natural Resources

Rationale IR #14: The proposal mentions a further decline is possible but does not explain what the whether the basis for a further decline is the failure of the proposed zero harvest or community wolf removal or whether it is the effect of environmental variability such as this dry hot 2014 summer which likely reduced pregnancy rates. Environmental variation may accentuate the extent of recovery actions or mask them. Environmental variation should not be a separate and possible monitoring activity but part of assessing effects of management actions. For example modeling projects that the difference between a years with a high number of plant growing degree days (and effects on pregnancy rates) after 3 years can differ by 700 caribou relative to a years with a low number of plant growing degree days.

Response (ENR): ENR has requested of Don Russell (caribou biologist in Whitehorse) a summary of environmental trends 1979-2014 for NWT barren-ground caribou herds based on the MERRA climate database maintained by the CARMA group (Circum Arctic Rangifer Monitoring and Assessment), with an interpretation of herd-specific trends and their implications to each herd. ENR expects those results in the early part of 2016 and will make them available to the WRRB and other interested parties as soon as a report is available. A recent paper by Chen et al. (2014) found a correlation between spring calf:cow ratios in the Bathurst herd and a composite index of summer range productivity, with a time lag, with the suggested mechanism being poor summer feeding conditions leading to poor cow condition and low pregnancy rates the following winter and reduced calf ratios the following year. In addition, statistician/modeller J. Boulanger has begun to work with key environmental trend variables (e.g. drought index, warble fly index, growing degree days) to assess the correlation between these variables and caribou vital rates using the OLS population model he has used for the Bathurst herd for several years. As an example of key trends, Fig. 1 below shows trends in the July drought index based on the MERRA climate data-base for the Porcupine and Bathurst herds. The drought index has been relatively low and declining for the Porcupine range while the Bathurst drought index has increased from 2009 to 2014. This trend may be an indication that drought has led to poor summer feeding conditions for the Bathurst herd, which could be correlated with reduced cow condition in the fall and a low pregnancy rate, and a subsequent low

recruitment ratio in late winter.

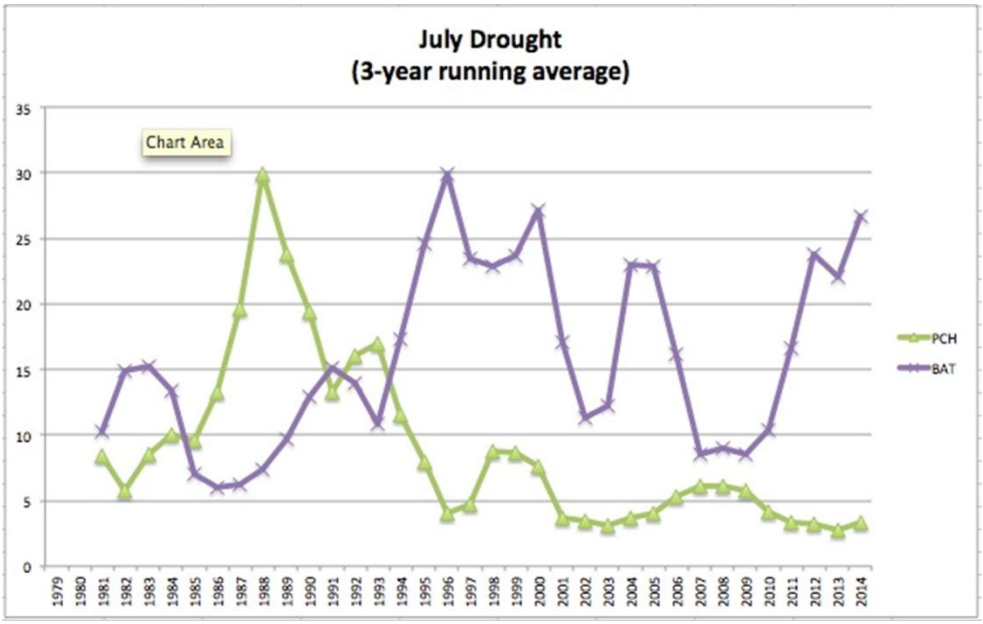

Fig. 1. Changes in the July drought index 1979-2014 for the Porcupine and Bathurst caribou summer ranges, courtesy of D. Russell, Whitehorse (presentation to International Porcupine Caribou Board Nov. 2015)

Information Request #15: Please provide results of the annual monitoring of occupied wolf dens since 2009 and the rate of wolf sightings during calving ground and late winter calf:cow surveys.

Parties Responsible: Environment and Natural Resources

Rationale IR #15: Information from on-going monitoring is required to support additional actions. Up until 2012, the sighting rate of wolves on the late winter range did not show a decrease* (despite reduced wolf numbers) but the sighting rate on the calving grounds had increased up to 2012. The wolf den information is a minimum number of wolves and using annual variability in sampling effort could lead to an estimate and associated variance. The current monitoring of dens in the summer does not completely relate to occurrence of wolves on the winter ranges as wolves from neighbouring herds may be present.
*Information in Species At Risk assessment for barren-ground caribou 2013 draft

Response (ENR): ENR will provide information on the rates of wolf sightings during spring composition surveys of BNE caribou and on wolf sightings during calving ground caribou surveys, under separate cover. ENR carried out an evaluation of the reliability of estimating wolf numbers from late-winter caribou recruitment surveys (Frame and Cluff 2011) and concluded that the high variability of incidental wolf observations and relatively low coverage of caribou surveys means that defining wolf numbers precisely from these surveys is difficult.

A thesis study by M. Klaczek (2015) on the ecology of wolves on the Bathurst caribou range will also be provided. Klaczek's study included observations of wolves at dens from the Bathurst summer range and his results suggest that abundance and productivity of wolves on that herd's range have declined substantially since the late 1990s when the herd was much larger. It seems likely that caribou herds that have declined by 90% or more will support fewer wolves, although the effect of wolf predation in declining herds or herds at low numbers may still be important and is likely to be greater than in herds at high numbers (Seip 1991). Two graphs of the number of active wolf dens and the mean number of wolf pups at dens in late summer by M. Klaczek were provided in ENR's 2014 summary on monitoring of the

Bathurst and BNE herds, and are shown below.

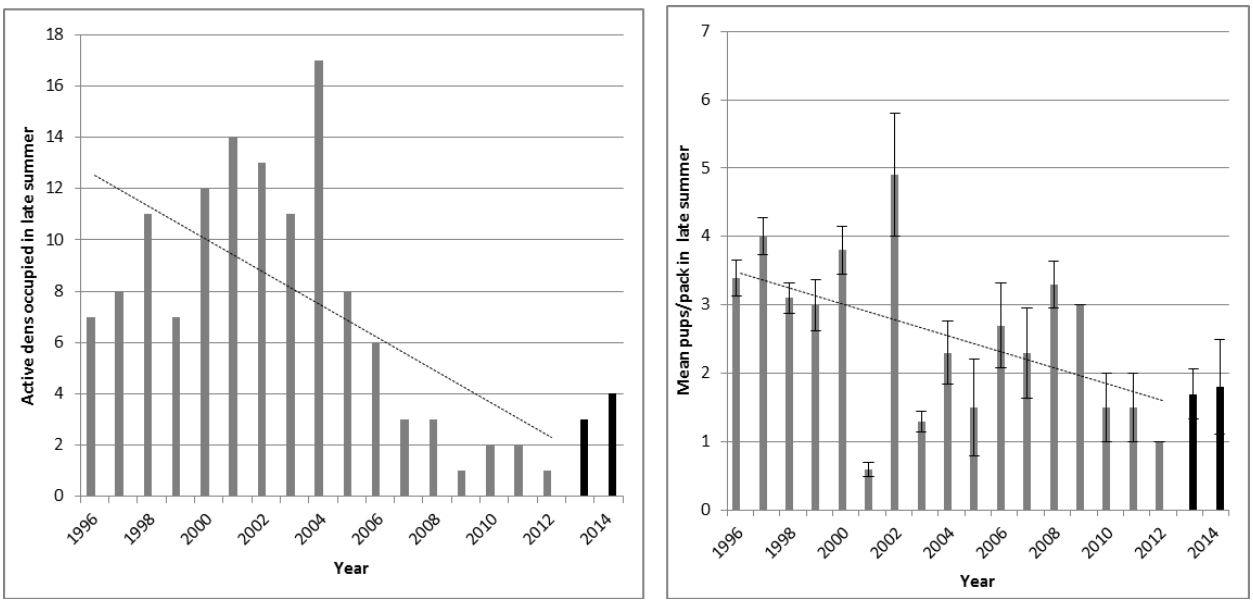

Figure 2. Observed a) number of active dens and b) pup recruitment (± SE) during annual aerial surveys (1996-2012) and repeated aerial/ground based surveys of tracked individual packs (2013-2014) on the summer range of the Bathurst herd, Northwest Territories and Nunavut Canada.

Obtaining precise estimates of wolf numbers on large remote ranges is difficult as their overall numbers are low and they tend to be clumped as packs. Surveys to count wolves require high coverage and intensive flying to identify wolf tracks and follow them to find the wolves (Gardner and Pamerin 2014; Mattson et al. 2009). ENR is reviewing methods of monitoring wolf abundance in the NWT and considering the use of wolf survey methods that have been used elsewhere. In addition, ENR will carry out in 2016 a review and feasibility assessment of methods of reducing wolf numbers in caribou range, and identify potential options for reducing wolf predation on the Bathurst herd in order to support increased caribou survival rates. The feasibility assessment will include a collaborative element that includes Aboriginal governments and co-management boards. Views about killing wolves and other predators are often polarized and in some communities wolf trapping or hunting would need to consider cultural beliefs about acceptable methods. Any programs to increase wolf harvest will need to include monitoring of the number of wolves taken, the effort from hunters or trappers to kill the wolves, and continued monitoring of caribou demographics (pregnancy rate, calf recruitment, cow survival) to assess whether wolf reduction is effective.

Information Request #16: Please provide trends in the size and location of seasonal ranges and describe implications of the changes for management actions.

Parties Responsible: Environment and Natural Resources

Rationale IR #16: Calving ground size (and thus density) have changed which is both an indicator for the extent of the decline as well as important in census design. Changes in the location of post-calving and fall ranges have implications for harvest and predator management.

Response (ENR): ENR has not carried out a systematic assessment of changes in seasonal ranges of the Bathurst herd, but will provide a series of maps that show the herd's annual range and 4 seasonal ranges in 5-year periods from 1996 to 2012, based on collared caribou locations. As has been

demonstrated for other herds (Fortymile herd, Valkenburg et al. 1994, George River herd, Bergerud et al. 2008), the herd's range has contracted since 2000 as the herd's size has declined. The reduced range size is most noticeable in winter, with collared caribou locations showing reduced use of more southern ranges, e.g. southeast of Great Slave Lake. In recent years the herd's calving distribution has occupied an increasingly limited area, which has meant that flight lines on surveys have been spaced more closely (10km initially, then 5km on reconnaissance flights and 1.9km on photo-plane spacing in June 2015). In winters 2014-2015 and 2015-2016, the Bathurst herd's winter distribution has been relatively limited spatially, with little overlap with neighbouring herds, which has in part made possible the use of the mobile conservation zone for the Bathurst herd in those two winters. The herd has generally wintered in relatively remote areas closer to tree-line, which has meant that access for hunters has been relatively limited. It has also provided a target area for increased wolf harvest in the winter. The presence of up to 50 collars on Bathurst caribou (as of March 2015) provides for an increased confidence in knowing the herd's distribution at all times, and will be essential to management actions.

Information Request #17: Please describe whether the 61% breeding females on the 2015 calving grounds is linked to environmental trends or whether it reflects a higher proportion of younger caribou as calf cow ratios were high 2009-2011.

Parties Responsible: Environment and Natural Resources

Rationale IR #17: In 2006, the percentage of breeding females on the calving grounds was also low (76%) but the 2005 was a hot dry summer and pregnancy rates were reduced. So the proposal should describe whether the 2015 61% breeding females is linked to the exceptional 2014 summer. The composition data from the 2015 calving ground should be included to describe whether it was a low proportion of adult females or a high proportion of younger caribou that dominated the composition data which will affect future trends in productivity and herd size.

Response (ENR): ENR will provide a draft survey report on the June 2015 Bathurst calving photo survey in the near future, which will include the results of the composition survey carried out on the calving grounds. Preliminary numbers indicate that there were an estimated 13,625 adult females on the June survey area, of which 8,075 were breeding cows (59%). Numbers of yearlings were relatively low, consistent with relatively low calf:cow ratios recorded in late winter for this herd in recent years. A number of factors could have contributed to the apparently low pregnancy rate in winter 2014-2015 (reflected in a low proportion of breeding cows in June 2015), but it seems likely that the hot dry summer of 2014 meant poor plant growth and poor feeding conditions for caribou, likely linked to cows being in poor condition in the breeding season, and a low pregnancy rate. In the response to IR14 above, a graph of the July drought index for the Bathurst herd from D. Russell shows increasing drought conditions from 2009 to 2014 and an exceptionally high value in 2014. A recent paper by Chen et al. (2014) found a correlation between spring calf:cow ratios in the Bathurst herd and a composite index of summer range productivity, with a time lag, with the suggested mechanism being poor summer feeding conditions leading to poor cow condition and low pregnancy rates the following winter and reduced calf ratios the following year. The caribou cohorts that were yearlings in 2009, 2010 and 2011 would be 6, 5 and 4 years old in June 2015, thus the females in those cohorts should be of prime breeding age.

Information Request #18: Please provide changes in population size from cumulative effects of landscape disturbances relative to the effects of a zero harvest or community wolf removal management actions on population size.

Parties Responsible: Environment and Natural Resources

Rationale IR #18: Although cumulative effects are assumed to influence pregnancy rates, those effects do translate into changes to herd size. For example, computer model projections supplied to the Range Planning Team in November 2015, for the difference between no development and current development scenario was a loss of 640 cows after 3 years (caused by a 3% decline in pregnancy rates).

The effects of developments are identified by TG as affecting herd size (TG's closing statement to MVEIRB's public registry for Dominion Diamonds). Other Parties also raised strong concerns about the effects of mining on the Bathurst caribou herd. Yet the 2016 Joint Proposal does not include managing the effects of industrial disturbance. Although it refers to the Range Plan, that Plan is not due to 2018 and its implementation date is unreported.

Response (ENR): The effects of harvest on caribou herds depend on the herd's size and trend, the scale of the harvest relative to herd size, and the sex ratio of the harvest. Results of hunter harvest modeling carried out for ENR were summarized by Boulanger (2014) and ENR (2014b) and provided in fall 2014 to parties engaged in management discussions on the Bathurst and BNE herds. An example of the possible effects of a large harvest and the effect of its elimination is provided below.

