Northwest Territories Environment and Natural Resources

Michael Neyelle
Chair
Sahtú Renewable Resources Board
PO BOX 134
TULÍT'A NT X0E 0K0

DEC 15 2015

Dear Mr. Neyelle:

Proposal for Management Actions for the Bluenose-East Caribou Herd 2016-2019

The Department of Environment and Natural Resources (ENR), Government of the Northwest Territories (GNWT) would like to submit to the Sahtú Renewable Resources Board (SRRB) a management proposal for the period of November 2016 to November 2019, for the Bluenose-East (BNE) herd. Please note that the attached proposal has a very similar counterpart proposal sent jointly and concurrently by the Tłı̨chǫ Government and ENR to the Wek'èezhìi Renewable Resources Board (WRRB). The proposal was shaped in part by comments sent to us by WRRB on November 27, 2015 on a previous version of the draft proposal, and by comments from the SRRB in a letter to ENR on November 3, 2015.

We look forward to the Board's recommendations with respect to management of the Bluenose-East herd.

Sincerely,

Ernie Campbell
Deputy Minister

.../2

c. Ms. Deborah Simmons, Executive Director, SRRB

Ms. Amy Amos, Executive Director
Gwich'in Renewable Resources Board (GRRB)

Mr. Eugene Pascal, Chair, GRRB

Ms. Jody Pellissey, Executive Director, WRRB

Mr. Jonas Lafferty, Interim Chair, WRRB

Ms. Jody Pellissey
Advisory Committee for Cooperation on Wildlife Management

Mr. Patrick Gruben, Chairperson, Inuvialuit Game Council (IGC)

Mr. Steve Baryluk, IGC

Chief Leonard Kenny, Deline First Nation

Mr. Russel Kenny, President, Deline Renewable Resources Council

Mr. Roger Boniface, President
Fort Good Hope Renewable Resources Council

Ms. Ethel Blondin-Andrew, Chairperson, Sahtú Secretariat Incorporated

Chief Greg Labouchan, K'asho Got'ine Community Council

Chief Ryan Kochon, Behdzi Ahda First Nation Band Council

Mr. David Codzi, President, Behdzi Ahda Renewable Resource Council

Chief David Etchinelle, Begaee Shuhagot'ine

Mr. David Menacho, President, Tulita Renewable Resource Council

Mr. Larry Carpenter, Wildlife Management Advisory Council NWT

Mr. Jeff Walker, Superintendent, Sahtú Region, ENR

Mr. Gary Bohnet, Principal Secretary, Office of the Premier, GNWT

.../3

Mr. Jack Bird, Assistant Deputy Minister Operations, ENR, GNWT

Ms. Lynda Yonge, Director of Wildlife Division, ENR, GNWT

Mr. Ben Kovic, Chairperson, Nunavut Wildlife Management Board

Ms. Cathy Towtongie, President, Nunavut Tungavik Inc.

Mr. David Nivingalok, Chair, Kugluktuk Hunters and Trappers Committee

Mr. Stanley Anablak, President, Kitikmeot Inuit Association

Mr. Gabriel Nirlungayuk, Deputy Minister
Department of Environment, Government of Nunavut (GN)

Mr. Dirkus Gissing, Director of Wildlife, Department of Environment, GN

Mr. Mathieu Dumond, Manager of Wildlife, Department of Environment, GN

Management Proposal to Sahtú Renewable Resources Board and Wildlife Management Advisory Council (NWT)

1. Applicant Information
Project Title: Government of the Northwest Territories Proposal on Management Actions for Bluenose-East Caribou 2016-2019
Contact Person: Lynda Yonge Wildlife Director Department of Environment & Natural Resources Government of the Northwest Territories YELLOWKNIFE, NT X1A 3S8 Phone: 867-920-8043 Fax: 867-873-0293 Lynda_Yonge@gov.nt.ca

2. Management Proposal Summary	
Start Date: November 1, 2016	**Projected End Date:** November 1, 2019
Length: 3 years	**Project Year:** 1 of 3
A June 2015 calving ground survey of the Bluenose-East (BNE) herd caribou resulted in an estimate of 17,396 ± 4,616 breeding cows, which indicated that abundance of breeding females had decreased by ~29% per year since the June 2013 estimate of 34,472 ± 4,363 (95% CI; Figure 1; Boulanger 2015). Relative to the June 2010 and 2013 surveys which suggested an annual rate of decrease of ~14%, the recent survey suggests that the rate of decrease in breeding females has more than doubled over the past two years. In view of this rapid decline, the Department of Environment and Natural Resources (ENR), Government of the Northwest Territories (GNWT) is proposing management actions to slow the herd's decline and promote recovery for a 3-year period from November 2016 to November 2019. ENR proposes that resident and commercial harvest from this herd remain at 0 and that Aboriginal harvest be limited on a herd-wide basis to 950/year in total and 100% bulls. This harvest would be reviewed on an annual basis and as new information becomes available. Until an allocation accepted by all user groups becomes available, the allocation in the Northwest Territories (NWT) is proposed as 611 caribou (Tłı̨chǫ 373, Sahtú 163, Dehcho 15, Inuvialuit 8, NWT Métis Nation 14, Akaitcho 20, and North Slave Métis Alliance 17). This would leave an allocation of 339 BNE caribou for Nunavut (NU). Although ENR has no authority over wildlife management in NU, ENR and co-management partners will work collaboratively with responsible authorities in NU towards implementing a consistent overall approach to Aboriginal harvest of this inter-jurisdictional herd that ranges through NWT and NU. ENR and partners will consider potential actions to address other factors that may affect the herd's trend and ability to recover, including predators and human disturbance on the landscape.	

Key points include:

- ENR will lead a review of wolf monitoring and management in the NWT in 2015-2016 and with input from Aboriginal governments and boards will carry out a feasibility assessment of predator management options that could be used to hasten recovery of barren-ground caribou herds.
- ENR will explore specific and measurable predation management actions for BNE caribou that are community based and/or undertaken with territorial governments and wildlife management authorities. A pilot project is being developed for the Bathurst range for winter 2015-2016 and if successful, methods could be extended to the BNE range in 2016-2017.
- There are currently no mines in BNE caribou range in the NWT, but Tundra Copper has carried out exploration activity on the BNE calving grounds; ENR will participate in environmental assessment processes for development activities that may affect the BNE herd. ENR expressed opposition to the Tundra Copper activities to the Nunavut Impact Review Board in 2015.

ENR recognizes the importance of increased communication and engagement with communities and harvesters about the status of the caribou herds and about management actions underway, and the importance of accurate harvest reporting by all harvesters.

ENR will continue to monitor the BNE herd's status using calving ground photo surveys every 3 years, annual spring recruitment surveys, regular fall composition surveys to monitor sex ratio, and annual reconnaissance surveys over the calving grounds. Satellite collars will be maintained on the herd (30 cows, 20 bulls) with annual additions to replace collars that are on caribou that die and collars that reach the end of their battery life. Accurate monitoring of harvest will be essential to overall monitoring and management of this herd. Additional monitoring may be carried out if resources are available.

A joint proposal with the same primary content as the current one will be submitted by the Tłı̨chǫ Government (TG) and ENR to the Wek'èezhìi Renewable Resources Board (WRRB). The format of the current proposal is based on a template developed by the WRRB.

Permits required to conduct proposal

Renewable Resource Boards (WRRB, the Sahtú Renewable Resources Board (SRRB) and the Wildlife Management Advisory Council NWT (WMAC-NWT) may hold public hearings to review proposals involving a Total Allowable Harvest (TAH) for the BNE herd, as included in this proposal. NWT and NU Wildlife Research Permits will be required annually to conduct monitoring recommended in this proposal.

3. Background

A. Bluenose-East Caribou Status in 2015

The June 2015 calving ground survey of the BNE caribou herd estimated 17,396 ± 4,616 (95% Confidence Interval) breeding females, which compared to the June 2013 estimate of 34,472 ± 4,363 indicates that the abundance of breeding females has declined by ~29% per year since 2013 (Fig. 1; Boulanger 2015). This result is alarming for two reasons: 1) the rate of decrease has accelerated in recent years. It is now twice the -14% annual rate of change observed between calving ground surveys in 2013 and 2010; and 2) if the observed annual rate of -29% continues, in two years, the number of breeding females would be less than half

of what it, which is before the next calving ground survey scheduled for June 2018. The accelerated decrease in abundance of the BNE herd is similar to the rapid rate of decline observed in the Bathurst herd between 2006 and 2009, when the annual rate of decline based on breeding cow estimates exceeded -~30% (Boulanger et al. 2011). The 2015 photo survey results confirmed the steep downward trend in the BNE herd suggested by the June 2014 reconnaissance survey of this herd's calving grounds. The calving ground photo herd estimate is 38,592 ± 4,733 (CI) for 2015, which compares to 68,295 ± 18,041 in 2013 (Boulanger et al. 2014).

An overview of population monitoring of the BNE and Bathurst caribou herds was provided by ENR (2014a) in late 2014 to Aboriginal governments and co-management boards participating in meetings on management of the two herds. An update with estimates from the BNE June 2015 calving ground survey was provided by letter to Aboriginal governments and co-management boards on September 24, 2015 and a further update as provided on December 2, 2015. Complete survey reports will be provided as they become available.

