October 23, 2020

Mr. Joseph Judas, Chair
Wek'èezhìı Renewable Resources Board
4504 49TH AVENUE
YELLOWKNIFE NT X1A 1A7

Dear Mr. Judas:

2020 Wolf (Dìga) Management Proceeding - Technical Session Commitments

In response to the commitments made during the Science Technical Session on October 5th, 2020 of the Wolf (Diga) Management Proceeding, the Department of Environment and Natural Resources, Government of the Northwest Territories submits to the Wek'èezhìı Renewable Resources Board the attached documents. Please note that we are unable to provide updated precision estimates for the Ungulate Biomass Calculation at this time and respectfully request an extension to October 30th, 2020.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Ms. Karin Clark,
A/Director, Wildlife and Fish Division
Environment and Natural Resources
Yellowknife, NWT
Karin_Clark@gov.nt.ca

Attachment

.../2

c. Dr. Brett Elkin
A/Assistant Deputy Minister, Operations
Environment and Natural Resources

Mr. Bruno Croft
Regional Superintendent, North Slave
Environment and Natural Resources

Ms. Laura Duncan
Tłı̨chǫ Executive Officer
Tłı̨chǫ Government

Ms. Tammy Steinwand-Deschambeault,
Director, Department of Culture and Lands Protection,
Tłı̨chǫ Government

Summary of Wolf Stomach Contents on the BNE and BA winter ranges (<u>Within</u> the 2019/20 North Slave Wolf Harvest Incentive Area)

Type of mortality	No. Stomachs examined	Number Empty	Primary item was BG Caribou	Included Garbage	Other Mammals
Ground Based - NWT hunters	11	0	9	2	1
Ground Based - Kitikmeot hunters	0	n/a	n/a	n/a	n/a
Ground Based - Sport Hunters	4	0	4		
Mine Site	1	1	n/a		
Aerial Removals	36	2	33	2	4
Capture and Post Capture	5	1	4		
Totals	**57**	**6**	**50**	**4**	5
% of Total		10.5%	98%	8%	10%

Note: Percentages for BG Caribou, Garbage, and Other Mammals exclude portion of stomachs that were empty.

Summary of Stomach Contents for Wolves harvested within the North Slave Region (<u>Outside</u> of the 2019/20 North Slave Wolf Harvest Incentive Area).

Type of mortality	No. Stomachs examined	Number Empty	Primary item was BG Caribou	Included Garbage	Snowshoe Hare	Moose	Other Mammals	Fish
Ground Based - NWT hunters	36	0	16	14	8	1	7	11
% of Total:			44%	39%	22%	3%	19%	31%

Note: Fish contents may have been consumed by wolves at landfill sites, or may have been consumed as bait used by trappers.

Methodology for identification of stomach contents

Hair, bone, and tissue found in the stomach were examined, photographed, and subsampled. For each stomach with contents, a full range of subsamples were collected, and together with high resolution digital photos, were examined by an ecologist with over 25 years of experience in the identification of wildlife species, based on hair, bone, feather, and scale samples. Given the current Covid-19 situation, samples were sent to the ecologist in Alberta in August, instead of having the samples examined in ENR's Lab in Yellowknife. A reference collection of documented species hair samples were made available - to allow for the confirmation and identification of wildlife species found in the stomach contents.

POTENTIAL IMPACTS OF WOLF REMOVAL ON THE BATHURST AND BLUENOSE EAST CARIBOU HERDS: AN UPDATE

October 21, 2020

Don Russell

INTRODUCTION

Based on previous analysis with respect to potential impacts of wolf removal within the ranges of the Bathurst and Bluenose East caribou herds, the Technical Working Group requested some additional analysis. Notes from the session highlighted 4 points:

1) Updated model runs using actual Bathurst and Bluenose East survival rates
2) Emigration factor included as a part of population dynamics
3) Additional model runs with calf survival less than .5 (three levels of calf survival)
4) More model runs with a standard deviation of predation rate (two levels of predation rate)

Thus, in this report:

1. the model was updated using actual BNE and BAH survival rates from 2015-2020.
2. 2 possible future mortality rates for the 2010-2024 years were modelled. 1) based on 2015-2020 average and 2) based on the 2018-2020 average. The rational is that the 2015-2020 might capture the variability but the 2018-2020 captures a possible trend in adult female survival for the 2 herds.
3. Two levels of calf survival were modelled 1) 45% female and 50% male as in the original report, and 2) an higher mortality based on Adamczewski et al (2020) report 65% female and 70% male. Although the suggestion was for three levels of calf survival, in the end, so as not to double the number of runs required, I simply modelled the expected extremes.
4. In the model we assume that 60% of total age/sex mortality is due to wolves. I include a scenario in which we explore the implication of only 25% of calf mortality due to wolves.
5. We also model a scenario where, given the high survival of adult cows in recent years, that wolves are only responsible for 30% of the non-calf mortality.
6. Finally, we model a scenario that allows us to project the implications on final population size assuming that 15% of the herd annually emigrates into an adjacent herd.

In the request from the Board to vary wolf kill rates, there was no need to vary kill rates as the way I calculate wolf predation does not require an estimate of kill rate. I don't impose a 29 caribou/wolf factor. I calculate 1) the # caribou that die (X) based on sex/age mortality estimates, 2) assume 60% of caribou mortality is wolves thus 0.6X caribou killed by wolves and 3) given the # wolves (Y) estimated in each herd range, the kill rate is 0.6X/Y.