To place the harvest in perspective with recent demographic trends of the Bathurst herd, the following examples are provided. The most recent population analysis for the herd suggests an overall cow survival rate of 77% and relatively low calf survival 2012-2015 (Boulanger et al. 2016). At this cow survival rate, the herd will likely continue to decline rapidly as cow survival rates must be at least 80-85% for a stable herd. If the herd has 13,000 cows in total, then at a survival rate of 77%, 2,990 cows would die in a year. If overall mortality includes cow harvest of 1,000, this would mean that 1,990 cows would die of natural causes and 1,000 additional ones from harvest. If this harvest was eliminated and 1,990 cows still died of natural causes, then the overall cow survival rate would be 85%. At this cow survival rate, the herd should be stable. In this example, eliminating the cow harvest of 1,000 could be the difference between a herd that is stable and one that is declining at a fairly rapid rate. As a further example, if the overall cow survival rate is 77% and the cow harvest is 150, then 2,990 cows would die in a year and 2,840 would die of natural causes. Eliminating the cow harvest would leave 2,840 cows dying in a year and an overall cow survival rate of 78.2%. In this case the change in cow survival rate from harvest removal is limited because most of the mortality is due to natural causes and the scale of the harvest relative to herd size is small. The Bathurst harvest was reduced about 95% in 2010 and this contributed substantially to a shift from rapid decline 2006-2009 to a stable trend 2009-2012. Eliminating the harvest is not a guarantee of the herd stabilizing or recovering, however, as natural factors (predators, weather effects) will still affect cow, calf and bull survival rates. If the natural survival rate of cows is low, or if pregnancy rates and calf recruitment are low, then the herd may still decline with no harvest.

The possible effects of wolf removal on caribou survival rates will depend strongly on the number of wolves present on the herd's range, the proportion of those wolves removed, and the number of years during which wolves are removed. The following text is copied from the joint Bathurst proposal to WRRB: "Among the key aspects that need to be considered is the number of wolves associated with the herd and the proportion or number of these that would need to be removed to improve caribou survival rates. The annual kill rate of wolves has been estimated at ~ 29 caribou / adult wolf, i.e., with apparent consumption rates ranging from 4.4 – 5.6 kg of caribou per wolf per day (Hayes et al. 2000), thus removal of substantial numbers of wolves could increase caribou calf and adult survival rates over winter. This could have an impact on the herd, considering the current small size of the

Bathurst herd. However, a review of wolf control programs in 1997 concluded that wolves would need to be reduced by at least 55% for at least 4 years over a large area to increase ungulate survival rates (Orians et al. 1997). Removal of up to 30% of wolves is considered in Alaska as a sustainable harvest (i.e. no net reduction of wolves) due to the rapid replacement of wolves by pups or wolves from elsewhere, in addition to the higher per capita kill rates and larger losses of meat to scavengers associated with small wolf packs (B. Dale, ADFG, pers. comm. 2015)." Considering these findings, the effect of community-based wolf reduction will depend to a large extent on how many wolves are removed as a proportion of wolves present, and on the length of the period during which wolves are killed. ENR has begun a review of wolf monitoring methods in the NWT and will lead a feasibility assessment of wolf reduction options that may be considered in future. A key aspect will be identifying options that will be acceptable to NWT communities and a realistic assessment of the level of wolf removal that would be needed to have a significant effect on caribou survival rates.

The Bathurst Caribou Range Planning Team has conducted simulation modeling of various preliminary scenarios that has included varying levels of industrial development, harvest and mortality on the Bathurst caribou herd. Three industrial development scenarios were assembled using best available information and expert judgment. The Cumulative Impact Monitoring Program's Inventory of Landscape Change was used as the starting point for current disturbances on the landscape. Future scenarios utilized, with modifications, the future development scenario used in the Ekati - Jay Project cumulative effects assessment. The development scenarios are referred to as: current, future low and future high and are shown in Figure 3. The current scenario is meant to reflect all development footprints on the range of the Bathurst herd at present. Future low is meant to be a plausible future development scenario given the current investment climate, while future high is a comparatively aggressive development scenario.

The CARMA Cumulative Effects Integrated Model was used to examine effects of these development scenarios in combination with two harvest levels and three mortality levels on caribou population size and trend (all model runs were conducted in collaboration with D. Russell, Shadow Lake Environmental Consultants, Whitehorse, YK). Harvest was modeled as:

1. low/moderate scenario of 200 animals 60 of which are cows; and,
2. high harvest scenario being 3% of the population with a 2:1 ratio of bulls to cows.

Annual mortality was modeled at three different levels with the following average annual values:

1. low - adult females = 11%; yearlings = 11%; calves = 38%
2. moderate - adult females = 17%; yearlings = 13%; calves = 46%
3. high - adult females = 27%; yearlings = 17%; calves = 48%

Predation was not simulated directly as a result of predator-prey dynamics but rather different mortality rates were used as a proxy for predation effects and to compare relative differences in herd trajectories. We did not set out to simulate or make direct linkages to the potential effects of a community-based wolf removal program through changes in mortality rates; the purpose of the simulations was to more simply demonstrate and learn about the interactive effects of different drivers that may affect birth and death rates in a barren-ground caribou population. The starting condition of model runs was a population size of 15,000 animals and average environmental conditions.

Figures 3 and 4 show the results of differing development scenarios in combination with the three levels of mortality. Generally, across the three development scenarios the population trajectory increased under low levels of mortality, remained somewhat stable under moderate mortality and declined under high mortality scenarios. The population size and trend of all three mortality levels for the current and future low development scenarios were quite similar. However, under the future high development scenario population size was reduced for all three mortality levels at the end of the

simulation period as compared to the current and future low development scenario.

Figure 5 shows results of differing harvest scenarios in combination with three levels of mortality (under a constant current development scenario). Across the harvest scenarios, the population trajectory increased under low levels of mortality, remained somewhat stable under moderate mortality and declined under high mortality scenarios. The population size and trend of all three mortality levels for the zero and 200 animal harvest scenarios were quite similar. However, under the 3% harvest with 2:1 bulls to cow scenario population size was reduced for all three mortality levels at the end of the simulation period as compared to no harvest and a harvest of 200 animals.

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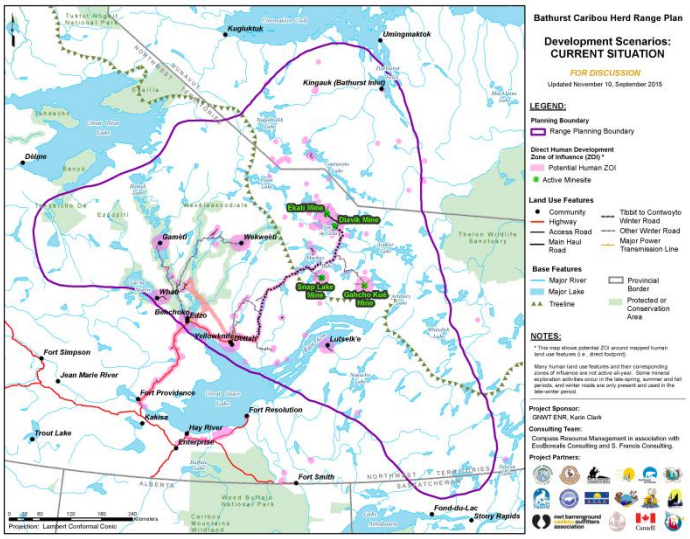
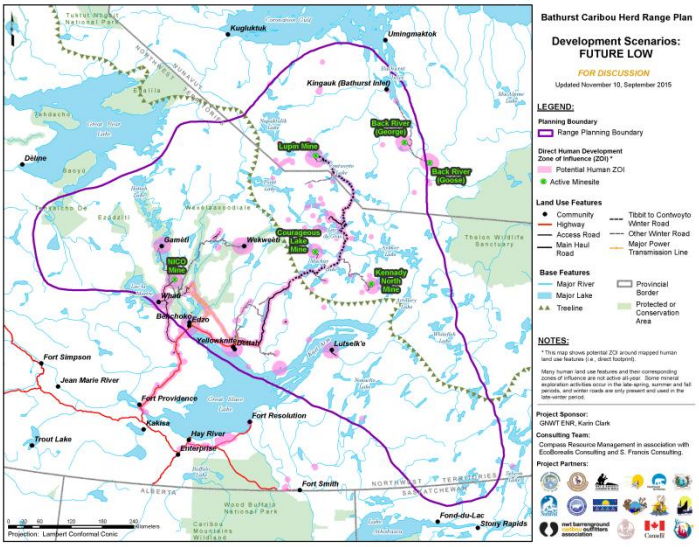
Figure 3: Development scenarios developed by the Bathurst Caribou Range Plan Working Group as discussed at the December 2015