Other demographic indicators for the BNE herd in recent years are consistent with a rapidly declining trend between 2010 and 2015: late-winter calf:cow ratios in recent years have averaged below 30 calves:100 cows (ratios of 30-40 calves: 100 cows or greater are associated with stable herds), estimated cow survival has been well below the 80% needed for a stable herd (Boulanger et al. 2014, ENR 2014A), and there is evidence of low pregnancy rate in at least some years, including 2010, 2012 and 2015 (ENR 2014a). Limited evidence gathered by Tłı̨chǫ and Sahtú hunters during winter harvesting suggested that cows were in relatively poor condition between 2010 and 2014 (Garner 2014), and particularly between 2010 and 2012 (ENR 2014a, Carlsson et al. 2015).

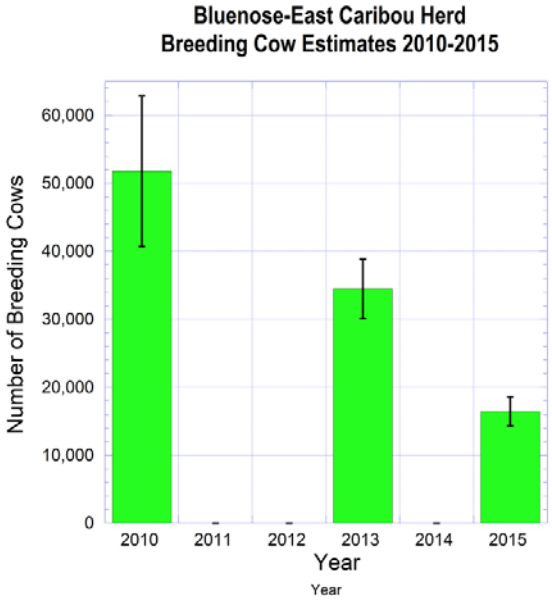

Fig. 1. Estimated numbers of breeding cows (± 95% CI) in the BNE herd 2010-2015.

ENR notes that the declining trend in the Bathurst and BNE caribou herds is consistent with generally declining trends, with very few exceptions, in migratory tundra caribou herds in North America: George River and Leaf River herds in Quebec/Labrador; Qaminirjuaq herd in NU; Bathurst, Bluenose-West and Tuktoyaktuk Peninsula herds in the NWT, with the Cape Bathurst herd stable-declining slightly (based on preliminary estimates from 2015 surveys);

Central Arctic, Western Arctic and Teshekpuk herds in Alaska. The Porcupine herd is the lone exception in Alaska with an increasing trend.

The average estimated/reported BNE harvest in winters 2009-2010 to 2012-2013 was about 2700 caribou/year, and likely at least 65% cows (ENR 2014a; BGTWG 2014). These estimates are considered minimums; wounding losses were not included, some harvest was un-reported and the true harvest may have been at least 4000/year (ENR 2014A). The increased BNE harvest since the winter of 2009-2010 may reflect a deflected Bathurst harvest. The Bathurst harvest before 2010 was not fully documented but estimated at 4000-7000/year, mostly cows (Adamczewski et al. 2009). After 2010 Bathurst harvest was limited to 300 caribou (80% bulls; ENR 2014a) in 2 large management zones, while the BNE harvest was unrestricted.

B. Management Context for the Bluenose-East Caribou Herd

Guidance for the management and monitoring of the BNE herd is primarily found within the Advisory Committee for the Cooperation on Wildlife Management's (ACCWM) management plan for the Cape Bathurst, Bluenose-West and BNE herds, finalized in November 2014 (ACCWM 2014). In 2015, the ACCWM requested and received support from ENR for development of an Action Plan for the BNE herd; when completed, this may influence management actions proposed for this herd.

In October 2010, the WRRB issued a report with a series of recommendations focused primarily on the Bathurst herd; recommendations for the BNE herd included closing resident and commercial harvest and a Harvest Target of 2800 caribou (4% of an estimated 70,000) with an 85% bull ratio. This harvest target was not implemented when 2010 population surveys demonstrated that the herd was over 100,000 and had an increasing trend (Adamczewski et al. 2014).

In fall and winter 2014-2015, ENR hosted three meetings of Aboriginal leaders (August 27, November 7 and November 28) and two 2-day technical meetings (October 9-10 and October 22-23) to review evidence for decline in the Bathurst and BNE herds and to consider management actions to address these declines. Meeting summaries were sent to participants and are available from ENR on request. In early 2015, the ACCWM recommended, and ENR accepted, a harvest limit for NWT Aboriginal hunters of 1800 BNE caribou, with at least 80% of those being bulls, for the remainder of winter 2014-2015. Although the NU harvest of this herd was not well documented, it was assumed to number up to 1000/year. After an unsuccessful attempt on a short time-frame to reach agreement among NWT Aboriginal user groups of this herd and co-management boards on an allocation or sharing formula, , ENR determined an allocation for the herd in NWT. This was based in large part on recent documented harvest from this herd but also on several other criteria including access to other caribou. The allocation on February 6, 2015 was to include caribou already taken to that point, and the 1800 tags were to be shared as follows: Tłı̨chǫ 1100 (61.11%), Sahtú 480 (2.67%), Dehcho 45 (2.50%), Inuvialuit 25 (1.39%), NWT Métis Nation 40 (2.22%), Akaitcho 60 (3.33%), and North Slave Métis Alliance 50 (2.78%).

4. Description of Proposed Management Action

Goal of Management Actions

The short-term goal of the management actions proposed is to slow the herd's decline and promote recovery. Over the longer-term, the goal of management is to promote recovery of the herd so that sustainable harvesting that addresses community needs levels is again possible.

Harvest management for the Bluenose-East herd

In view of the recent rapid decline in the BNE herd, ENR suggests that the herd is in the orange phase (intermediate and declining) of the ACCWM management plan, where a TAH acceptable to the ACCWM could be set. The rate of decline is such that the herd could reach the red zone (20,000 or less) in 2 years, and the rapid decline must be considered along with herd size when proposing management options. Accordingly, resident and commercial harvest from this herd should remain at 0 and Aboriginal harvest should be limited on a herd-wide basis to a maximum of 950/year in total and 100% bulls. Assuming an overall herd size estimate of 38,592, a harvest of 950 represents 2.5 % of the herd. ENR considers that the harvest limit of 1800 (2800 in total for the herd, including NU) from 2014-2015 is too high to continue, given the herd's rapid decline and poor demographic indicators. The 50% decline in the herd's breeding cows from 2013 to 2015 indicates that the herd's breeding cows need to be conserved if the herd is to stabilize and recover. As noted in the ACCWM plan, harvest of bulls should focus on young or small bulls so that many of the large bulls are left for breeding. Harvest recommendations should be reviewed annually or as new information becomes available.

ENR supports meetings of all user groups and boards to develop an allocation or sharing formula for Aboriginal harvest of BNE caribou. Until an allocation formula accepted by all user groups becomes available, the allocation in NWT is proposed as 611 caribou (Tłı̨chǫ 373, Sahtú 163, Dehcho 15, Inuvialuit 8, NWT Métis Nation 14, Akaitcho 20, and North Slave Métis Alliance 17). This allocation is based on an allocation determined by ENR for the winter 2014-2015 harvest season, and based primarily on recent harvest information. Management of harvest using tags, authorizations or other methods will be developed in collaboration with Aboriginal communities.

This would leave an allocation of 339 BNE caribou for NU. ENR has no authority for wildlife management or caribou harvest in NU but will collaborate with responsible authorities in NU towards implementing a consistent overall approach to Aboriginal harvest of this herd in the NWT and NU. Collaboration between the GNWT and the Government of Nunavut (GN) on trans-boundary caribou herds has been extensive at a technical level for a number of years, including GN participation in 2015 BNE and Bathurst calving ground photo surveys. Updates on survey results have been provided to GN as they have become available, along with the herd-wide harvest proposed by TG and ENR. The GNWT has also been in contact with GN at the minister's level on caribou management issues. An update provided by GN in late November 2015 indicates that a hearing under the Nunavut Wildlife Management Board (NWMB) is likely to occur in February or March 2016; TAH for the BNE herd will be assessed at that time. GN has been working with regional wildlife boards, communities and the NWMB on these caribou harvest issues; the process in NU includes a needs assessment and community consultation. ENR will remain in frequent

contact with GN on these issues and participate where possible in the NWMB process.

Wolf monitoring and management

ENR will carry out a review of wolf monitoring and management in the NWT in winter 2015-2016. Wolves are difficult to count, particularly on the large remote ranges used by barren-ground caribou herds in NWT and NU. In view of the further decline in the BNE, Bathurst and other NWT herds, ENR will carry out a feasibility assessment of wolf management options in 2015-2016, to consider the practicality, costs, and likely effectiveness of different management actions. This assessment will be developed with the input of Aboriginal governments and boards, as well as other interested parties. ENR has had a number of discussions with biologists and managers with the Alaska Department of Fish and Game on approaches that they have used in feasibility assessments for predator management; 3 of Alaska's 4 tundra migratory herds have declined in recent years and management actions, including predator management, to address these declines is under discussion.

At this point, grizzly bear management to benefit BNE caribou is not being considered, although observations on calving ground surveys, including surveys on the BNE calving grounds in 2013 and 2015, suggest that there may be more bears than wolves on the calving grounds. Bears are known to contribute significantly to caribou calf mortality in the first few weeks after calving, but substantial caribou killing by bears is limited to this time period. Wolves are effective predators of caribou year-round. The BNE calving grounds are within NU, thus any consideration of predator management on the calving grounds would need to be discussed under NU processes for wildlife management.

ENR supports the development, implementation and evaluation of specific and measurable predator management actions for caribou that are community based ad/or undertaken with territorial governments and wildlife management authorities for 3 years To start, GNWT and TG are meeting to develop a predator management program for the 2015-16 harvesting season focused on the Bathurst herd and the Bathurst mobile conservation zone. If successful, the approach could be extended or adapted in 2016-2017 the BNE herd. A summary of the proposed approach is provided below.

The basic premise is that communities will have meaningful input into deciding how to hunt and trap wolves in a culturally respectful manner, selecting candidates (including interested youth) who will be trained in effective field techniques for hunting/trapping wolves, skinning, and fur preparation, and identifying appropriate locations away from communities for skinning and processing wolf carcasses. Selected individuals will receive training from recognized expert wolf hunters/trappers and/or expert instructors. ENR would develop, coordinate, and provide the training workshops with input from TG.

Individuals for community-based teams would be selected from Wekweètì and Gamètì. Teams will establish field camps in focal areas during winter months and harvest wolves in a manner consistent with Tłı̨chǫ practices. ENR with support from TG will provide funding, training, and field support, and monitor overall program effort and effectiveness. Tłı̨chǫ hunters have the option to either deliver the wolf carcass (entire unskinned wolf) to ENR and receive straight pay-out (proposed as $200) or prepare the hide themselves for submission to ENR either with traditional skinning (proposed as $400 for the hide and $50 for the skull) or pelts prepared to taxidermy standards through the Genuine Mackenzie Valley Fur Program (proposed as $400 for the pelt, $50 for the skull, and a prime fur bonus of $350 if the pelt sells

for more than $200 at auction). Wolf carcasses will be necropsied by ENR biologists.

In addition to training Tłı̨chǫ hunters as part of a community-based wolf harvesting program, recommendations from communities and governments were made in 2014-2015 to extend wolf hunting opportunities and incentives to NWT residents and non-residents (i.e., guide-outfitters). The opportunity for resident hunters and guided outfitters to hunt wolves on the Bathurst range is already in place. ENR will work with other Aboriginal governments to increase wolf harvesting over the winter range of the Bathurst herd in culturally appropriate ways, and these approaches may be extended to the range of the BNE herd.

Land use in the Bluenose-East caribou range

There are currently no mines in BNE caribou range in the NWT or NU, but Tundra Copper carried out exploration activity on the BNE calving grounds in summer 2015. ENR will participate in environmental assessment processes for developments that may affect the BNE herd. ENR expressed opposition to the Tundra Copper activities to the Nunavut Impact Review Board, as did the GN. ENR participated in a workshop June 2015 in Iqaluit on the draft Nunavut Land Use Plan and supported GN's position opposing development on all caribou calving grounds in NU, and participated in a workshop in November 2015 in Iqaluit hosted by the NWMB focused on protection of caribou habitat in NU. Any other industrial development proposed for the BNE herd's range will need to be considered carefully in view of the herd's reduced numbers and declining trend.

Public education and hunter education

As part of harvest management for the BNE herd, ENR suggests that an area where greater effort is needed is hunter education, with an emphasis on promoting traditional practices of using all parts of harvested caribou and minimizing wastage. Below are a few extracts from the consultation meetings that took place leading up to the Draft Bathurst Caribou Management Plan of 2004.

> *"People do not do things without the caribou being aware of it. We depend on the caribou and so, when we will kill a caribou, we show respect to it. If we don't do that and we don't treat them really well, the caribou will know about it."* (Rosalie Drybones, Gamètì. 1998).

- *"People should know how to think and talk respectfully about caribou."*
- *"People should respect caribou as gifts from the Creator."*
- *"All people should have knowledge of the caribou to respect caribou. This means knowing caribou behavior as well as how to think and talk about caribou."*
- *"Hunters should not be too particular when hunting caribou."*
- *"Caribou should not suffer in death."*
- *"Hunters must not boast about their harvest."*
- *"It is important to use all parts of the caribou and waste nothing."*
- *"People must care for the stored meat and discard bones and other unused parts in a manner that will not offend the caribou."*
- *"The relationship between the people and the caribou is based on mutual respect."*
- *"The rules about caribou respect are meant to be obeyed."*

Wastage is prohibited under the NWT Wildlife Act:

> **57.** (1) Subject to the regulations, no person shall waste, destroy, abandon or allow to spoil
>
> (a) big game, other than bear, wolf, coyote or wolverine, or an upland game bird that is fit for human consumption; or
>
> (b) a raw pelt or raw hide of a fur-bearing animal or bear.

ENR suggests the following education/public awareness initiatives to improve hunter practices and reduce wounding and wastage:

- Continue to work with the communities, in particular, more closely with schools, on promoting Aboriginal laws and respecting wildlife, including how to prevent wastage;

- Invite elders to work with the youth to teach traditional hunting practices and proper meat preparation.

Posters, pamphlets, media and road signs will be used to better inform the public about respecting wildlife, traditional hunting practices, wastage, poaching and promoting bull harvest.

ENR has promoted sound hunter harvest practices, reduction of wastage, harvesting bulls instead of cows, and related conservation education in NWT communities for a number of years. In response to community demands, ENR is currently developing a Hunter Education program. A working group developed the materials which are currently out for review with individuals, boards, agencies and organizations involved in the Wildlife Act creation.

Monitoring of the Bluenose-East herd

Caribou Surveys:

Calving ground photo surveys to estimate numbers of breeding cows and herd size would be continued at 3-year intervals, calf recruitment would be monitored annually, and fall composition surveys to estimate sex ratio would be carried out every 2-3 years. Although not listed in the ACCWM plan, ENR proposes to carry out reconnaissance surveys over the calving grounds in June annually in years between population surveys to provide an index of numbers of cows in the herd. Experience with the Bathurst herd and more recently with the BNE herd has shown that these reconnaissance surveys are less precise than calving ground photo surveys but track trend in numbers of breeding cows (ENR 2014a), thus can provide information on herd trend in years between population surveys. In years of calving ground photo surveys, statistician J. Boulanger also carries out an update on demography of the herd using an OLS (ordinary least squares) model (see Boulanger et al. 2011, 2014) which includes estimation of cow survival rate from collars and the model, and provides an up-to-date review of the herd's dynamics. This is expected in early 2016 and will be repeated after the 2018 calving ground photo survey.

Condition Assessment and visual monitoring:

Information on BNE caribou condition has been gathered in recent winters by Tłı̨chǫ community monitors from hunter-killed animals and was summarized by Garner (2014) and ENR (2014a). Health and condition of BNE caribou has also been monitored in the Sahtú

region and was summarized by Carlsson et al. (2015). Limited sample numbers have somewhat constrained the reliability of the assessments of trend in condition and pregnancy rate. Reliable reporting of caribou condition with adequate sample numbers could improve understanding of the herd's nutritional status and the influence of environmental conditions that are tracked though the drought index, oestrid (warble and bot fly) index and indices of snow conditions on herd condition. Condition sampling in winter from hunter-killed caribou will continue with a focus on increasing sample sizes and completeness of monitoring.

Collars:

GPS collars on the BNE herd will be increased annually to 50 (30 on cows and 20 on bulls) with late-winter collar deployments, to replace collars with expired batteries or collared caribou that die. This number of collars has the support of the TG as of 2014, recognizing that the caribou collars are key elements in monitoring and management. In the past, there have been up to 60 collars on BNE caribou in years of post-calving surveys, as these surveys depend strongly on having enough collars to find a large percentage of post-calving aggregations. The calving ground photo survey recently recently used to estimate population size for the BNE herd (2010, 2013, 2015) is less dependent on large numbers of collars, thus 50 collars should be sufficient for most applications of collar data, including population surveys. ENR (2014b) provided a brief review of uses of collars and recommended numbers of collars for various applications in a rationale for increasing the numbers of collars on the Bathurst herd (appended). Some applications, such as monitoring cow survival rates with good precision, would require 100 collared caribou, while other applications can be addressed reliably with 50 or fewer collars.

Given the decline in the herd, consideration should be given to increasing the number of collars on both cows and bulls. The use of collars has in the past been a contentious issue, as recognized in the ACCWM plan. However, at this particular and critical time with low and declining BNE numbers, it is important to have the best available information. The additional collars may assist in determining where and when predators should be removed as well as tracking whether actions like predator management might be having an effect on the herd. The collared caribou should also help in developing better monitoring studies that determine if changing environmental and climactic conditions, as well as the influence of resource development, are affecting the caribou.