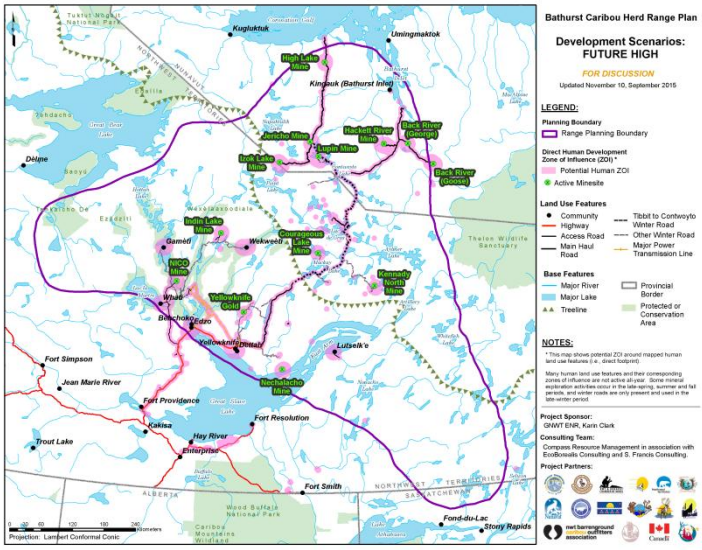
a) Current development scenario

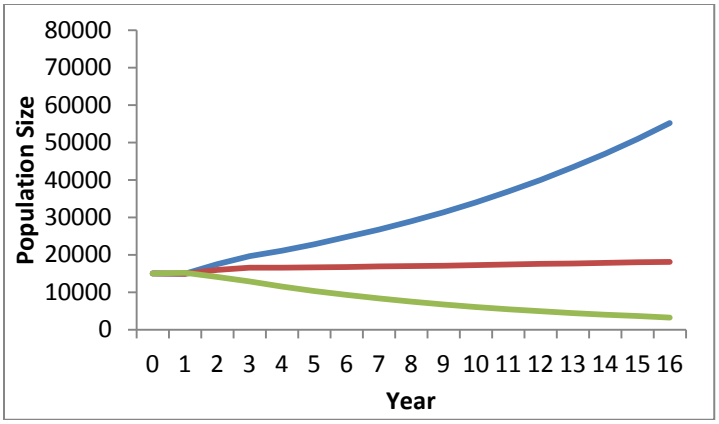


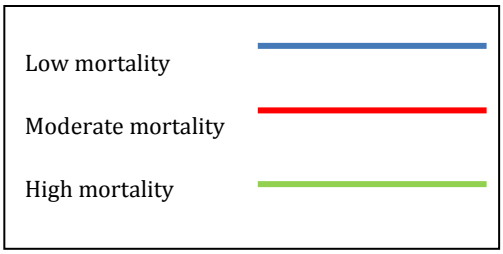
b) Future low development scenario



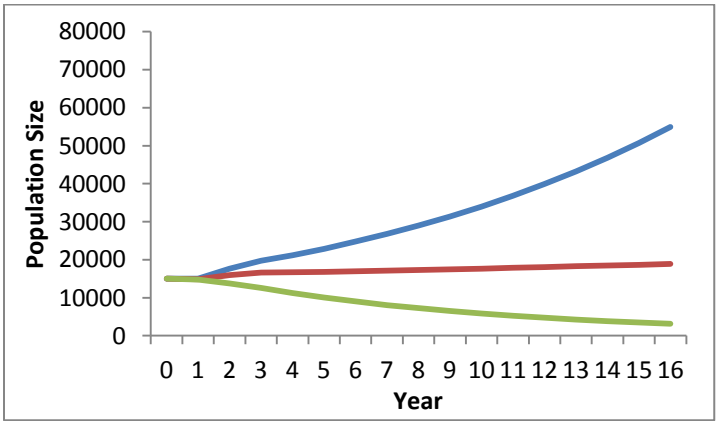
c) Future high development scenario



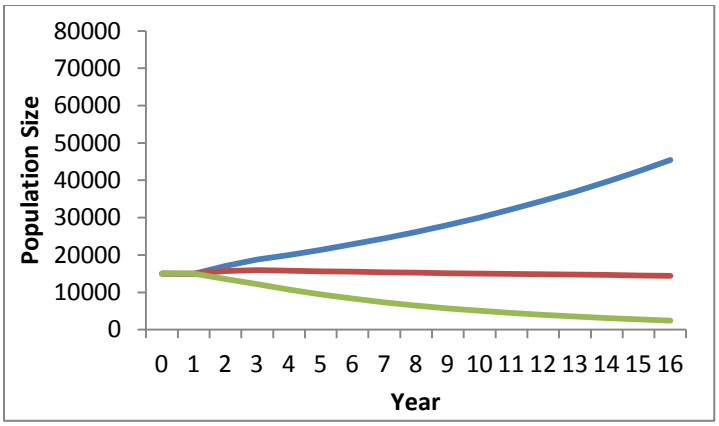




a) Current development scenario

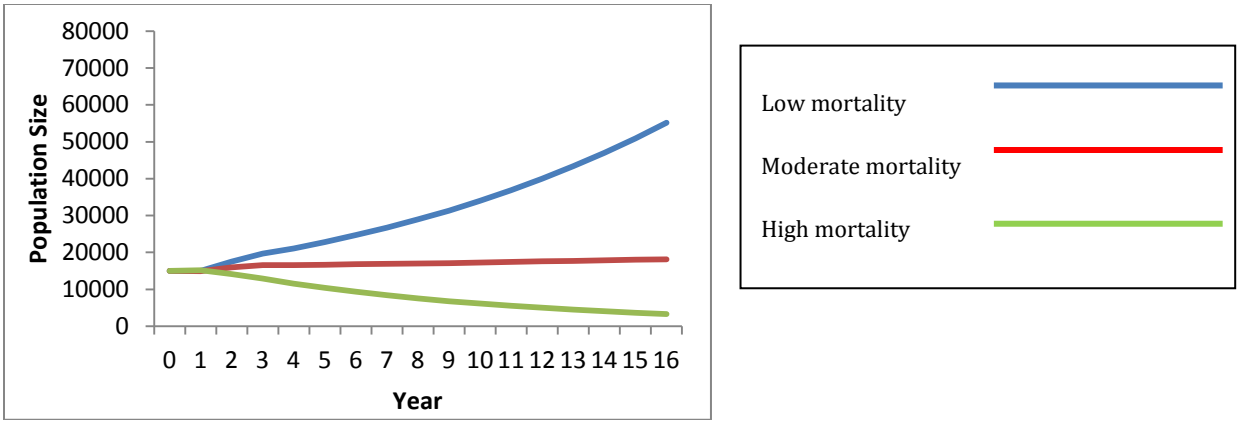


b) Future low development scenario

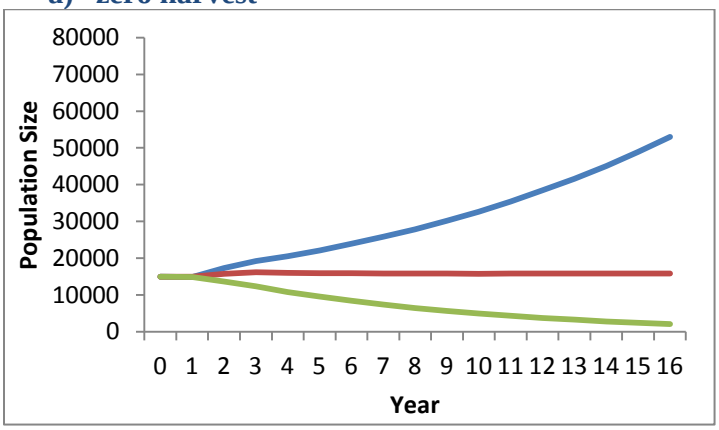


c) Future high development scenario

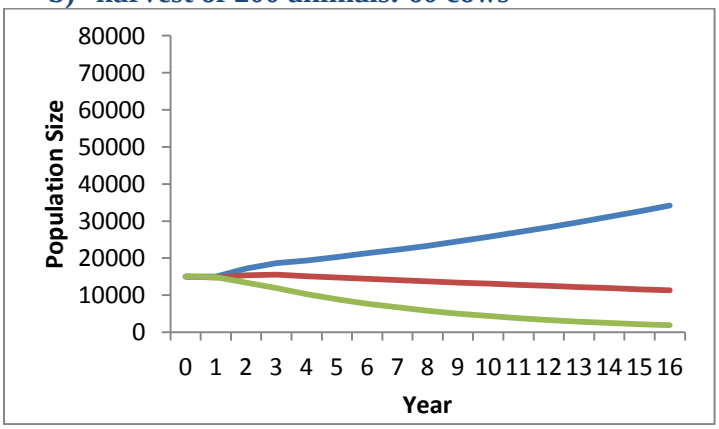
Figure 4 – Herd trajectories under differing development scenarios and variable mortality: a) current development scenario; b) future low development scenario; and, c) future high development scenario. Starting population is 15 000 animals under average environmental conditions. Low mortality (adult females = 11%; yearlings = 11%; calves = 38%); moderate mortality (adult females = 17%; yearlings = 13%; calves = 46%) and high mortality (adult females = 27%; yearlings = 17%; calves = 48%)



a) zero harvest



b) harvest of 200 animals: 60 cows



c) harvest of 3% of herd 2:1 ratio of bulls to cows

Figure 5 – Herd trajectories under different harvest levels and variable mortality: a) zero harvest; b) harvest of 200 animals, 60 of which are cows; c) harvest of 3% of the herd with a 2:1 ratio of bulls to cows. Starting population is 15 000 animals under average environmental conditions and current development scenario. Low mortality (adult females = 11%; yearlings = 11%; calves = 38%); moderate mortality (adult females = 17%; yearlings = 13%; calves = 46%) and high mortality (adult females = 27%; yearlings = 17%; calves = 48%)

Appendix 1. Summary of wolf and bear sightings from Bathurst and Bluenose-East caribou surveys – from D. Cluff, regional biologist North Slave region, GNWT ENR, Jan. 2016

Overview: the graphs and poster on following pages are provided to the WRRB in partial response to Information Requests in January 2016 on Bathurst and Bluenose-East caribou herds.

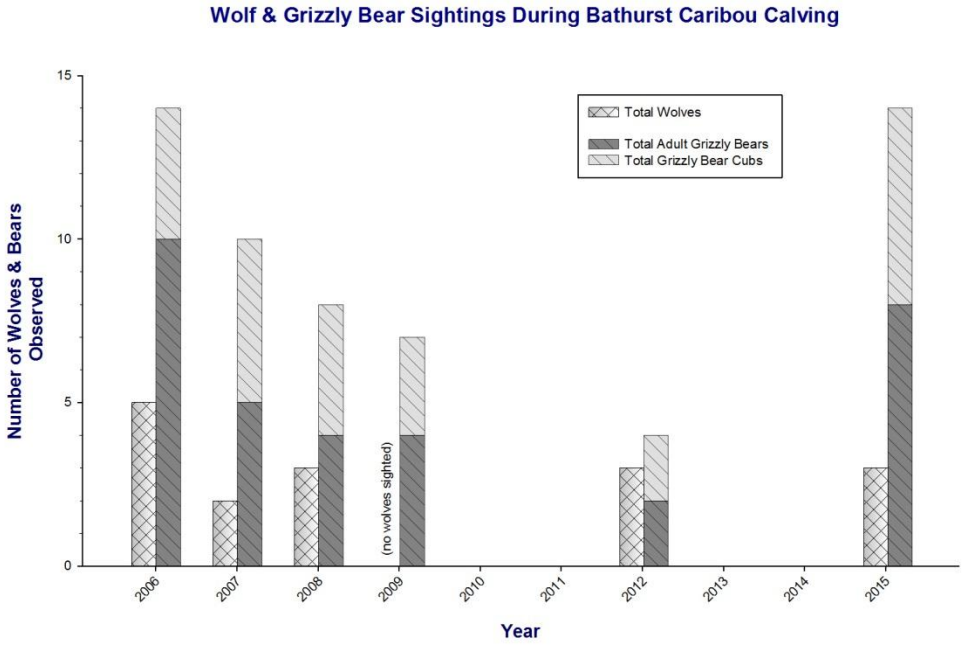
Part A shows the actual total numbers of bears and wolves seen on the Bathurst and BNE calving surveys. Sightings are not corrected for effort (e.g., time) spent in the air searching.

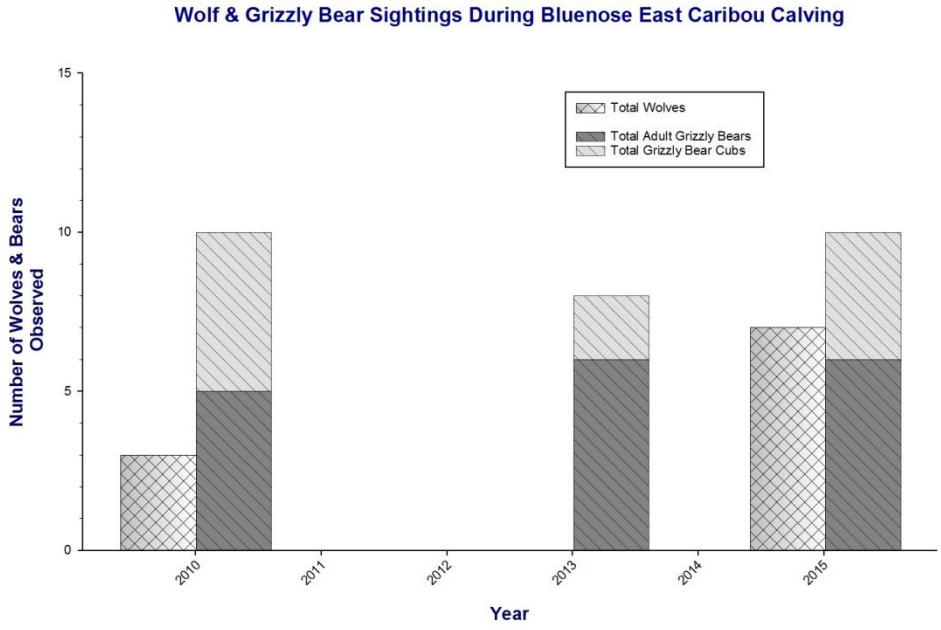
Part B shows the same information in Part A but on the basis of wolf and grizzly bear sightings per 10 hours flown (i.e., effort) on Bathurst and Bluenose-East calving ground surveys. There is no clear trend in wolf sightings from 2006 to 2015 for the Bathurst herd. The numbers of bears seen have consistently exceeded the wolf sightings over this time for the Bathurst surveys. The highest rate of bear sightings occurred in 2015. Observations of wolves and bears on the Bluenose-East calving grounds began in 2010 and suggest an increasing trend in bear sightings from 2010 to 2015. A trend in wolf numbers is not clear as variability was high and there were no wolf sightings in 2013. The limited data suggest that bear sightings on the BNE calving grounds have been more common than wolf sightings, as for the Bathurst calving ground.

Part C shows the numbers of wolves and bears seen during late-winter (March/April) helicopter based composition surveys of the Bathurst and BNE herds, and Part D shows the same information on the basis of 100 hours flown and 1000 km flown. An overall trend in wolf sightings on these surveys is difficult to discern, with high variability among years.

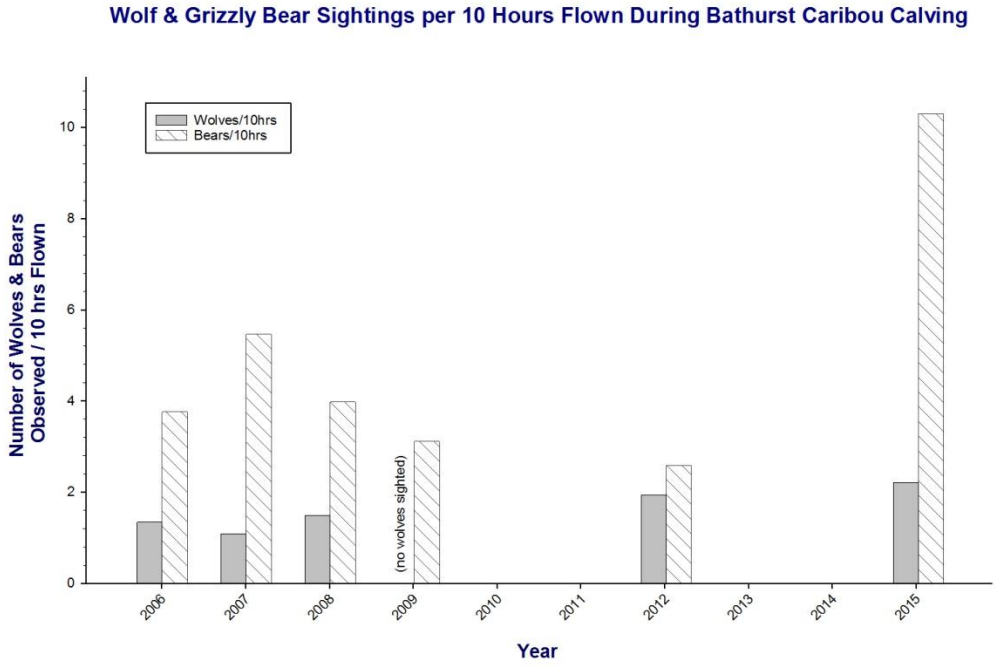
Part D is a poster from Paul Frame and Dean Cluff presented at the 13th Arctic Ungulate Conference in Yellowknife in Aug. 2011. The authors analysed results of 17 late winter caribou surveys and found that "The number of wolves observed from year to year was variable with no apparent pattern. Search effort and number of caribou seen did not influence the numbers of wolves observed". A dedicated survey with high coverage may be needed to adequately detect trends in wolf numbers.

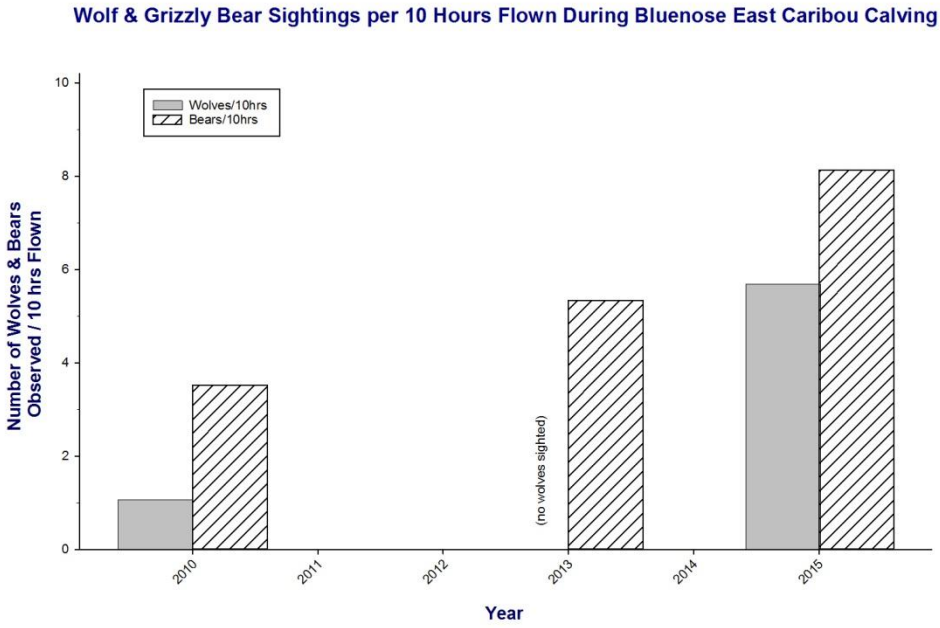
A. Wolf and bear sightings (total) during calving ground surveys of Bathurst and Bluenose-East herds