A programming option that has recently become available is "geo-fencing" where the number of GPS locations collected increases substantially and allows more detailed analysis of the movements of collared caribou near mines, roads or other designated sites. ENR is considering the use of these options on collars that will be placed in future on BNE caribou to assess their responses to disturbed areas like mines, camps and roads.

Harvest:

Accurate harvest reporting by all harvesters will be a priority for the BNE herd. In recent years caribou harvest monitoring from the BNE herd has occurred via community monitors in combination with check-stations and patrols by wildlife officers. Reported harvest has been viewed by those involved in the field as under-reported and there is room for improvement on more complete harvest reporting. Sahtú communities and the SRRB have indicated through letters and proposals that Sahtú harvesters want to monitor and manage caribou harvest through community-based programs. ENR is willing to be flexible on caribou harvest monitoring that is culturally appropriate, provided there is sufficient information on how a

community based plan would work operationally, accountability mechanisms for reporting and monitoring the harvest are identified, and consequences of a failure to comply are specified. Estimates of BNE harvest in NU have been the best estimates of experienced GN wildlife staff in Kugluktuk. Accurate harvest reporting needs to be a priority for all communities and harvesters that hunt the BNE herd.

Further monitoring:

Additional monitoring that may be considered to improve monitoring and understanding of the BNE herd's status, distribution and ecology is summarized below. These methods will be considered if resources (funds and staff time) are available.

Further monitoring that could be considered includes:

(1) Annual composition surveys on the calving grounds to determine the proportion of breeding females as an index of pregnancy rate;
(2) Annual fall composition surveys to provide increased information about summer calf survival;
(3) Detailed assessments of wolf numbers and condition on the BNE winter range;
(4) Annual winter assessments of caribou pregnancy rate from fecal samples collected during late-winter composition surveys; and
(5) Annual monitoring of environmental factors (drought index, insect index) that may affect caribou feeding, pregnancy rate and condition.

Wolf monitoring:

In a parallel proposal on the Bathurst herd, TG and ENR have described detailed monitoring plans associated with wolf monitoring and harvest on the Bathurst winter range. Those approaches may be extended to the BNE range if successful and if resources are available. As an initial step, ENR would monitor the numbers of wolves taken annually in the BNE range.

ENR has begun a review of wolf monitoring in the NWT in 2015-2016, recognizing that several caribou herds are at low numbers or declining (or both) and that there is increased interest from Aboriginal governments and communities in increasing wolf harvest. Wolves are difficult to count reliably due to their generally low numbers and clumped distribution. ENR has also committed to leading a feasibility assessment, with input from Aboriginal governments and boards, of various wolf reduction options (practicality, costs, likely effectiveness). This would include consideration of wolf harvest methods that may be culturally acceptable in the NWT, as views and beliefs about wolves are diverse and some forms of wolf removal may be viewed as unacceptable.

Research on drivers of change in caribou abundance:

TG and ENR recognize that there are likely multiple factors that contributed to the BNE herd's recent decline, including adverse environmental conditions (e.g. a drought year in 2014 potentially leading to poor feeding conditions, poor cow condition and a low pregnancy rate in winter 2014-2015). A recent study by Chen et al. (2014) suggested that spring calf:cow ratios in the Bathurst herd were correlated with indices of summer range productivity one and a half years earlier; the mechanism proposed was that cows with poor summer feeding conditions were likely to be in poor condition during the fall breeding season, leading to low pregnancy rates. ENR has also asked biologist D. Russell to review environmental trend data collected

since 1979 by Circum Arctic Rangifer Monitoring and Assessment for NWT caribou herds (drought index, snow depth indices, warble/bot fly index, etc) that may assist in explaining how key environmental trends have contributed to declines in caribou herds.

ENR supports increased research into underlying drivers of change in herd abundance by partnership with academic researchers and remote sensing specialists. There is a need to better understand predation rates and their significance to caribou, environmental factors affecting caribou condition and population trend, and on the effects of climate change on these relationships.

Table 1: Biological monitoring of BNE herd (ENR lead for most elements)

Indicator(s)	Rationale	Desired Trend	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 of survey is low but these surveys have reliably tracked trend from population surveys at 3-year intervals.
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 2013, 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): proportion of breeding cows at least 80%.	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.	Bull:cow ratio above 30:100.	If bull:cow ratio below target, reduce bull harvest. Fall calf:cow ratios indicate spring & summer calf mortality relative to June ratios.	Every 3 years	Needed for June calving ground photo 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.	At least 30-40 calves:100 cows on average.	Sustained ratios ≤ 30:100, herd likely declining; may re-assess management.	Annual	Calf productivity & survival vary widely year-to-year, affected by several variables, including weather.
6. Caribou condition assessment	Condition assessment provides overall index of nutrition/environmental conditions, estimate of pregnancy rate	High hunter condition scores (average 2.5-3.5 out of 4)	Sustained poor condition suggests unfavourable environmental conditions and likely further decline.	Annual	Sample numbers to date limited (2010-2013). TG working to improve program, sampling.
7. Cow survival rate estimated from OLS model and annual survival estimates from collared cows	Cow survival estimated 75-78% in 2013 (from model). Need survival of 83-86% for stable herd.	At least 83-86% by 2018	If cow survival continues <80%, herd likely to continue declining.	Every 3 years (new population estimate)	Population trend highly sensitive to cow survival rate; recovery will depend on increased cow survival.
8. Total harvest from this herd by all users groups (numbers & sex ratio)	Accurate tracking of all harvest is essential to management and to knowing whether management actions are effective.	All harvest reported accurately and within agreed-on limits.	Re-assess recommended harvest annually; if herd continues to decline as found 2013-2015, re-assess harvest limit.	Annual	Multiple factors other than harvest may contribute to decline but harvest is one of the few factors humans control.
9. Maintain up to 50 satellite/GPS collars on herd (30 on cows, 20 on bulls)	Collar information is key to reliable surveys, tracking seasonal movements and ranges, monitoring survival and herd fidelity.	Additional collars added every March/April to maintain up to 50 collars on herd.		Annual additions to keep total of 50.	Information from collared caribou is essential to monitoring and management of all N. America caribou herds.
10. Wolf Harvest on BNE range	Several Aboriginal governments and communities have expressed interest in increasing wolf harvest by hunters and trappers to increase caribou survival.	Increased harvest of wolves	If herd continues to decline, consider increased focus on wolf harvest to slow herd decline and increase likelihood of recovery.	Annual	Control of predators, depending on methods, can be highly controversial.

5. Consultation

TG sent a letter to WRRB on August 25, 2015 proposing management actions for the BNE and Bathurst herds. This included a harvest limit of 950 caribou in total from the BNE herd (including NU) and 80% bulls, and an allocation among NWT user groups based on the ENR allocation of early 2015. ENR sent a letter to WRRB on September 22, 2015 on management actions for the Bathurst and BNE herds, which included agreement with TG on the harvest limit of 950 and the allocation as proposed by TG, but with a 100% bull sex ratio. WRRB recommended to TG and ENR on September 25, 2015 that the governments come to agreement on the BNE harvest (and other actions); TG and ENR then met in October 2015 and came to agreement on a BNE harvest of 950 and 100% bulls. The allocation among user groups had been previously agreed on by TG and ENR, although this could change if an allocation accepted by all users becomes available.

TG held a workshop on wolf management with Tłı̨chǫ elders in November 2015, the results of which were used to inform proposals on BNE and Bathurst caribou.

ENR supports a meeting of all BNE user groups and relevant boards, requested by co-management boards in fall 2015, to determine an allocation or sharing formula for harvest of this herd. This meeting is expected early in 2016.

ENR sent a letter to Aboriginal governments and co-management boards with an interest in the BNE herd, including government and Aboriginal organizations in NU, on September 24, 2015 outlining the herd's status with preliminary results of the June 2015 survey, noting the urgency of taking action in time for the winter harvest season, and requesting parties to respond to ENR with their recommendations on management actions by October 15, 2015. A further update letter was sent on November 2, 2015 describing proposed management for the BNE herd for winter 2015-2016.

ENR received a letter from the SRRB on management of BNE caribou on November 3, 2015, and has had an on-going series of meetings with SRRB, SSI and Sahtú communities in fall 2015. A community-based caribou management plan for Deline dated November 23, 2015 (Deline 2015) was made available to ENR at the end of November 2015. ENR will work with Sahtú organizations and communities on caribou harvest management that is culturally appropriate and consistent with overall management objectives for the herd.

WMAC-NWT sent a letter on BNE management to ENR November 20, 2015 with general support for conservation of the herd and noting the importance of addressing the NU harvest of the herd, requesting clarification about a proposed bull-only harvest from the herd, requesting support for a users' meeting on BNE harvest allocation, and noting the importance of a consistent approach to harvest management from the BNE herd.

ENR is preparing a joint management proposal for the BNE herd with TG, similar in content to the current proposal, to submit to WRRB in December 2015.

6. Communications

ENR will work with communities and boards in the Sahtú, Tłı̨chǫ and Inuvialuit Settlement Areas to inform harvesters and others about the status of the BNE herd and about management actions being taken to address the herd's low numbers.

As noted earlier, ENR is currently developing a Hunter Education program. A working group met twice to develop the materials which are currently out for review with individuals, boards, agencies and organizations involved in the Wildlife Act creation. ENR staff would work with communities in the BNE range to present the information in the most appropriate ways.