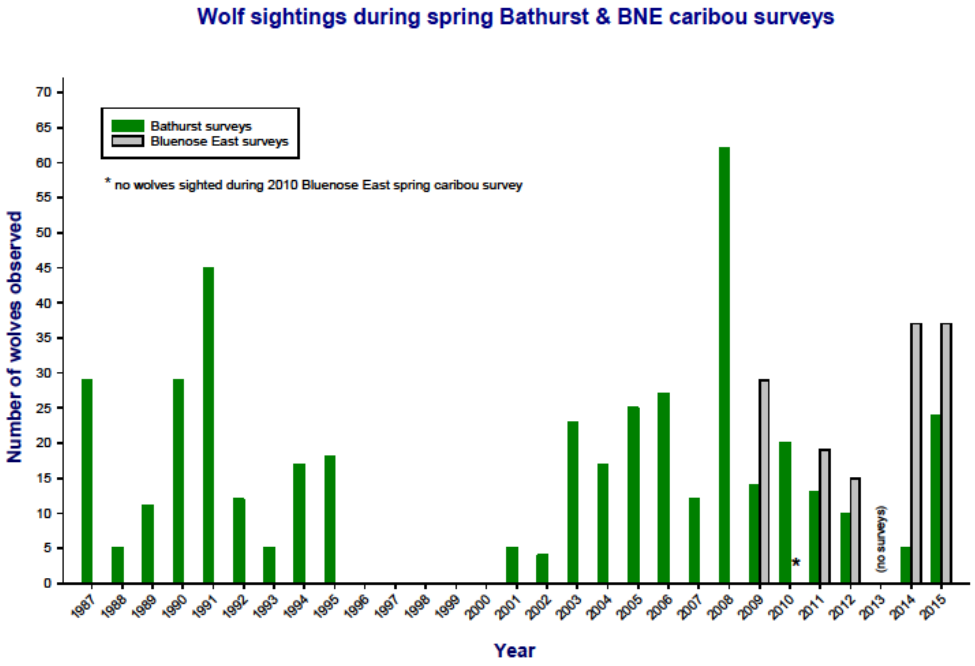


B. Wolf and bear sightings during calving ground surveys of Bathurst and Bluenose-East calving photo surveys, per 10 hours flown

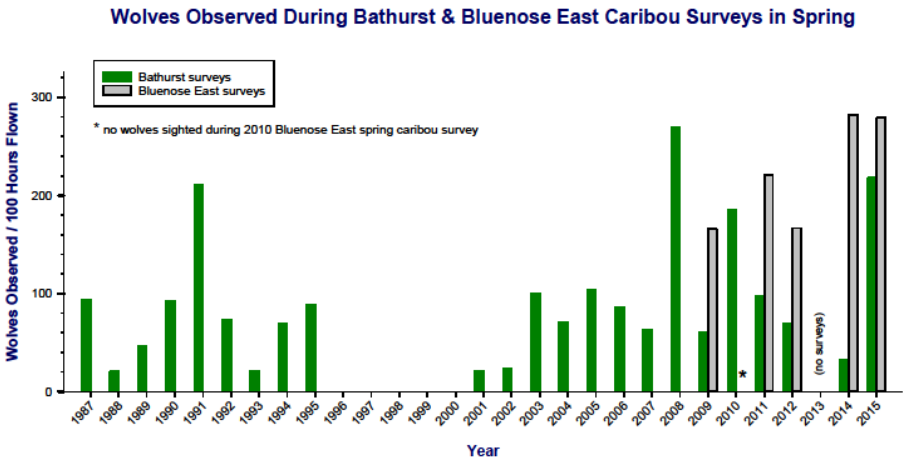


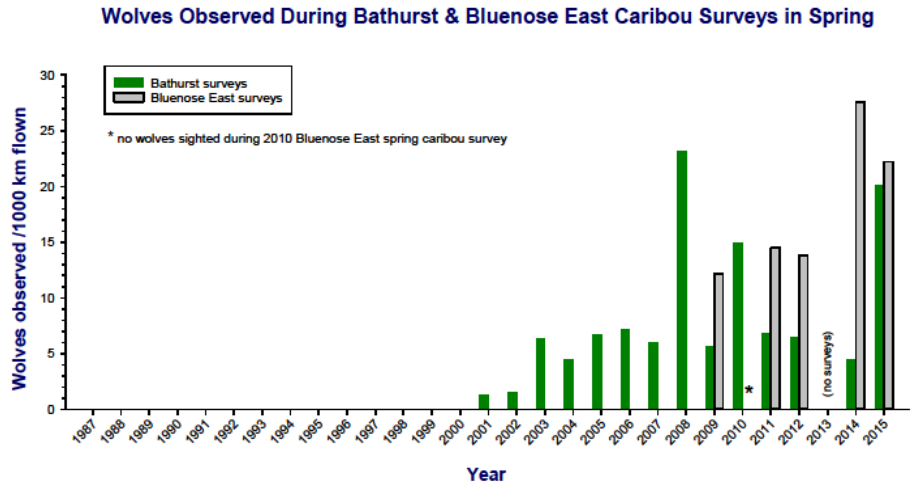


C. Wolf sightings during spring Bathurst and Bluenose-East caribou composition surveys (totals)


Wolf sightings during spring Bathurst & BNE caribou surveys
Bathurst surveys
Bluenose East surveys
* no wolves sighted during 2010 Bluenose East spring caribou survey
Number of wolves observed
Year
(no surveys)

Wolf sightings during spring Bathurst and Bluenose-East caribou composition surveys, per 100 hours flown (top) and per 1000 km flown (bottom)





D. Poster on value of wolf observations from caribou surveys as an index of wolf abundance. Frame and Cluff, presented at 13th Arctic Ungulate Conference in Yellowknife, Aug. 2011.

How Many Wolves?

Can we use observations from caribou surveys as an index?

Paul Frame and Dean Cluff

Government of the Northwest Territories, Environment and Natural Resources

ABSTRACT

Recent declines of northern caribou herds have raised concern about the impact of predation by wolves. Recent caribou management plans have recommended that wolf abundance be monitored. One such approach is a winter wolf sighting index derived during surveys of caribou distribution and composition.

We conducted a meta-analysis of wolves sighted during 17 late winter caribou surveys to investigate whether these sightings can be used to monitor trends in wolf abundance. The number of wolves observed from year to year was variable with no apparent pattern. Search effort and number of caribou seen did not influence the number of wolves observed.

Detectability of wolves likely contributed to the variation in wolf sightings among surveys.

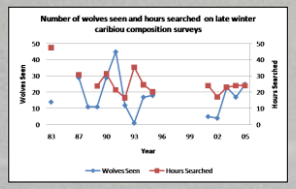
Sightings must also be calibrated against wolf abundance estimates before this technique can be used as an acceptable index of abundance. We suggest the use of a random stratified survey for estimating wolf abundance in migratory caribou range.

METHODS

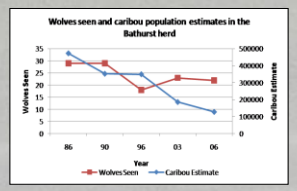
Wolf observations, the number of caribou seen, and the hours or distance searched were extracted from survey reports from the Bathurst caribou herd.

We used a bivariate correlation analysis to investigate relationships between the number of wolves observed and measures of search effort or number of caribou seen on a given survey.

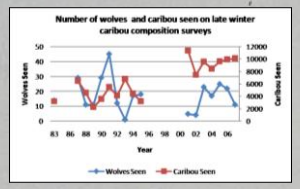
RESULTS



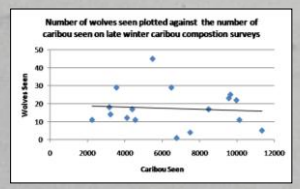
No relationship between wolves observed and search distance.
(Pearson correlation= 0.39, R^2= 0.15, P= 0.119)



Interestingly, wolves observed during aerial caribou surveys appear not to be influenced by caribou population numbers.



The lack of a pattern suggests the number of wolves observed is not related to the number of caribou seen.



No significant relationship between the number of wolves seen and number of caribou seen on a given survey.
(Pearson correlation= -0.19, R^2= 0.035, P= 0.39)

DISCUSSION

Because search effort or the number of caribou seen was not correlated with the number of wolves sighted, some other factor must be influencing the number of wolves seen.

While we do not know if the number of wolves observed during caribou surveys is representative of wolf abundance, it is still possible that changes in the number of wolves observed do represent wolf population changes.

Although we are unable to confirm whether observations made during caribou surveys accurately represent wolf abundance, with adjustments (detectibility, survey design) combining wolf and caribou surveys could still be a viable tool to track relative wolf abundance.

However, combining wolf survey design requirements within caribou survey designs may be problematic. Separate surveys may be best.

Sightings of wolves need to be first calibrated against abundance estimates.

Once calibrated, wolf sightings during caribou surveys could be a possible index of change in abundance with measurable confidence.

Because migratory wolves do not exhibit fidelity to winter ranges as territorial wolves do, the same aerial survey techniques used to estimate population size of other non-territorial species should work. Becker et al. (1998) described the difficulty of stratifying landscapes for wolves and suggested considering harvest records and prey distribution when doing so.

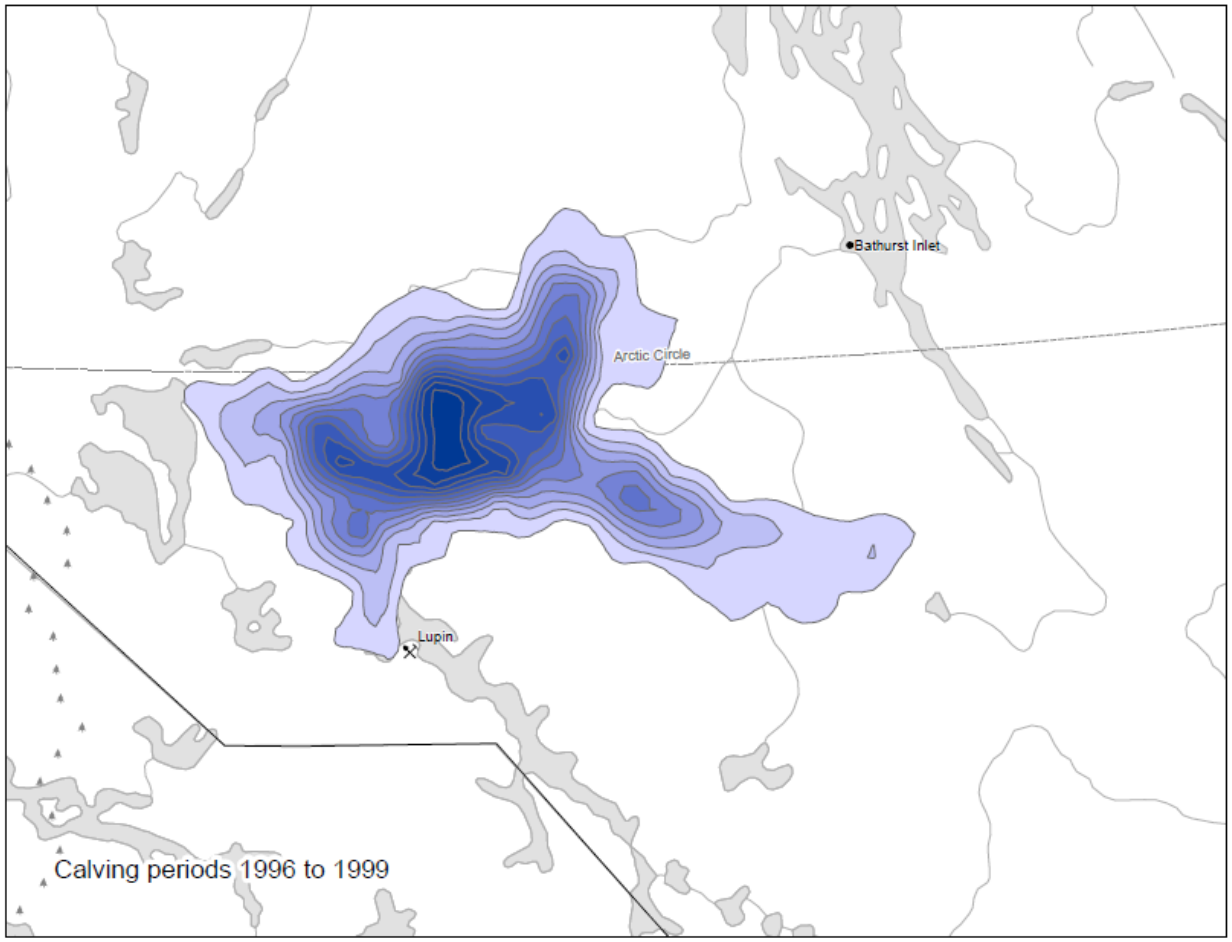
Frame et al. *(in prep.)* demonstrated that, at a habitat scale, migratory wolves select for areas near caribou, in winter. Therefore, the stratification for a wolf survey should be based on the relative abundance of caribou, the wolf survey could be done immediately following a caribou survey when their distribution and relative abundance is known. A grid based stratified random survey as used by Matson et al. (2009) could be conducted within days of a caribou survey and would produce estimates of wolf and caribou density.

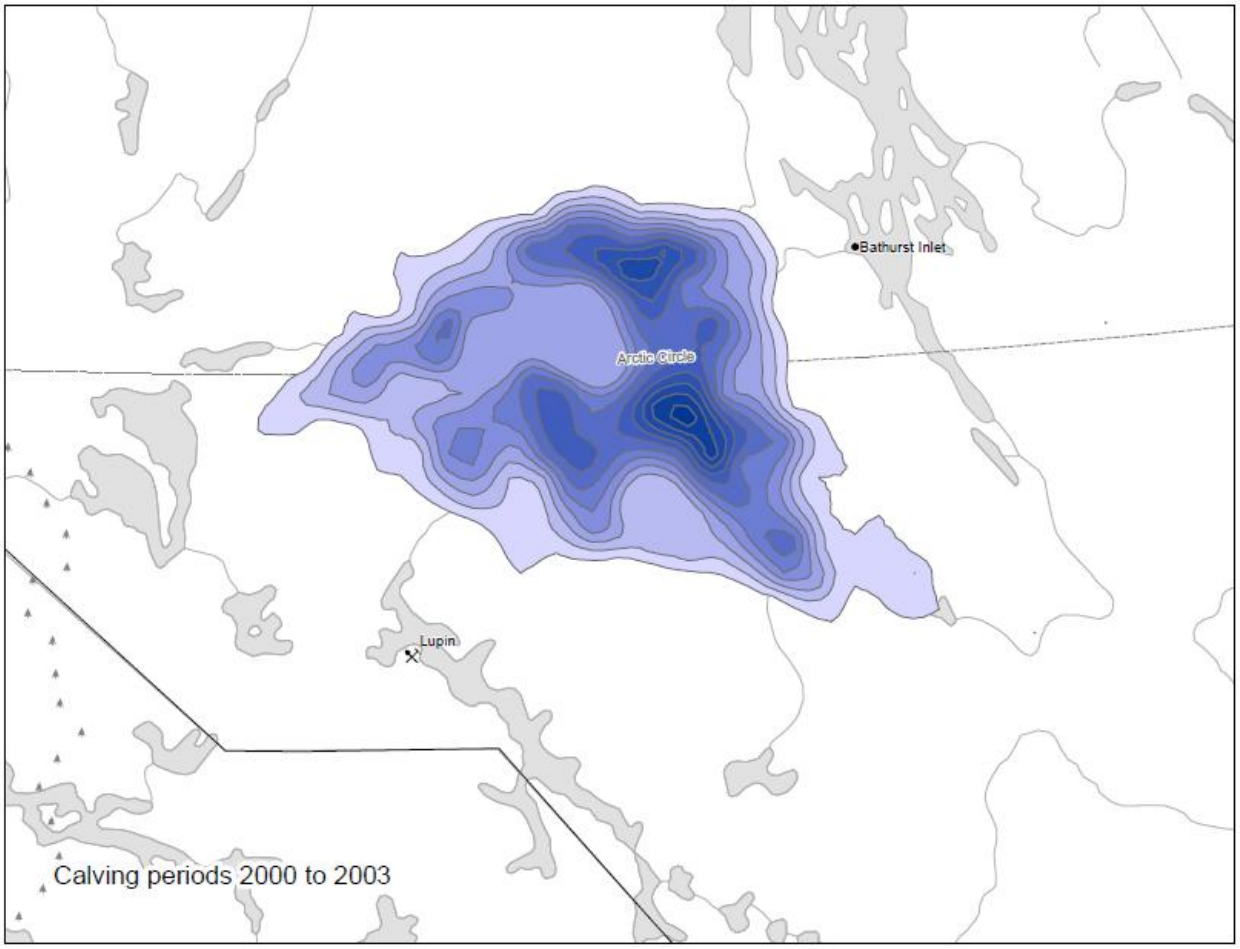
LITERATURE CITED

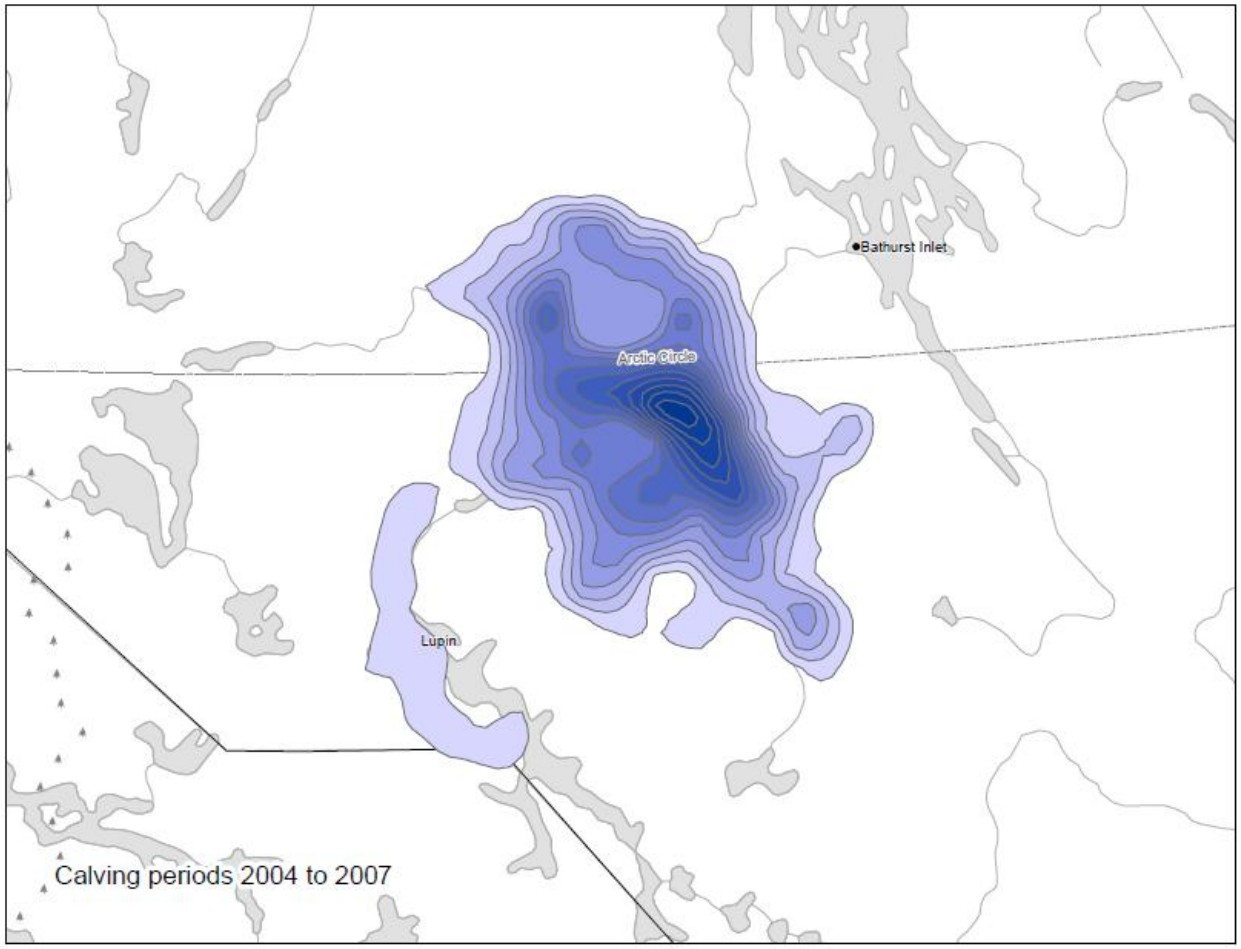
Becker, E. F., et al. 1998. A population estimator based on network sampling of tracks in the snow. *Journal of Wildlife Management* 62:968-977.

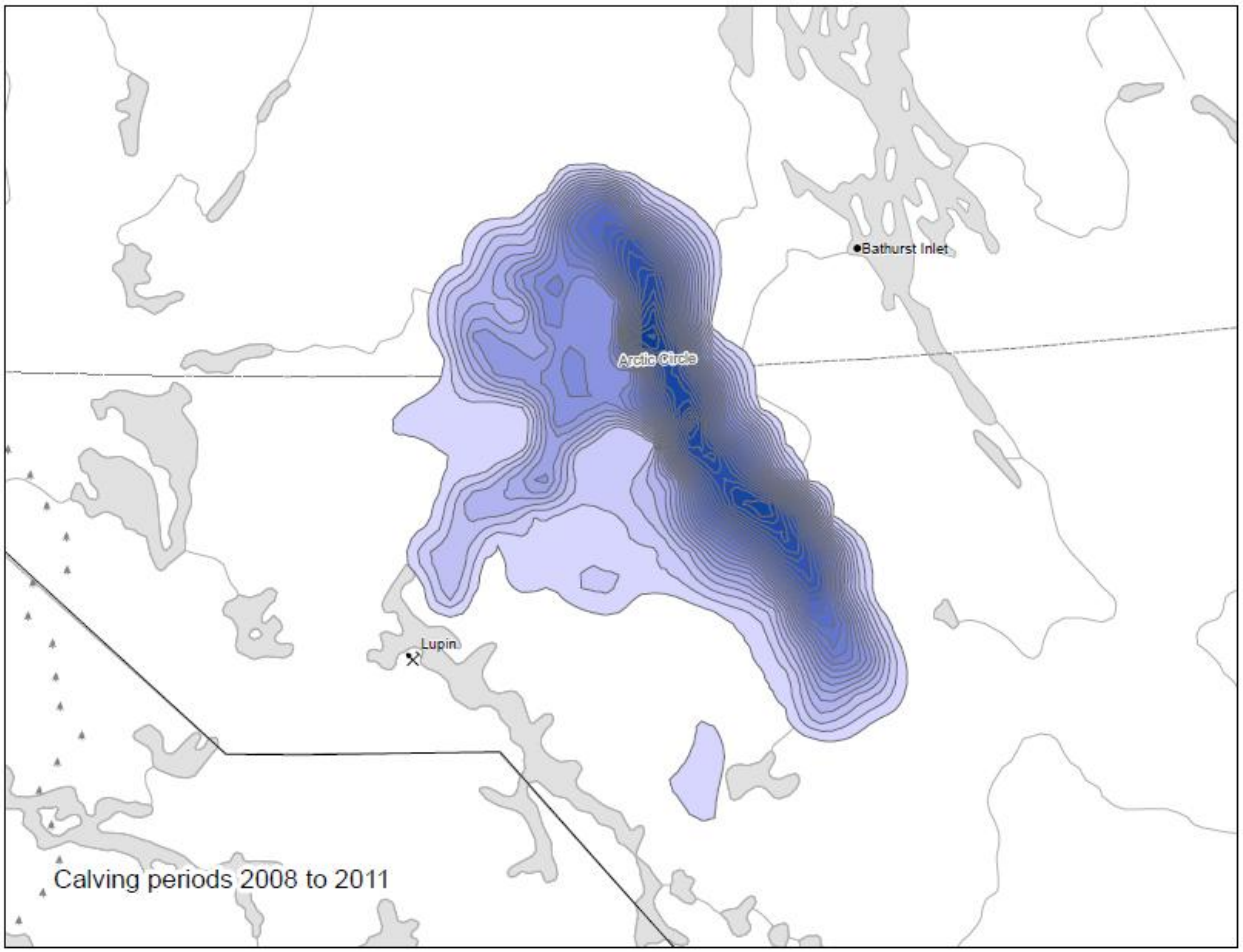
Mattson, I. J. K., et al. 2009. Winter survey of Bathurst caribou and associate wolf distribution and abundance. Manuscript Report. Government of the Northwest Territories, Environment and Natural Resources.

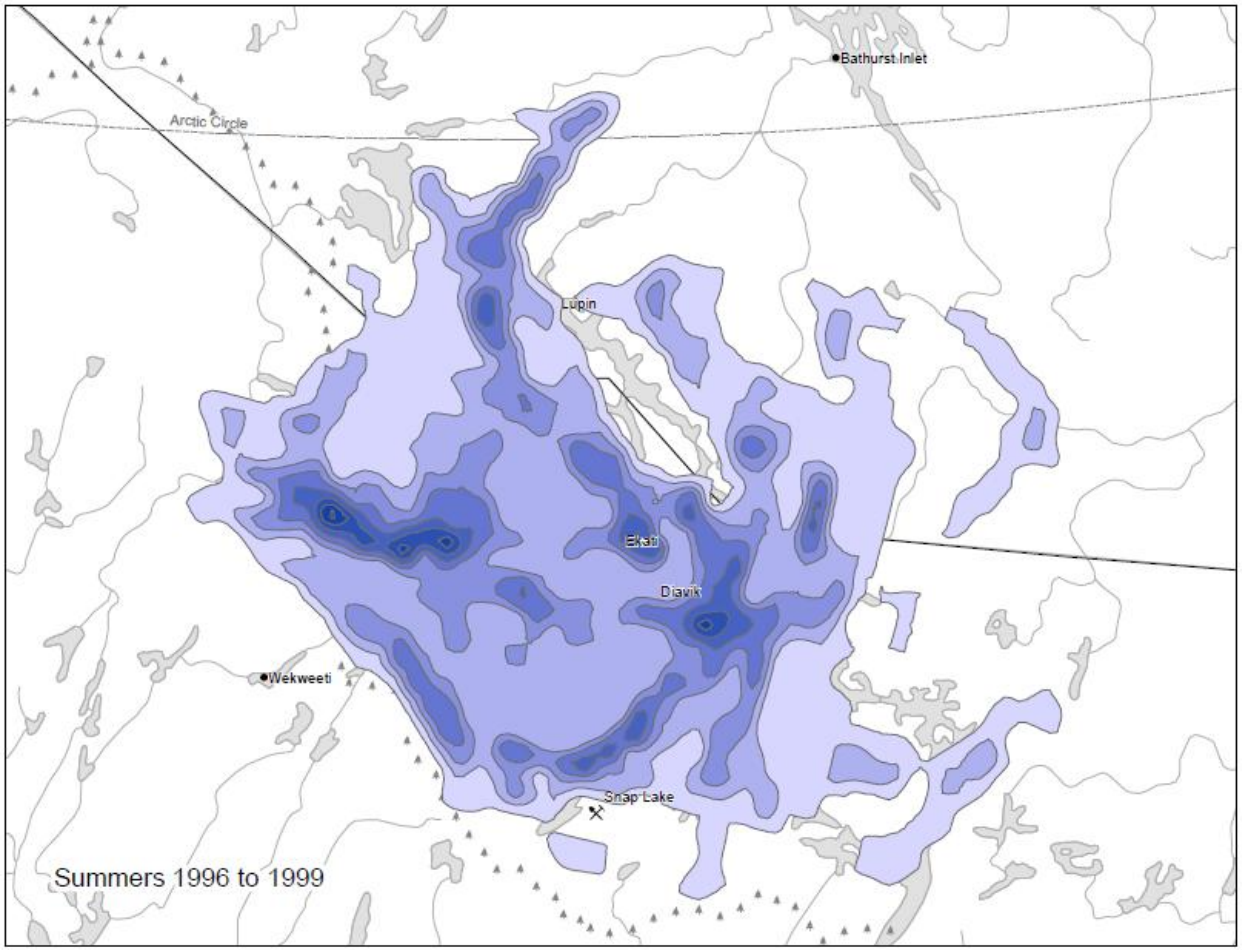
Appendix 2. Bathurst caribou calving, summer and winter ranges in 5-year periods from 1996 to 2012, and maps of overall Bathurst annual range in 5-year periods from 1996 to 2012 (Maps A. D'Hont, GNWT ENR).