7. References

Adamczewski, J., J. Boulanger, B. Croft, H. D. Cluff, B. Elkin, J. Nishi, A. Kelly, A. D'Hont, and C. Nicolson. 2009. Decline in the Bathurst caribou herd 2006–2009: a technical evaluation of field data and modeling. Environment and Renewable Resources, Government of Northwest Territories, Yellowknife, NWT, Canada.

Adamczewski, J. Z., J. Boulanger, B. Croft, T. Davison, H. Sayine-Crawford, and B. Tracz. 2014. A comparison of calving and post-calving photo surveys for the Bluenose-East herd of barren-ground caribou in the Northwest Territories, Canada in 2010. Manuscript Report No. 244, Department of Environment and Natural Resources, Yellowknife, Northwest Territories. 48 pp.

Advisory Committee for the Cooperation on Wildlife Management (ACCWM). 2014. Taking Care of Caribou – The Cape Bathurst, Bluenose-West, and Bluenose-East Barren Ground Caribou Herds Management Plan (Final). C/O Wek'eezhii Renewable Resources Board, 102A, 4504 – 49 Avenue, Yellowknife, NT, X1A 1A7.

Barren-ground Technical Working Group (BGTWG). 2014. Barren-Ground Caribou 2013/14 Harvest & Monitoring Summary. Unpublished Report. Wek'èezhìi Renewable Resource Board, Tlicho Government, and Government of the Northwest Territories. Yellowknife, NT. Online [URL]: http://wrrb.ca/sites/default/files/2013-2014%20BGC%20Harvest%20Summary%20Report%20_%20FINAL_Oct15_2015.pdf

Boulanger, J. 2015. Estimates of breeding females from the 2015 Bluenose East calving ground survey, Draft November 4, 2015. Department of Environment and Natural Resources, Yellowknife, Northwest Territories, unpublished report.

Boulanger, J., A. Gunn, J. Adamczewski, and B. Croft. 2011. A data-driven demographic model to explore the decline of the Bathurst caribou herd. Journal of Wildlife Management 75:883-896.

Boulanger, J., B. Croft, and J. Adamczewski. 2014. An estimate of breeding females and analyses of demographics for the Bluenose East herd of barren ground caribou: 2013 calving ground photographic survey. Department of Environment and Natural Resources, Government of Northwest Territories. File Report 143.

Carlsson, A.M., S. Kutz, R. Popko, A. Veitch, S. Behrens, Sahtú Renewable Resources Board and Sahtú Renewable Resource Councils. 2015. Community-based monitoring of wildlife health in the Sahtú Settlement Area: a synthesis of the program 2002-2014. Department of Ecosystem and Public Health, University of Calgary, Calgary, Alberta.

Deline. 2015. Deline caribou conservation: a Deline Gotine plan of action, Nov. 4, 2015 version. C/O Sahtú Renewable Resources Board, Tulita, NWT.

Chen, W., L. White, J. Z. Adamczewski, B. Croft, K. Garner, J. S. Pellissey, K. Clark, I. Olthof, R. Latifovic, G. L. Finstad. 2014 Assessing the Impacts of Summer Range on Bathurst Caribou's Productivity and Abundance since 1985. *Natural Resources*, **5**, 130-145. http://dx.doi.org/10.4236/nr.2014.54014

ENR (Government of the Northwest Territories, Environment and Natural Resources). 2014a. Overview: Monitoring of Bathurst and Bluenose-East Caribou Herds, September 2014. Environment and Renewable Resources, Government of Northwest Territories, Yellowknife, NWT, Canada.

ENR (Government of the Northwest Territories, Environment and Natural Resources). 2014b. Technical rationale to increase the number of satellite collars on the Bathurst caribou herd. Environment and Renewable Resources, Government of Northwest Territories, Yellowknife, NWT, Canada.

Garner, K. 2014. Tłı̨chǫ Caribou Health and Condition Monitoring Program. Final Report, Department of Culture and Lands Protection, Tłı̨chǫ Government, Behchokǫ̀, NT. 34 pp.

8. Time Period Requested

Management actions proposed here would apply from November 2016 until November 2019 with the results of the next calving photo survey of the BNE herd expected in 2018. ENR suggests that management actions, including the harvest of 950 caribou (100% bulls) and

allocation among NWT user groups, be reviewed annually or whenever key additional information is available (e.g. additional survey information or recommendations from ACCWM or boards).

Technical rationale to increase the number of satellite collars on the Bathurst caribou herd

Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT.

Updated
June 2014

1. Summary

Satellite and/or GPS-satellite radio-collars are used for many applications in monitoring of all herds of migratory barren-ground caribou in North America. To date (2014), a maximum of 20 collars have been used on the Bathurst herd, all on cows, and at times there have been as few as 8-9 collared caribou in the herd. This document briefly reviews the uses of radio-collars in caribou monitoring and management, outlines recommended numbers of collars/herd for particular uses, and provides a rationale for increasing the number of collars on the Bathurst herd to 65, with some of these being on bulls (ca. 15). The areas of greatest priority in management for this herd are in assigning and managing harvest from this herd in the winter, and in monitoring survival rates of cows. All applications of collar information would benefit from higher collar numbers, including greater confidence in monitoring surveys and in assessing caribou range use in relation to development such as mines and roads.

2. Introduction

Satellite and GPS collars have been used since 1996 on the Bathurst caribou herd to monitor seasonal distribution and migratory movements. To date (Jan. 2014), the number of collars on the Bathurst herd of barren-ground caribou at any one time has not exceeded 20, and all have been placed on adult cows. While capturing, handling and attaching a collar to caribou is challenging to Tłıchǫ values of respect for wildlife, elders gave their approval to initially place 10 collars on Bathurst caribou and then later 20 collars to monitor the herd due to concerns over potential effects of the diamonds mines, something the Tłıchǫ were very concerned about.

VHF-radio, satellite and GPS-collars are used as tools for monitoring all migratory herds of barren-ground caribou in North America. They provide key information on caribou throughout the year. Applications include monitoring herd movements, detecting timing of birth, defining seasonal ranges, assessing habitat preference, estimating survival rates, assessing movement between herds, assessing caribou responses to development, designing & modifying surveys, and monitoring and managing hunter harvest. A larger number of collared caribou on the Bathurst herd would increase confidence in monitoring and particularly in monitoring and managing the hunter harvest on the winter range. This document provides rationale for increasing the number of collars on the Bathurst herd from 20 to 65, with up to 15 placed on bulls, to achieve many of the research and monitoring objectives for the herd. A decision to increase the number of collars on the herd must be balanced with the need for respectful behavior towards caribou.

3. Meeting barren-ground caribou research and monitoring objectives with satellite and GPS-collars

Currently, collar location data are used to achieve many of the research and monitoring objectives for barren ground caribou herds in the NWT. These include:

- describing seasonal and annual ranges and how these might shift year to year;
- monitoring movements and responses of caribou to roads and industrial activities;
- when associated with plant communities, revealing selection for preferred habitats and avoidance of others;
- showing where and when caribou are congregating for calving and post-calving (to increase confidence in calving and post-calving population surveys);

- locating animals and appropriately allocating sampling during fall and spring aerial composition surveys;
- assessing rates of exchange or movement between neighbouring herds;
- assessing cow fidelity to calving grounds and other seasonal ranges; and
- tracking deaths of collared animals for estimating adult cow survival.

Collar location data have also been used by communities when planning their community hunts. Recently with harvest limits on the Bathurst herd due to its severe decline to 2009, collar data have been used to assign harvest to either the Bathurst herd or neighbouring herds, and to direct harvest to adjacent herds such as the Bluenose-East caribou herd, that do not currently have harvest targets in place. Because of variation year to year in winter range use and substantial overlap in the winter in some years between the Bathurst and Bluenose-East herds, collar locations are currently the only way to assess which herd is being hunted in particular areas.

The Government of the Northwest Territories (GNWT) recently commissioned studies to assess the numbers of collars needed per herd for various applications, including J. Rettie (2008) and J. Boulanger (2011). An independent review of the GNWT barren-ground caribou monitoring program, recommended increased numbers of collars on all herds, and particularly in herds where collar numbers were low, such as the Bathurst herd (Fisher et al., 2009). Recommended numbers of satellite and GPS-collars from these analyses are listed in Table 1, along with the source of the recommendation, the advantages of more collars, and the limitations of using few collars.

Recommended numbers of collars per herd vary from about 30 to about 100, depending on the objective. Numbers of collars used on caribou herds elsewhere also vary, with the maximum number used being about 100/herd in the Western Arctic and Porcupine herds. Analyses carried out for the George River herd in Quebec/Labrador showed that between 36 and 184 collars were required at different seasons if a 95% probability of defining the herd's distribution was desired (Otto et al., 2003). Of greatest relevance to the Bathurst herd in winter, Otto et al. (2003) found that 64, 49 and 34 collars were associated with 95%, 75% and 50% confidence in defining the George River herd's distribution in winter. Boulanger's analyses similarly showed that at least 40 collars were needed to reliably define a herd's winter range. Most of the analyses suggested that a minimum of 40-50 collars (in Table 1) are needed on a caribou herd to adequately address the research and monitoring objective with an acceptable level of certainty, and up to 100 or more collars were needed for some applications. Although concerns about collars remain, the value of the information gained by monitoring individual caribou from the Bathurst and other herds is substantial.