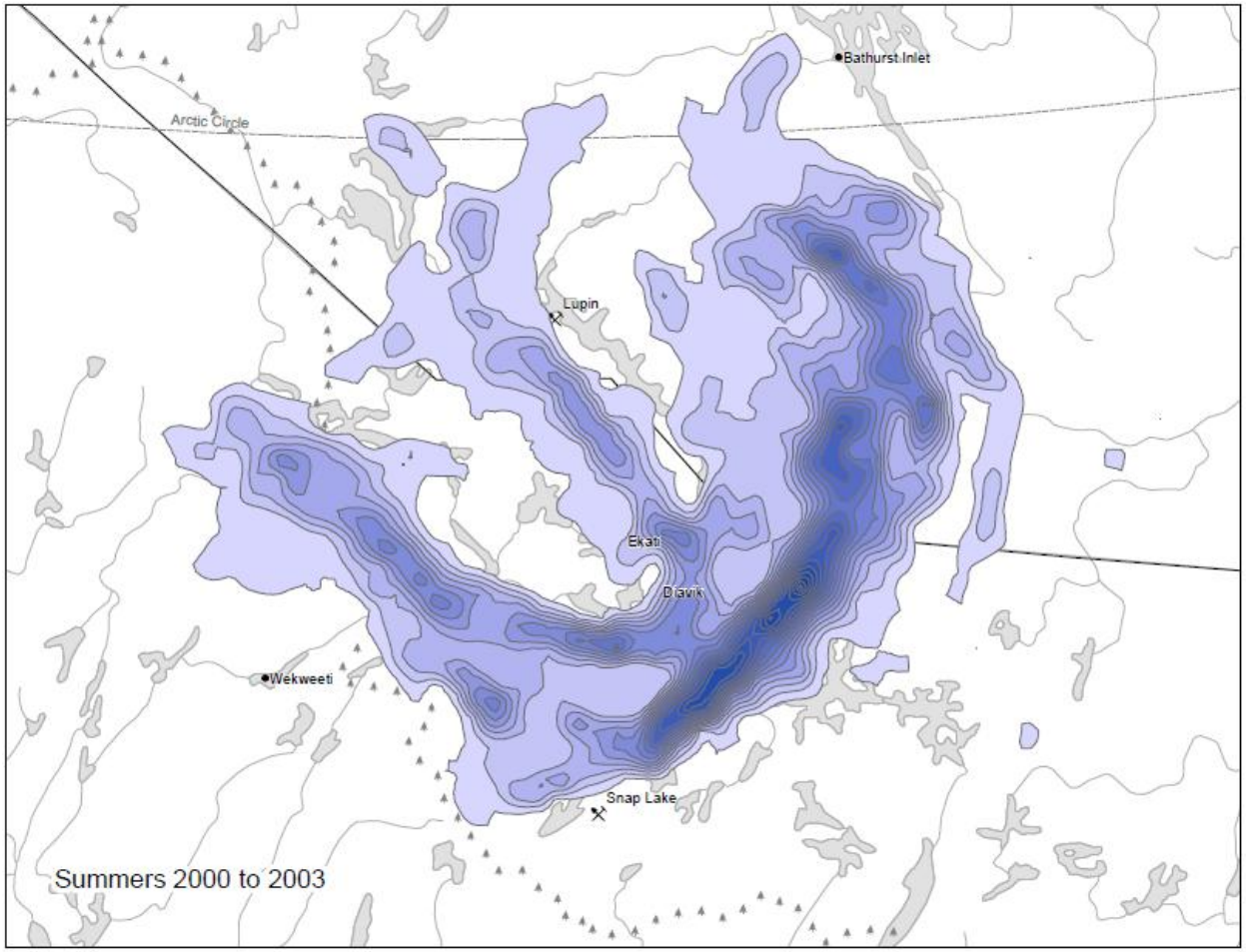



Bathurst Inlet
Arctic Circle
Lupin
Calving periods 2000 to 2003


Bathurst Inlet
Arctic Circle
Lupin
Calving periods 2004 to 2007


Bathurst Inlet
Arctic Circle
Lupin
Calving periods 2008 to 2011


Bathurst Inlet
Arctic Circle
Lupin
Ekati
Diavik
Wekweeti
Snap Lake
Summers 1996 to 1999


Bathurst Inlet
Arctic Circle
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Ekati
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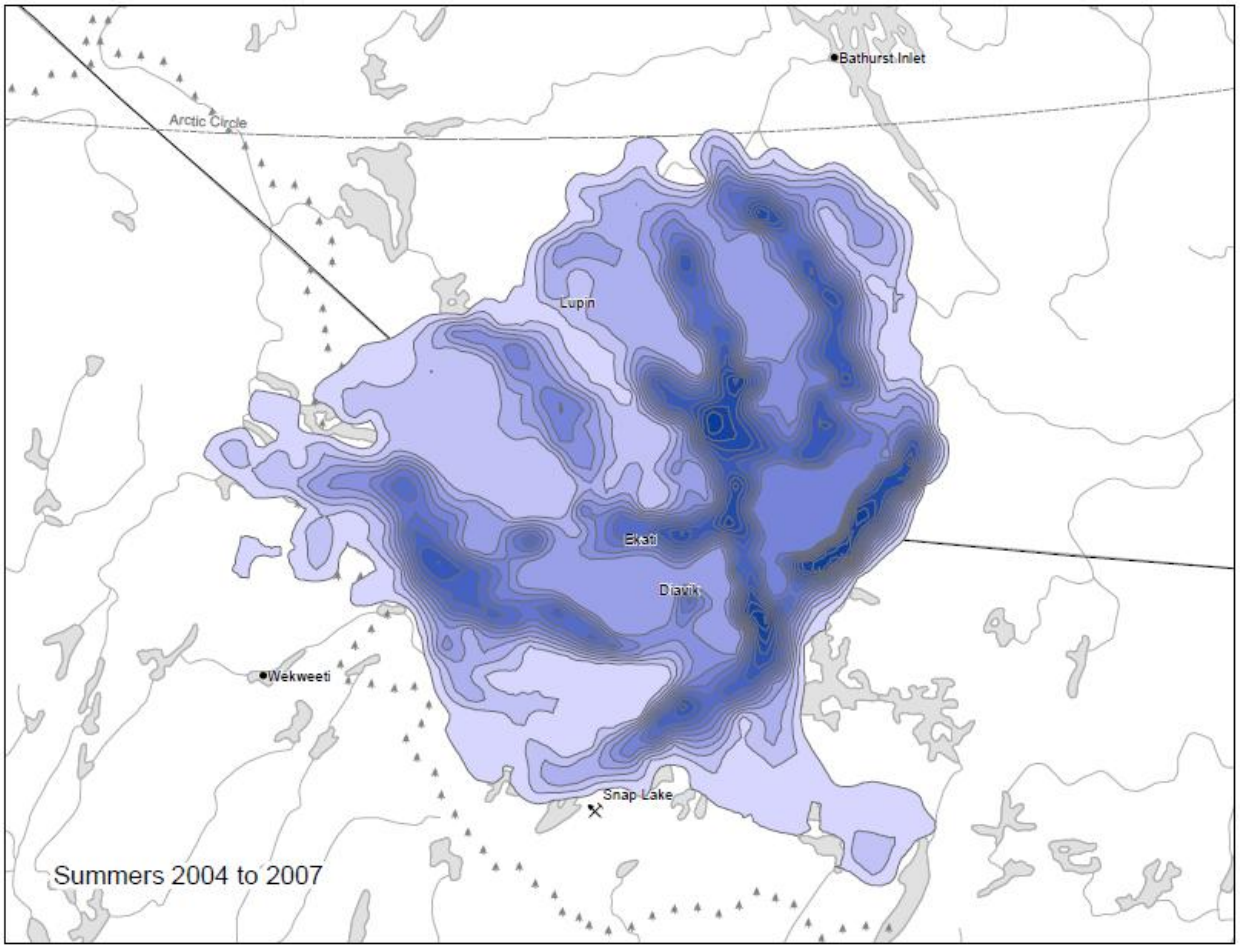
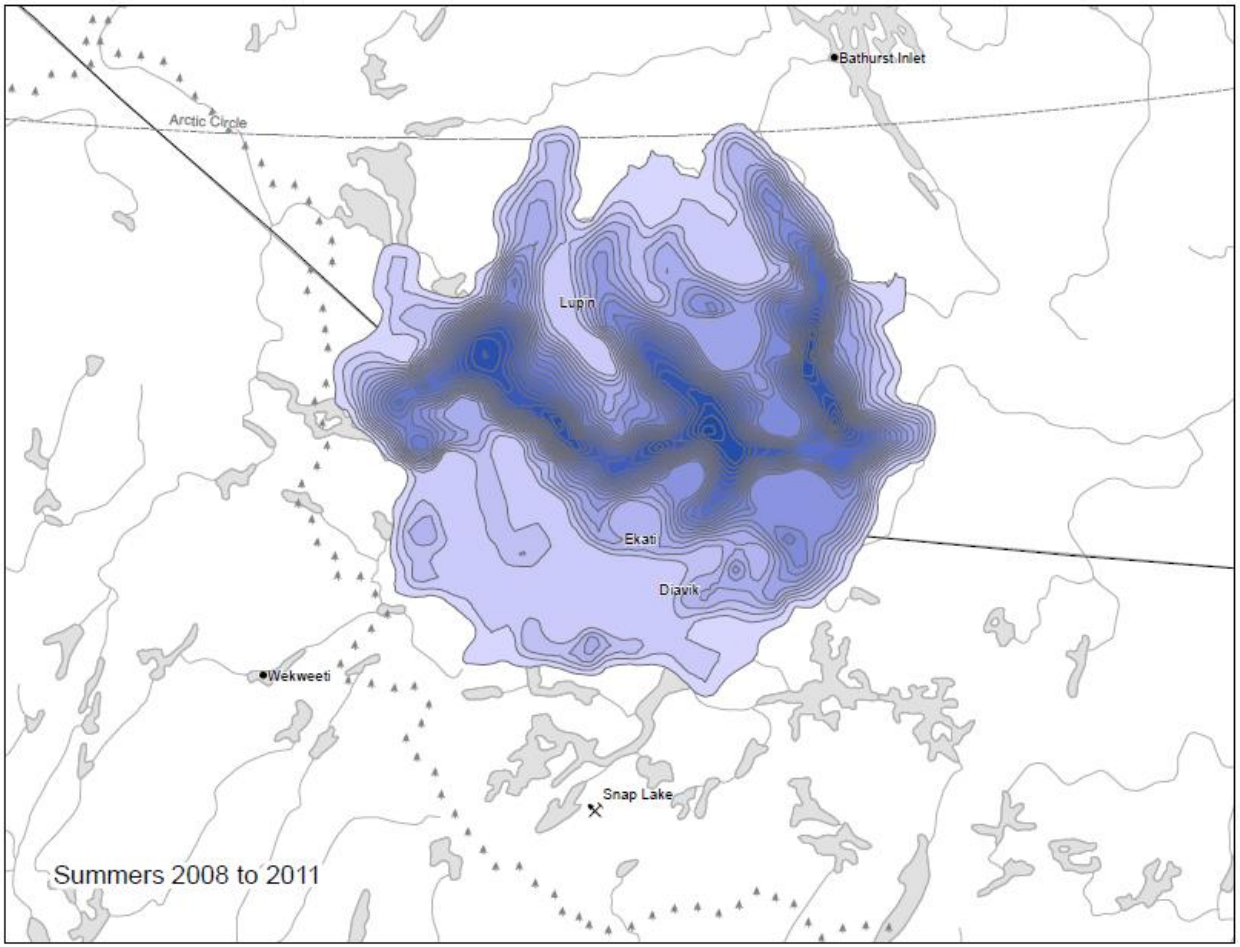
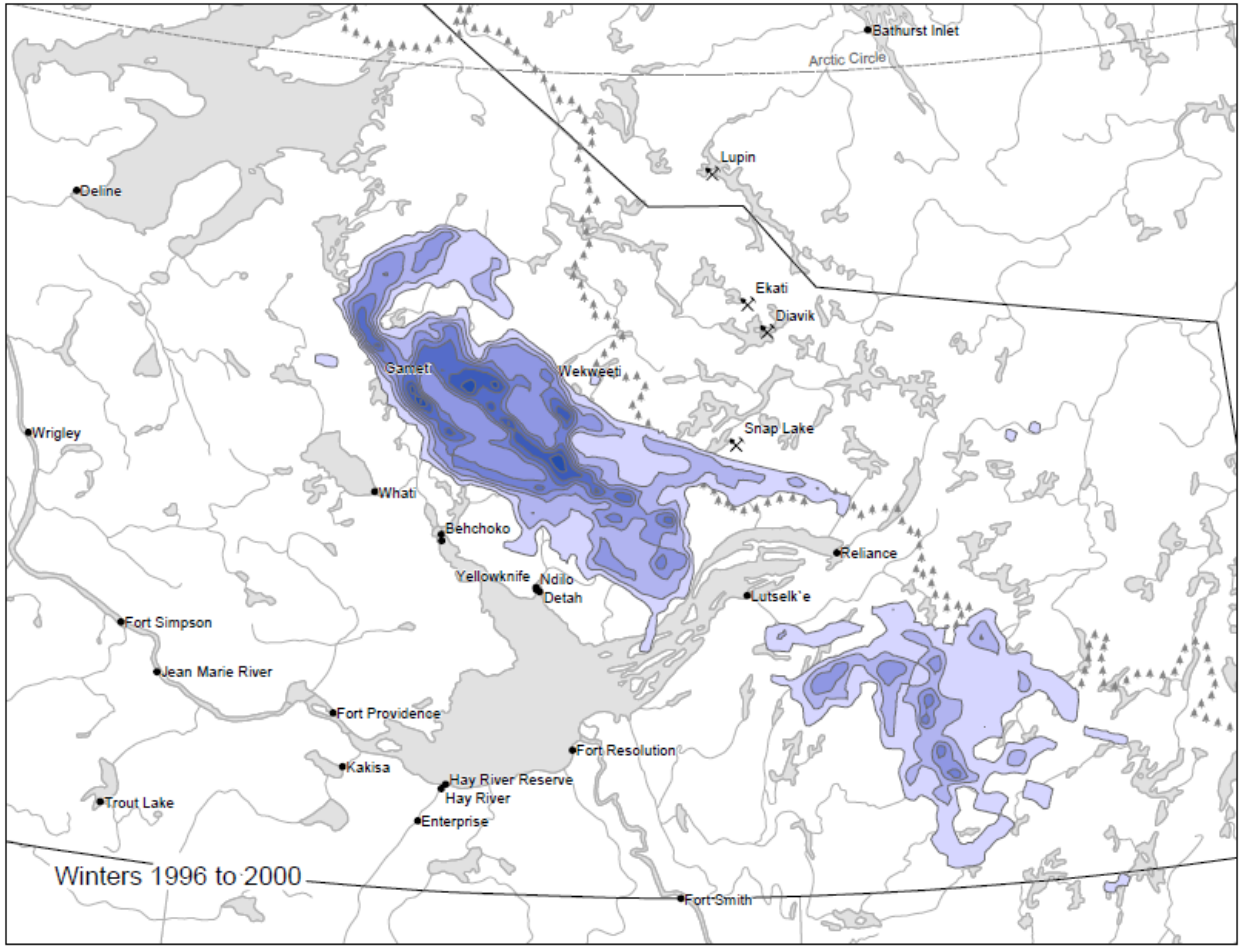
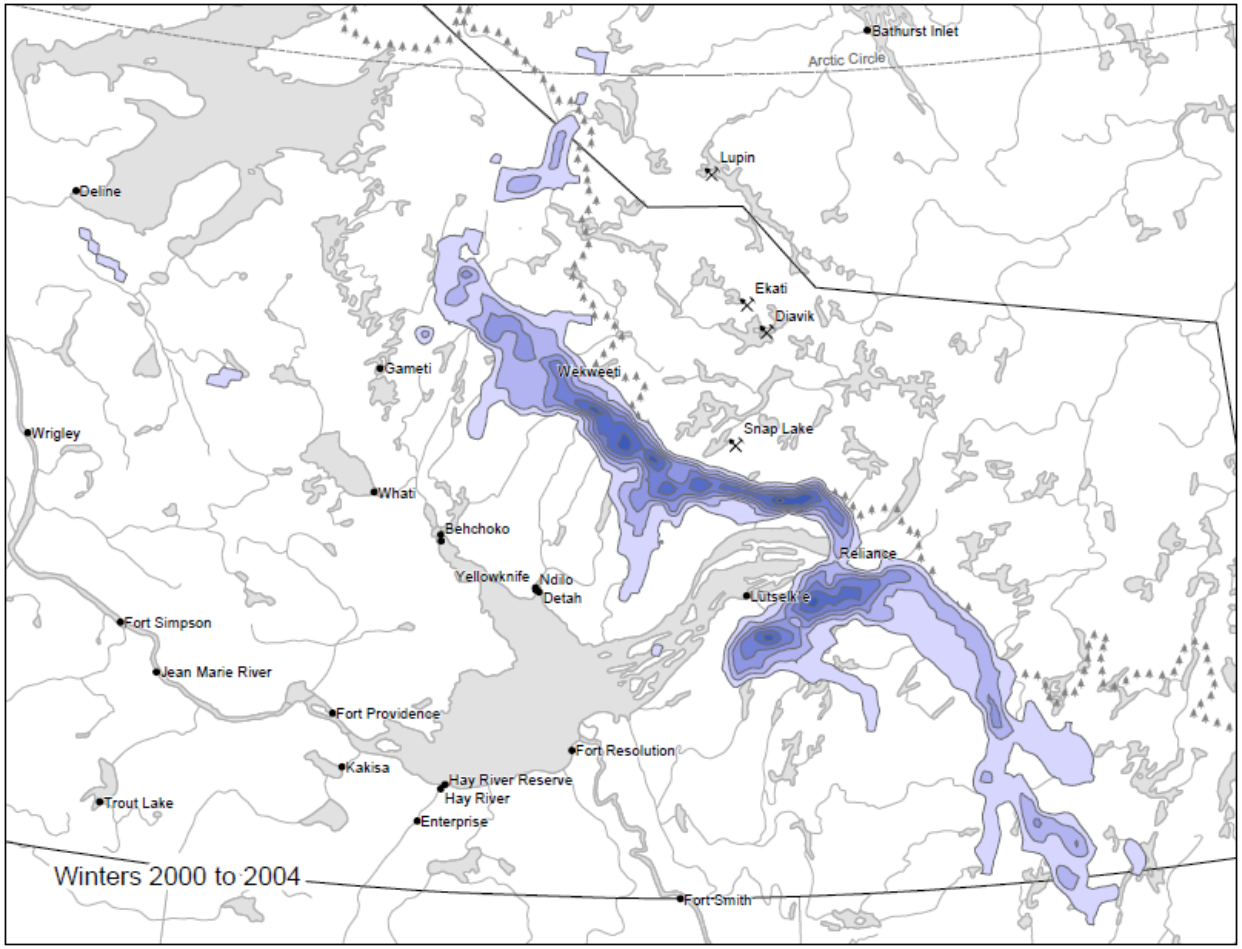
Snap Lake
Summers 2000 to 2003