4. Applications of collar data and advantages of increased numbers of satellite and GPS-collars on the Bathurst herd

4.1. Improved monitoring of Bathurst caribou cow survival rates

Studies of several barren-ground caribou herds, including the Bathurst herd (Boulanger et al. 2011) have shown that population trend is very sensitive to cow survival rate. A stable trend in population size generally depends on cow survival being at least 83-87% (Boulanger et al. 2011). Demographic analysis and simulation modeling of field data by J. Boulanger (pers. comm.), suggested that the cow survival rate was ~67% in 2009 during the rapid decline of the Bathurst herd, with an increase to ~ 78% in 2012. Although, the survival rate appears to have

improved, the current estimate is still too low for the herd to increase. Thus adult cow survival is a key demographic indicator that needs to be tracked directly and more precisely. Biologists in Alaska maintain approximately 100 collars annually on the Porcupine and Western Arctic caribou herds, in part to be able to monitor cow survival and detect small changes in mortality rates with a high degree of confidence (see Alaska Department of Fish and Game 2011). In contrast, detecting changes in cow survival in the Bathurst is not possible with 10-20 collars because the survival estimates are simply too variable due to the small sample size. However, a substantial improvement in estimating survival of Bathurst cows would be achieved by increasing the sample size of collared caribou cows to 50 individuals. In recent years, there appears to have been an increase in mortality of collared Bathurst cows in the summer. However, because of the low collar numbers on the herd, it is difficult to know whether this trend is truly representative of mortality patterns in Bathurst cows or whether the trend reflects low sample numbers and random chance. An increase to at least 50 cow collars would substantially improve our understanding of this apparent trend.

4.2. Defining caribou winter range and assigning caribou harvest to herd

Following the rapid decline in the Bathurst herd from 2006 to 2009, harvest was reduced in 2010 by about 95% to an annual limit of 300, with 80% of the harvest to be bulls (Boulanger et al. 2011). The harvest target of 300 Bathurst caribou was to occur only within R/BC/02 and R/BC/03. Although the population has stabilized, herd size was still at relatively low in 2012. Herd size and trend continues to be monitored closely via surveys and other indicators, and the harvest is monitored and managed closely. Accurate and representative data on the seasonal movements and locations of Bathurst and neighboring caribou herds is key to managing the winter harvest; thus, harvest management requires frequent locations of caribou from known herds that is most effectively provided by satellite and GPS-collars. In some winters (e.g. 2010-2011 and 2012-2013), overlap between the Bathurst and Bluenose-East herds on the winter range has been substantial. Determining whether Bathurst or Bluenose-East caribou were being hunted, and directing hunters to areas where they could hunt was determined from as few as 8-10 Bathurst collars and a similar number of Bluenose-East collars. But due to the small sample size of collared Bathurst caribou, we are unable to confidently assign herd identity to all hunted caribou, which results in a variable and potentially large source of error when monitoring locations of hunter-kills and trying to assign herd identity to kill locations. In addition to increasing the total number of collars on cows, maintaining some collars (i.e., 15) on Bathurst bulls would also improve overall harvest management especially if the overall strategy continues to emphasize bulls to be hunted in lieu of cows.

Defining the wintering range of a caribou herd of thousands is difficult when significant portions of the herd have no collared caribou among them. For the George River herd, 64 collared caribou resulted in a 95% probability of the herd's winter range being identified, and 49 collars resulted in a 75% probability (Otto et al. 2003). These probabilities can be interpreted as confidence levels; confidence in the George River winter range being well defined was lower at 49 collars than at 64 collars. Boulanger's analyses in 2011 similarly suggested that at least 40 collars were needed to define the winter range of the Bluenose-West and Bluenose-East herds with confidence. The risk to management of Bathurst harvest in winter is that significant portions of the herd are not defined spatially; hence harvest may be assigned to the wrong herd or undefined. An increase to 65 collars would increase confidence that harvest of caribou from the Bathurst herd and its neighbours is reliably assigned.

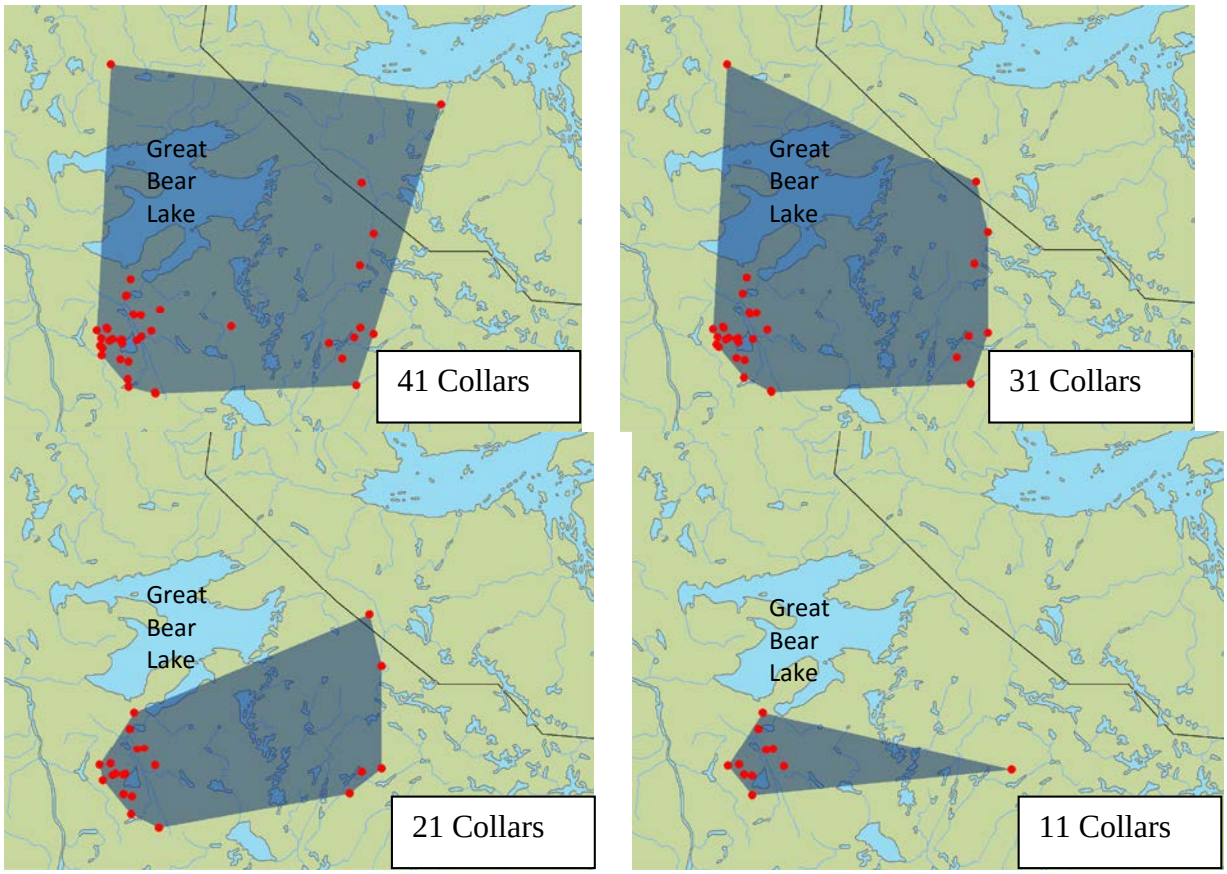

Fig. 1. Minimum Convex Polygon (MCP) derived from 41 caribou collar locations, Bluenose-East herd, on one day in early winter 2009, and then reduced randomly to fewer collars (J. Williams, ENR, maps).

To assist in visualizing the value of larger numbers of radio-collars and the limitations of low collar numbers, a series of maps is shown in Figures 1 and 2. The actual locations of 41 Bluenose-East collars on one day in early winter 2009 are shown in Fig. 1. Thereafter, by a random draw, the numbers of collars were reduced sequentially to 31, 21, and 11 collars. The location of a single larger aggregation of caribou with collars was still identifiable with 11 collars, but other collars and thus the caribou associated with each of those collars were no longer identified.

Figure 2 shows a similar series starting with 59 actual Bluenose-East collars (cows and bulls) on Aug. 17, 2012, reduced sequentially and randomly to lower numbers. In this case there was no main grouping of collars, rather a scattered distribution over the entire range. Assigning harvest to a herd could be done confidently with 49 or 59 collars, but with far less confidence with 9 or 19 collars. All uses of collars would be carried out with greater confidence with 65 collared caribou in the herd.

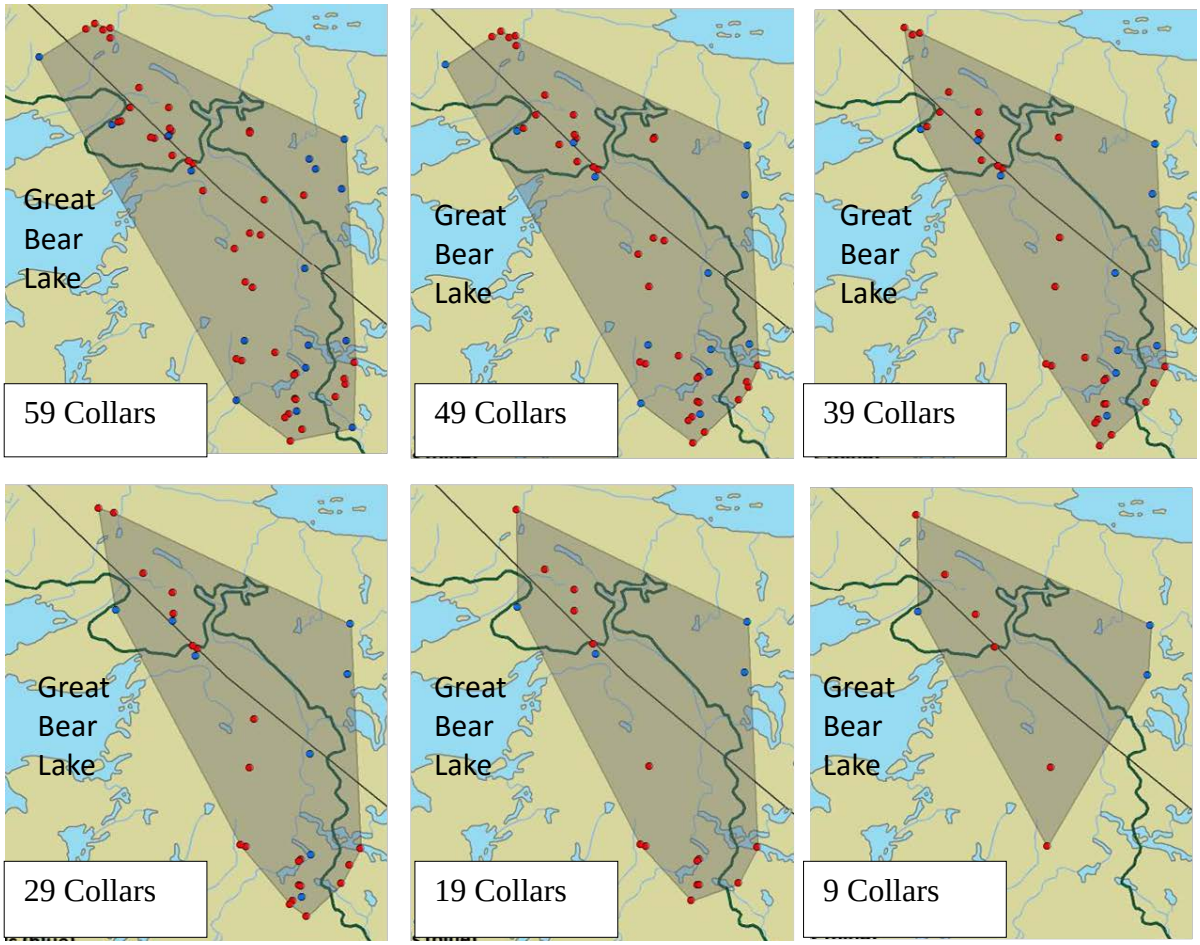

Fig. 2. Minimum Convex Polygon (MCP) from 59 caribou collar locations, Bluenose-East herd, on Aug. 17, 2012, then reduced randomly sequentially to 9 collars (J. Williams, ENR, maps). Red dots are cows and blue dots are bulls.

4.3. Managing caribou harvest on the winter range

If the winter range used at any point in time by the Bathurst herd and neighbouring herds is well defined, then the possibility arises of a more flexible approach to harvest management. At present, three large zones with fixed boundaries for the Bathurst winter range were defined in late 2009 based on range use over a number of years by collared caribou (RB/C/01, RB/C/02, and RB/C/03 in Figure 3). However, there is year-to-year variation in caribou winter range use, collared Bathurst caribou have wintered in zone RB/C/01 where Aboriginal harvest is unrestricted, and overlap with neighbouring herds has been substantial in some winters (Fig. 3). With adequate collar representation on Bathurst, Bluenose-East and Beverly/Ahiak caribou, a more flexible approach to harvest zones could be developed. The two current Bathurst zones could be divided into sub-zones with boundaries using natural and/or locally known topographical features, and the regulated harvest zone for the Bathurst herd could be defined each winter, by a combination of sub-zones identified by collared caribou locations that winter.

4.4.

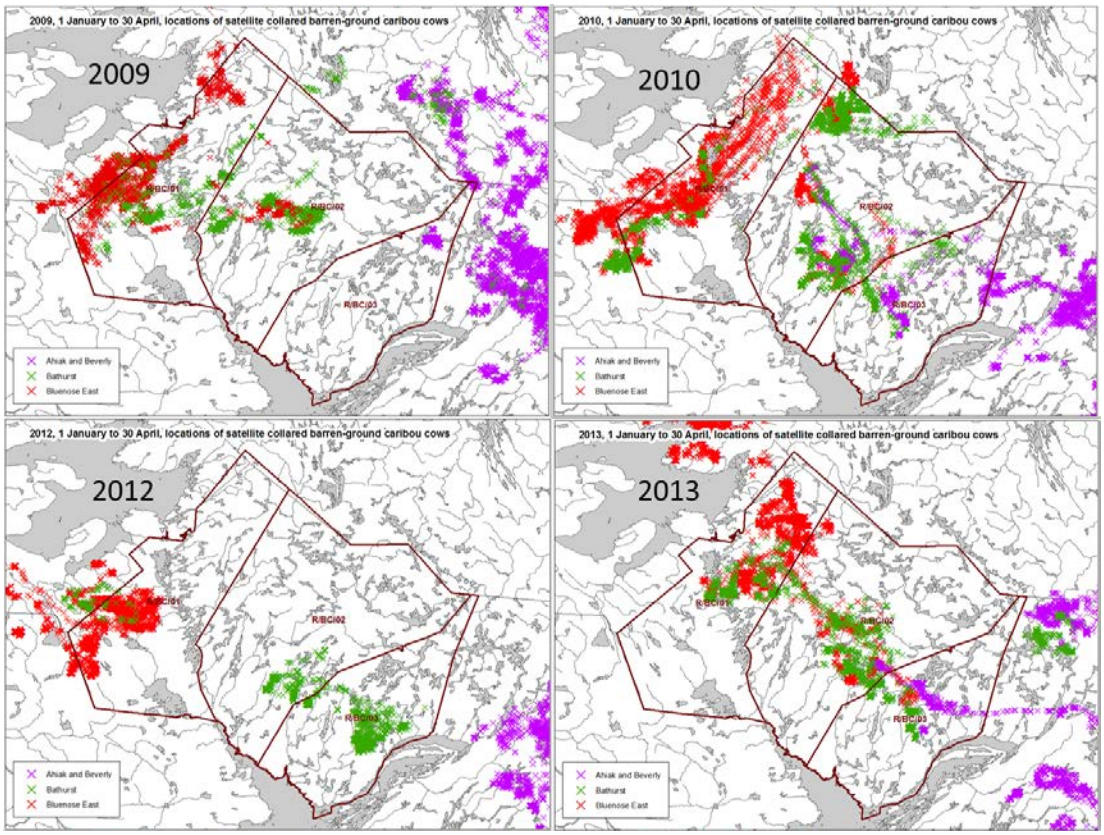

Fig. 3. Cumulative winter distribution of radio-collared caribou in RBC01, 02 and 03 from 3 herds (Jan-April) in four years. Red=Bluenose-East, Green=Bathurst, Purple=Beverly/Ahiak. Maps A. D'Hont, ENR.

4.5. Delineating winter range of bulls

Collars are placed on bulls from the Bluenose-West, Bluenose-East and Cape Bathurst herds in population survey years, because of the requirement of post-calving surveys for substantial collar numbers to identify all portions of the herd. This makes it possible to define seasonal movements and range use by bulls in these herds. Caribou are known to segregate during much of the year, thus winter ranges used by bull-dominated groups will likely be different from those used by mostly cow-calf groups. There have been no collars on Bathurst bulls to date. However, because of the Bathurst herd's decline, recommended hunter harvest has been at least 80% bulls in the accepted 300 annual caribou harvest. A harvest of primarily bulls may continue to be recommended for the Bathurst herd, depending on herd size and trend. Directing hunters to winter range where bulls from the Bathurst herd are concentrated would be enabled by an adequate sample of collars on Bathurst bulls (n = 15).

4.5.1. Improved reliability of caribou surveys

Composition surveys are used for the Bathurst and other caribou herds to assess recruitment of calves (calf:cow ratio in March) and sex ratio (bull:cow ratio; October). These are important secondary indicators of the herd's health and population trend. Collared caribou are key to defining the survey area for composition surveys. In particular, the calf:cow ratio and the

bull:cow ratio may vary according to the spatial dispersion of the herd, so an appropriate spatial stratification of survey effort is needed to collect a representative sample of caribou groups across their seasonal range. In this way, sufficient numbers of collared caribou, including bulls, can help ensure that the herd's distribution is well identified and that a composition survey is based on a representative sample of the herd. Similarly, a larger number of collared caribou during population surveys (calving or post-calving) increases confidence that the herd's distribution has been reliably defined.