Bathurst Inlet
Arctic Circle
Lupin
Ekati
Diavik
Wekweeti
Snap Lake
Summers 2004 to 2007


Bathurst Inlet
Arctic Circle
Lupin
Ekati
Diavik
Wekweeti
Snap Lake
Summers 2008 to 2011


Bathurst Inlet
Arctic Circle
Lupin
Deline
Ekati
Diavik
Gameti
Wekweeti
Wrigley
Snap Lake
Whati
Behchoko
Reliance
Yellowknife
Ndilo
Detah
Lutselk'e
Fort Simpson
Jean Marie River
Fort Providence
Fort Resolution
Kakisa
Hay River Reserve
Hay River
Trout Lake
Enterprise
Winters 1996 to 2000
Fort Smith


Bathurst Inlet
Arctic Circle
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Gameti
Wekweeti
Wrigley
Snap Lake
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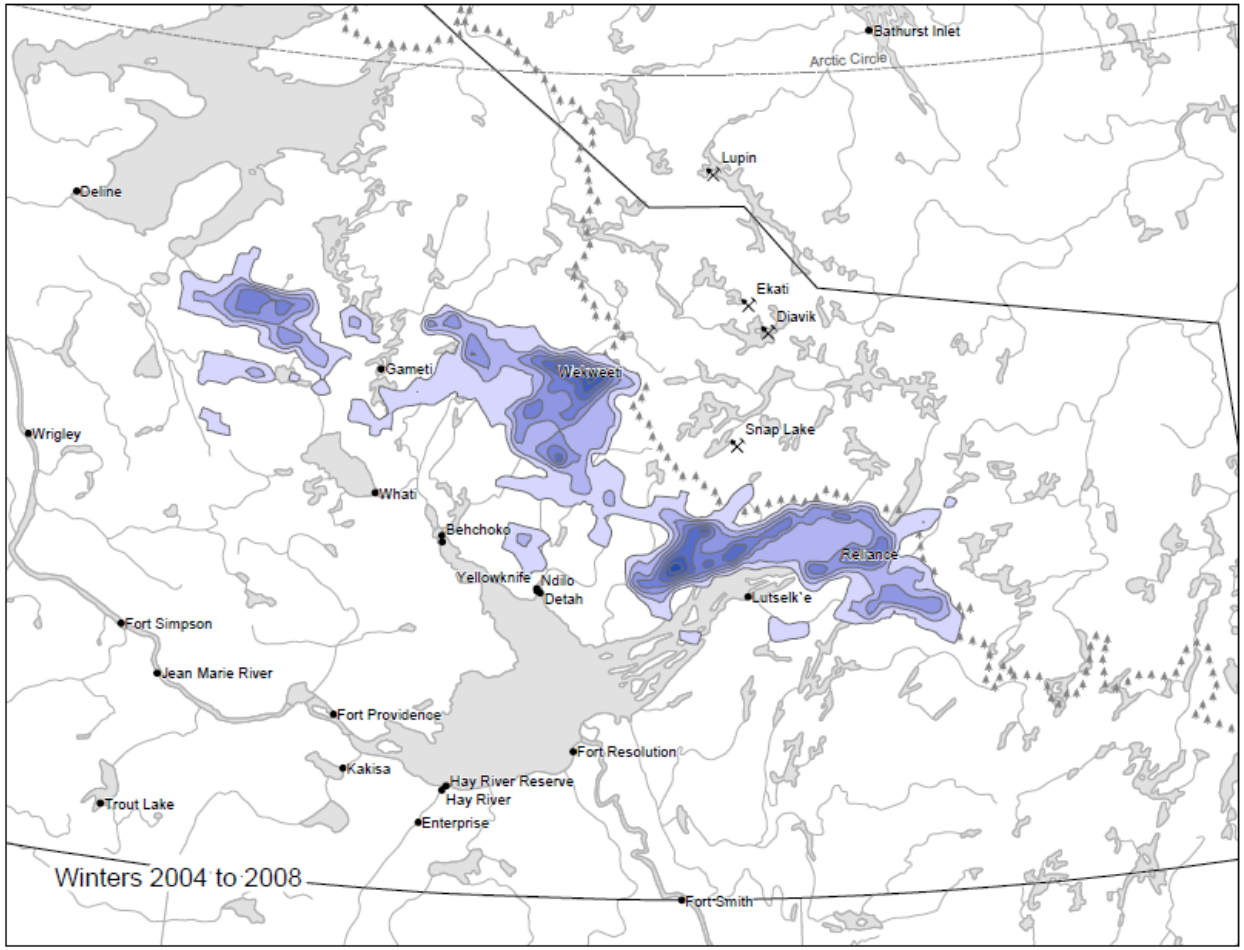
Reliance
Yellowknife
Ndilo
Detah
Lutselk'e
Fort Simpson
Jean Marie River
Fort Providence
Fort Resolution
Kakisa
Hay River Reserve
Hay River
Trout Lake
Enterprise
Winters 2000 to 2004
Fort Smith


Bathurst Inlet
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Lupin
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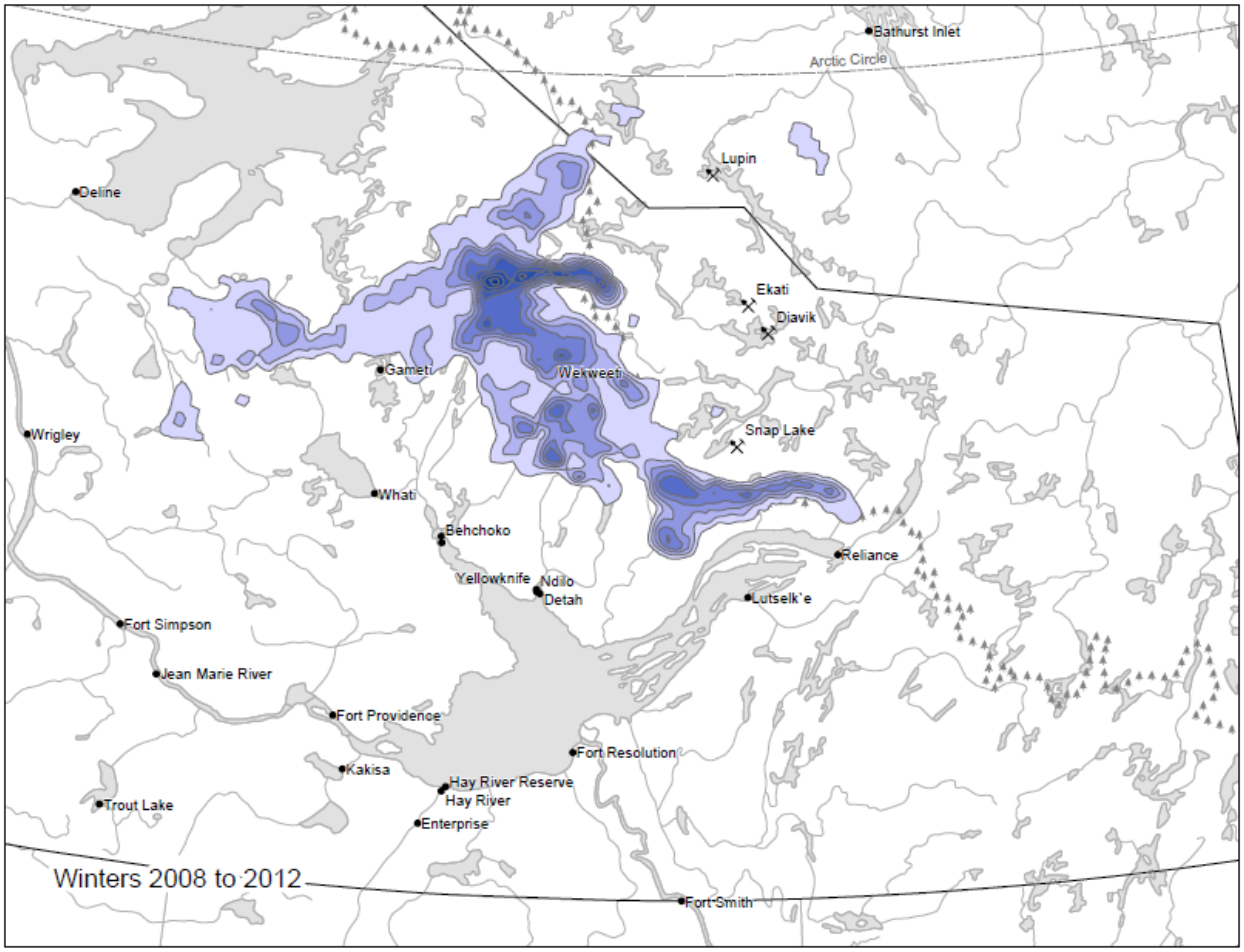
Gameti
Wekweeti
Wrigley
Snap Lake
Whati
Behchoko
Reliance
Yellowknife
Ndilo
Detah
Lutselk'e
Fort Simpson
Jean Marie River
Fort Providence
Fort Resolution
Kakisa
Hay River Reserve
Hay River
Trout Lake
Enterprise
Winters 2004 to 2008
Fort Smith