4.6. Increased capability of assessing caribou responses to development and minimizing disturbance.

The first study to document a Zone of Influence (partial avoidance) by caribou around the diamond mines in the Bathurst range used satellite collar locations (Johnson et al. 2005). More recently Boulanger et al. (2012) confirmed this avoidance by caribou to a distance of about 14 km from each active mine, using both aerial survey observations and collar locations. Other studies of caribou relying on collar locations have shown altered movements near linear corridors and declines by woodland caribou in southern Canada (e.g. Dyer et al. 2001). Additional mines and roads in the Bathurst range are proposed, under review or recently reactivated; these include Jericho, Izok Lake, High Lake, Bathurst Inlet Port and Road, Gahcho Kue, and Fortune Minerals. Several other known mineral deposits in the Bathurst range are in exploration phases. In all environmental assessment and impact statements focused on caribou, collar information has been the basis for defining caribou seasonal ranges and movements and caribou responses to roads, mines and other disturbed areas. Adequately defining movements and habitat use by Bathurst caribou will depend heavily on being able to define where the caribou are. A renewed Caribou Protection Measures program (used primarily in the 1980s to monitor movements of the Beverly and Qamanirjuaq caribou herds and limit industrial activity near caribou) has been proposed for the Sahtu region, and would depend on recent collar locations for the Bluenose-West and Bluenose-East herds. The study by Otto et al. (2003) was carried out to assess how many collared caribou were needed to reliably define the distribution of George River caribou so that low-level jet flights could be directed elsewhere. Knowing where the Bathurst caribou herd is, with confidence, will require an adequate number of Bathurst cow and bull collars to ensure that responsible development can be managed to minimize impacts on the herd.

5. Conclusion

Satellite and/or GPS-collars are used to monitor all migratory herds of barren-ground caribou in North America. Collars are able to provide key information on locations and movements of caribou throughout the year. Increasing the number of collared caribou on the Bathurst herd to 65 (includes 15 bulls) would greatly improve the overall herd monitoring program. The larger sample size of collared Bathurst caribou would improve confidence in harvest management and improve our understanding of mortality rates and causes in adult cows. A decision to increase the number of collars on the herd must be balanced with the need for respectful behavior towards caribou.

Table 1. Recommendations for radio-collar numbers in barren-ground caribou herds for various uses, advantages of higher collar numbers and limitations of low collar numbers. Tan shaded cells indicate specific objectives and priorities for monitoring Bathurst caribou with satellite & GPS collars.

Radio-Collar Application	Recommended Collar Number	Source	Advantages of More Collars	Limitations of Few Collars	Priority for Management
Defining Location of Caribou Herd Seasonally & Managing Harvest					
Defining Calving Range, George River herd	36 (95% probability) 23 (75% probability)	Otto et al. 2003	High probability that location of large percentage of cows is known; low probability of missing main groups of breeding cows	Increased likelihood that location of significant percentage of cows not known, especially if in unusual locations	High
Defining Winter Range, George River herd	64 (95% probability) 49 (75% probability)	Otto et al. 2003	High probability of larger and smaller aggregations of caribou identified	Increased likelihood that location of significant parts of herd, especially smaller aggregations, not known	High
Defining Winter Range, Bluenose-West & Bluenose-East herds	At least 40/herd	Boulanger 2011	Good confidence that larger and smaller aggregations of caribou in herd are known	Increased likelihood that location of significant parts of herd are unknown	Moderate
Assigning harvest in winter to herd in overlap areas between herds	At least 40/herd	Boulanger 2011	Good confidence that known harvest locations are assigned to correct herd, including overlap areas	Increased likelihood of harvest being assigned to wrong herd	High
Defining & managing mobile harvest zones	At least 40/herd	Boulanger 2011	Ability to define sub-zones to correct herd with confidence, and change if needed	Low confidence in assigning sub-zones to herd(s)	High
Monitoring Cow Survival Rate					
Monitoring cow survival rate (closely tied to population trend)	100/herd to detect slow decline in 10 years	Boulanger 2011	Ability to detect changes in cow survival, hence in herd trend, in a timely manner	Inability to detect change in cow survival rate, hence less ability to detect change in herd trend	High
Monitoring cow survival rate (closely tied to population trend)	60/herd to detect rapid decline in 3-5 years	Boulanger 2011	Ability to detect changes in cow survival, hence in herd trend, in a timely manner	Inability to detect change in cow survival rate, hence less ability to detect change in herd trend	High
Monitoring cow survival rate (closely tied to population trend)	100/herd to detect 7% decrease in survival in 3 years	Rettie 2008	Ability to detect changes in cow survival, hence in herd trend, in a timely manner	Inability to detect change in cow survival rate, hence less ability to detect change in herd trend	High
Monitoring cow survival rate (closely tied to population trend)	40-60/herd to detect 10-13% decrease in survival in 3 years	Rettie 2008	Ability to detect changes in cow survival, hence in herd trend, in a timely manner	Inability to detect change in cow survival rate, hence less ability to detect change in herd trend	High
Monitoring cow survival rate (closely tied to population trend)	100 collars (each) on Porcupine & Western Arctic Herd	N/A	Ability to detect changes in cow survival, hence in herd trend, in a timely manner	Inability to detect change in cow survival rate, hence less ability to detect change in herd trend	High
Land Use & Disturbance Studies					
Land Use – defining seasonal ranges &	No specific recommendations –	ENR staff experience	Ability to define where large proportion of herd is seasonally & on migration, in	Increased likelihood of locations of significant proportions of herd not	Moderate (increasing)

Radio-Collar Application	Recommended Collar Number	Source	Advantages of More Collars	Limitations of Few Collars	Priority for Management
movements	see Section 1		relation to proposed developments	known	
Land Use – assessing caribou response to roads, mines, camps					
Designing caribou surveys & assessing movement between herds					
Post-calving population surveys	Cape Bathurst 30, Bluenose-West 60, Bluenose-East 40-60	Rettie 2008	Critical for post-calving surveys to find caribou groups; need collars on bulls also	Potential to miss significant portions of herd; inaccurate surveys	High
Composition Surveys	No specific recommendations – see Section 1	ENR staff experience	Key to defining areas where larger and smaller numbers of caribou are, and to identify overlap areas between herds	Poor representation of herd composition; potential for inaccurate calf:cow and bull:cow ratios	Moderate
Calving photo surveys, George River herd	36 (95% probability) 23 (75% probability)	Otto et al. 2003	Confidence in breeding cows being concentrated on the calving ground at time of survey; ability to find cows calving in unusual areas - e.g. late spring or low pregnancy rate	Less confidence in survey result being representative of herd; less ability to find cows calving in unusual areas - e.g. late spring or low pregnancy rate	Moderate

6. References:

Alaska Department of Fish and Game. 2011. Caribou management report of survey-inventory activities 1 July 2008-30 June 2010. P. Harper, editor. Juneau, Alaska. 345pp.

Boulanger, J. 2011. Sample sizes of collared caribou needed to delineate winter ranges and use of winter range polygons. Draft report November 22, 2011 for Government of the Northwest Territories, Environment and Natural Resources, Yellowknife, NT. 15 pp.

Boulanger, J., A. Gunn, J. Adamczewski and B. Croft. 2011. A data-driven demographic model to explore the decline of the Bathurst caribou herd. Journal of Wildlife Management 75: 883-896.

Boulanger, J., Kim G. Poole, A. Gunn & J. Wierzchowski. 2012. Estimating the zone of influence of industrial developments on wildlife: a migratory caribou Rangifer tarandus groenlandicus and diamond mine case study. Wildlife Biology 18: 164-179.

Clark, K. 2009. Discussion paper – caribou collaring. Report from the Wek'eezhii Renewable Resources Board, Yellowknife, NT. 15 pp.

Dyer, S. J., J. P. O'Neill, S. M. Wasel, and S. Boutin. 2001. Avoidance of industrial development by woodland caribou. Journal of Wildlife Management 65: 531-542.

Fisher, J. T., L. D. Roy, and M. Hiltz. 2009. Barren-Ground Caribou Management in the Northwest Territories: An Independent Peer Review. Alberta Research Council, Vegreville, Alberta. 53 pp.

Johnson, C. J., M. S. Boyce, R. L. Case, H. D. Cluff, R. J. Gau, A. Gunn and R. Mulders. 2005. Cumulative effects of human developments on arctic wildlife. Wildlife Monographs 160.

Otto, R. D., N. D. Simon, S. Couturier, and I. Schmelzer. 2003. Evaluation of satellite collar sample size requirements for mitigation of low-level military jet disturbance of the George River caribou herd. Rangifer 14:297-302.

Rettie, W. J. 2008. Determining optimal sample sizes for monitoring barren ground caribou populations. Contract Report, Government of the Northwest Territories, Environment and Natural Resources, Yellowknife, NT. 31 pp.

Thomas, D. C. 1998. Needed: less counting of caribou and more ecology. Rangifer Special Issue 10: 15-23.