Bathurst Inlet
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Wekweeti
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Behchoko
Reliance
Yellowknife
Ndilo
Detah
Lutselk'e
Fort Simpson
Jean Marie River
Fort Providence
Fort Resolution
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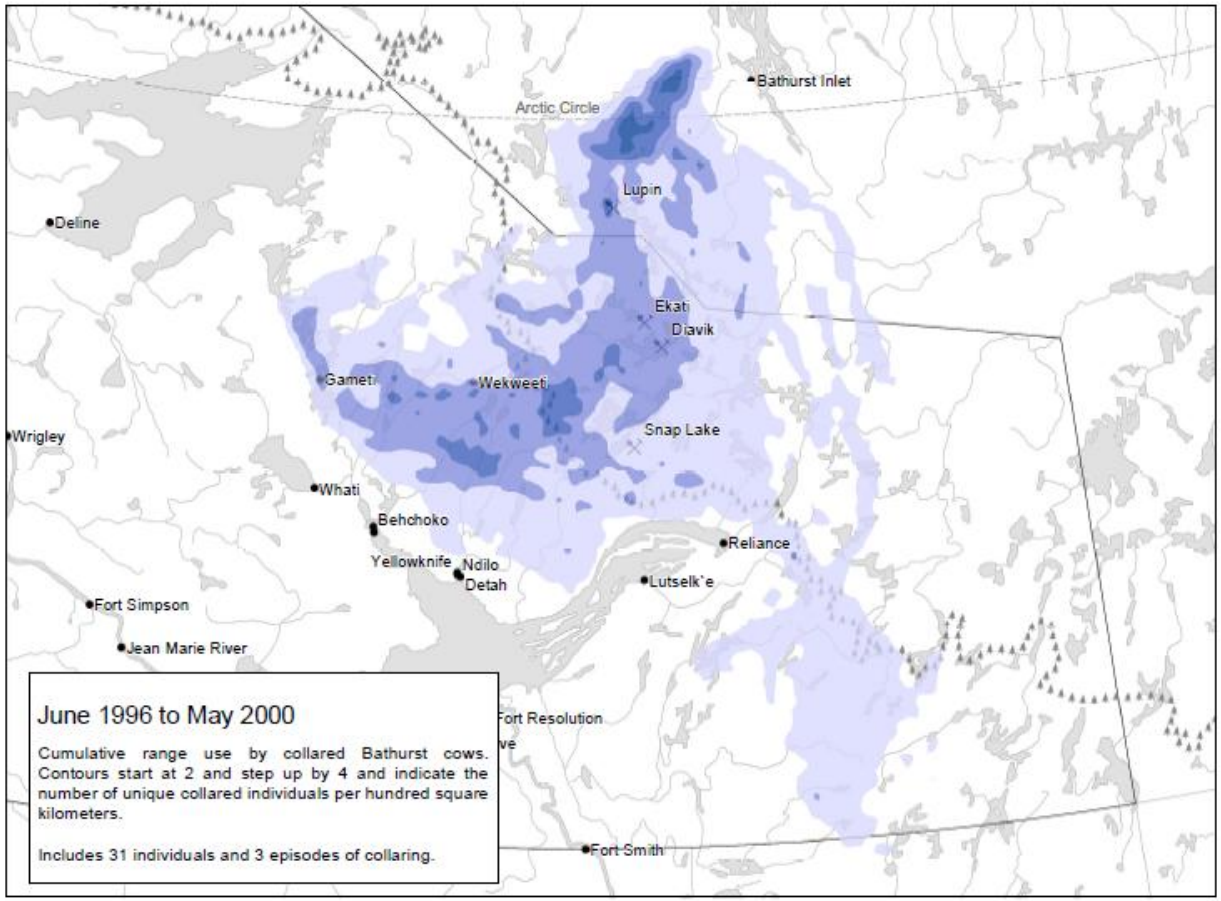
Hay River Reserve
Hay River
Trout Lake
Enterprise
Winters 2008 to 2012
Fort Smith


Bathurst Inlet
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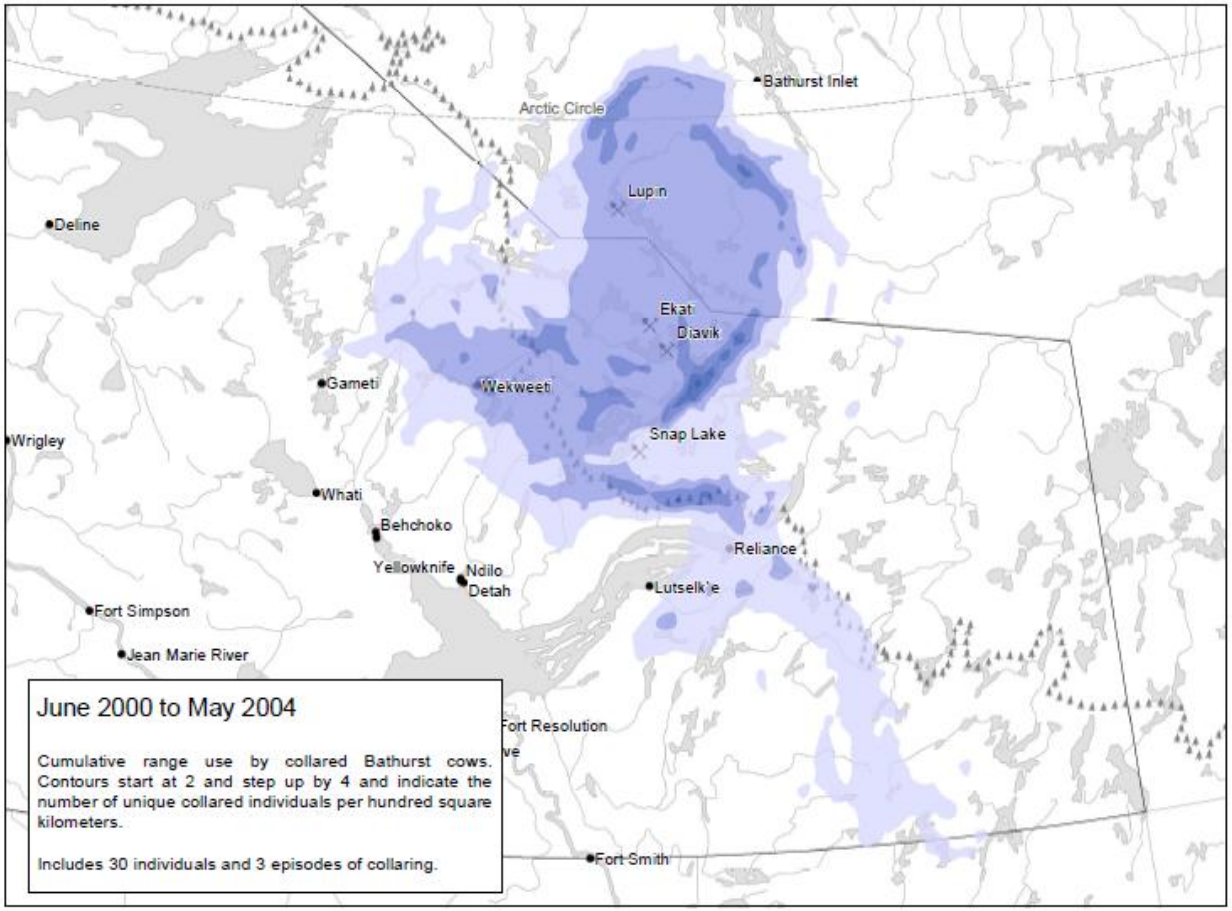
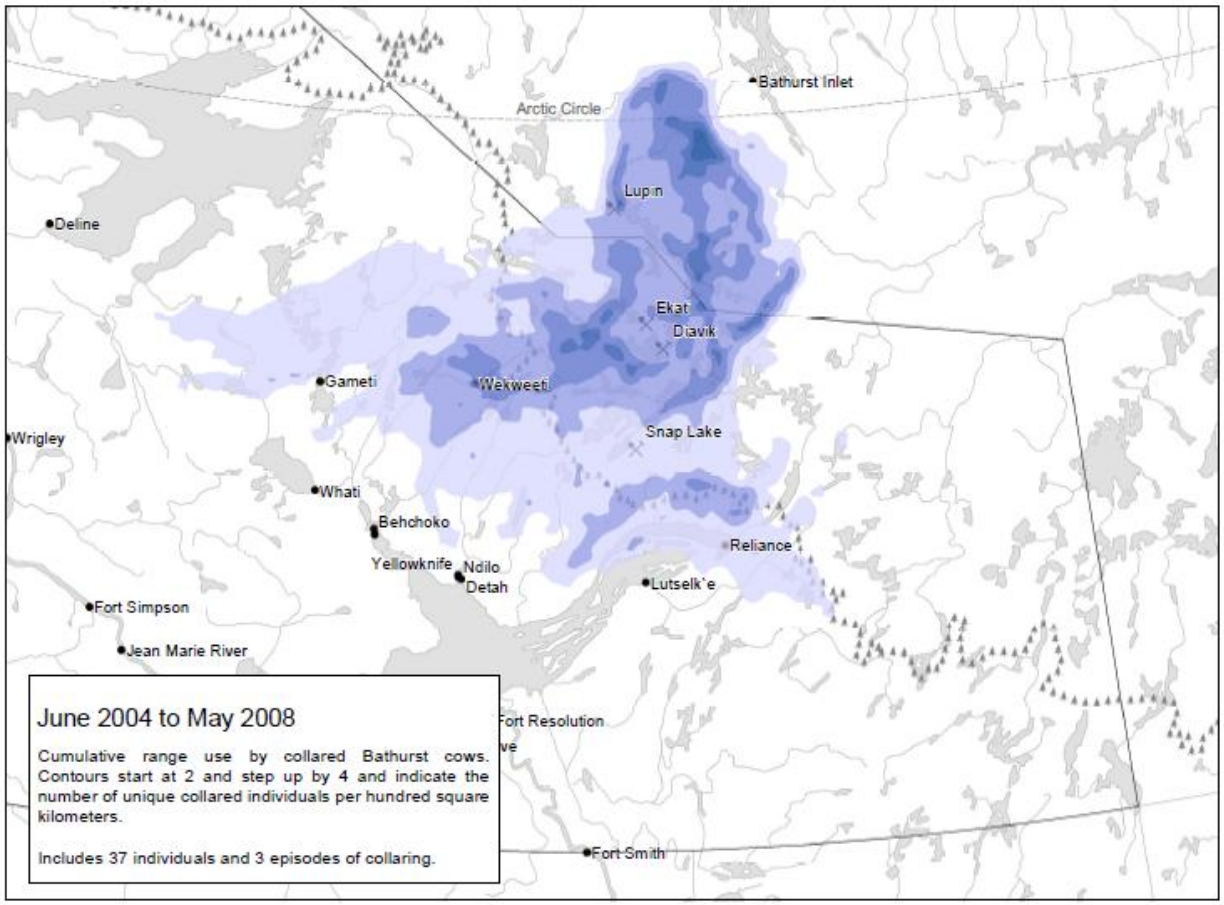
Behchoko
Reliance
Yellowknife
Ndilo
Detah
Lutselk'e
Fort Simpson
Jean Marie River
Fort Resolution
Fort Smith
June 1996 to May 2000
Cumulative range use by collared Bathurst cows. Contours start at 2 and step up by 4 and indicate the number of unique collared individuals per hundred square kilometers.
Includes 31 individuals and 3 episodes of collaring.


Bathurst Inlet
Arctic Circle
Lupin
Deline
Ekati
Diavik
Gameti
Wekweeti
Wrigley
Snap Lake
Whati
Behchoko
Reliance
Yellowknife
Ndilo
Detah
Lutselk'e
Fort Simpson
Jean Marie River
June 2000 to May 2004
Cumulative range use by collared Bathurst cows. Contours start at 2 and step up by 4 and indicate the number of unique collared individuals per hundred square kilometers.
Includes 30 individuals and 3 episodes of collaring.
Fort Resolution
Fort Smith


Bathurst Inlet
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Wekweeti
Wrigley
Snap Lake
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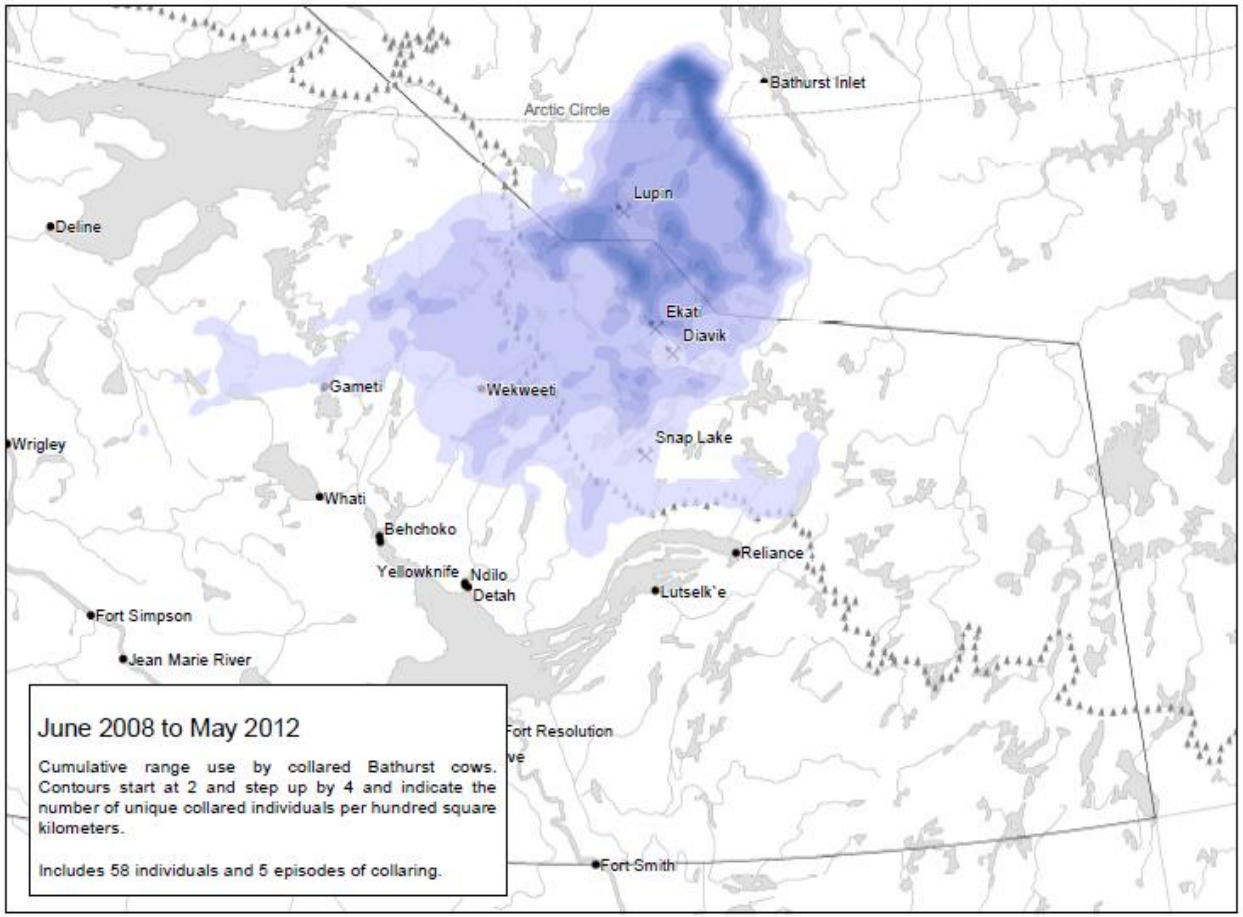
Behchoko
Reliance
Yellowknife
Ndilo
Detah
Lutselk'e
Fort Simpson
Jean Marie River
June 2004 to May 2008
Cumulative range use by collared Bathurst cows. Contours start at 2 and step up by 4 and indicate the number of unique collared individuals per hundred square kilometers.
Includes 37 individuals and 3 episodes of collaring.
Fort Smith


Bathurst Inlet
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Snap Lake
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Behchoko
Reliance
Yellowknife
Ndilo
Detah
Lutselk`e
Fort Simpson
Jean Marie River
June 2008 to May 2012
Cumulative range use by collared Bathurst cows. Contours start at 2 and step up by 4 and indicate the number of unique collared individuals per hundred square kilometers.
Includes 58 individuals and 5 episodes of collaring.
Fort Smith