<u>BAH and BNE herd status</u>

Population estimates for 1yr+ caribou for the BAH and BNE were last recorded in 2018 resulting in estimates of 8,207 for the BAH and 19,769 for the BNE (Adamczewski et al 2019). These values were a 29% and 23% exponential decline from comparable estimates in 2015. During this period (2015-2020), adult female mortality averaged 17.7% for the BAH and 18.3% for the BNE. Since 2018, mortality has dropped to 12.8% for the BAH and increased slightly to 18.3% for the BNE (Boulanger 2020).

Calf mortality in both herds is indirectly determined from calving ground surveys coupled with Fall and March composition surveys. Regardless of the annual variability in calving surveys it appears the calf:cow ratios in the fall and spring indicate that little calf mortality occurs after the fall surveys (Cluff et al. 2019). For the BAH, the average calves:100 cows from 2006-2019 was 34.1 in the fall and 32.8 in the spring. For the BNE herd, those values between 2009-2019 were 38.2 and 36.4 in the fall and spring. In July, Adamczewski et al (2020) recorded 44 calves:100cows in the BAH and 46.9 for the BNE. His assessment was that there was a large loss of calves in the first 5 weeks of life.

Wolf removal program

In the previous modeling report (Russell 2020) we described the wolf removal program, determining an algorithm to "assign" wolves removed in the spring of 2020 to the BNE, BAH and Beverly herd. We used that partition of wolves to determine the % of wolves removed during the 2020 spring and modelled the implications to the BAH and BNE. In this analysis we are simply modeling three wolf removal strategies 1) no removal, 2) reducing and maintaining the wolf population at 60% below 2019 levels from 2020-2023 and 3) reducing and maintaining the wolf population at 80% below 2019 levels from 2020-2023. For that analysis we are assuming pre-removal, 48 wolves in the BAH range and 122 wolves within the range of the BNE (ENR, pers comm.)

MODELLING APPROACH

The Caribou Cumulative Effects model was used to model the BAH and BNE herds from 2018-2024 through 4 years of wolf removal (2020-2023). Starting populations and composition of the herds were based on the results of the 2018 census and composition counts.

Herd abundance was projected on the basis of estimated mortality rates for both herds in 2018-2020 and based on future mortality rates (2021-2024) as the average mortality rates between 2015-2020 applied to the 2021-2024 period. Because, for the Bathurst caribou herd, the survival rates were quite high since 2018, we also ran the model with the average mortality rate between 2018-2020 applied to the 2021-2024 period.

Two levels of calf mortality were modeled. The first was based on the long term average of a number of herds (45% females and 50% males). Given recent surveys indicate that there are higher mortality rates, especially in the post-calving and summer season for the BAH and BNE herds (Adamczewski et al 2020), we also ran scenarios assuming a 65% female and 70% male annual calf mortality.

Three levels of wolf removal were modeled: 1) no removal; 2) 60% of current estimated wolf numbers; and, 3) 80% of current wolf numbers were modelled. Figure 1 presents how the scenarios were set up – in total 12 scenarios were run on each of the BAH and BNE herds.

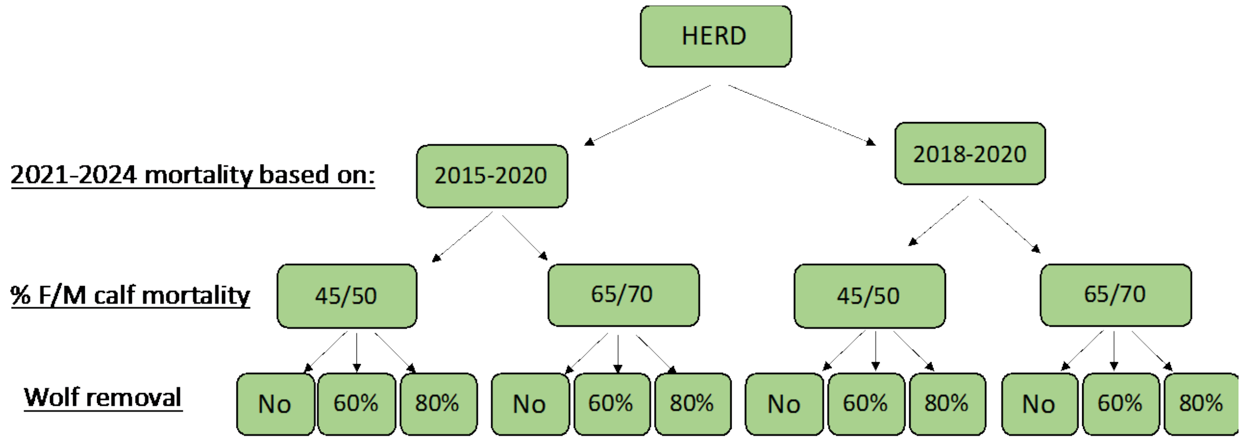


Figure 1 Scenarios modelled to project impacts of wolf removal on the BAH and BNE herds. Scenarios were based on 2 levels of 2021-2024 mortality rates, 2 levels of calf survival and 3 wolf removal strategies.

Figure 2 presents the steps to calculate adjusted mortality rates based on wolf removal strategies. The algorithm uses estimated mortality rates then makes an assumption on the % of total mortality due to wolves (60% in our scenarios). We then calculate the number of age/sex of caribou killed by wolves. Given the total number of wolves estimated for each herd range (48 for BAH and 122 for BNE) we can calculate how many caribou of each age/sex class that would be "saved" by removing a wolf. Summing over all wolves removed, we re-calculate the mortality rate for each age and sex. Those values are provided to the CCE to project population size.

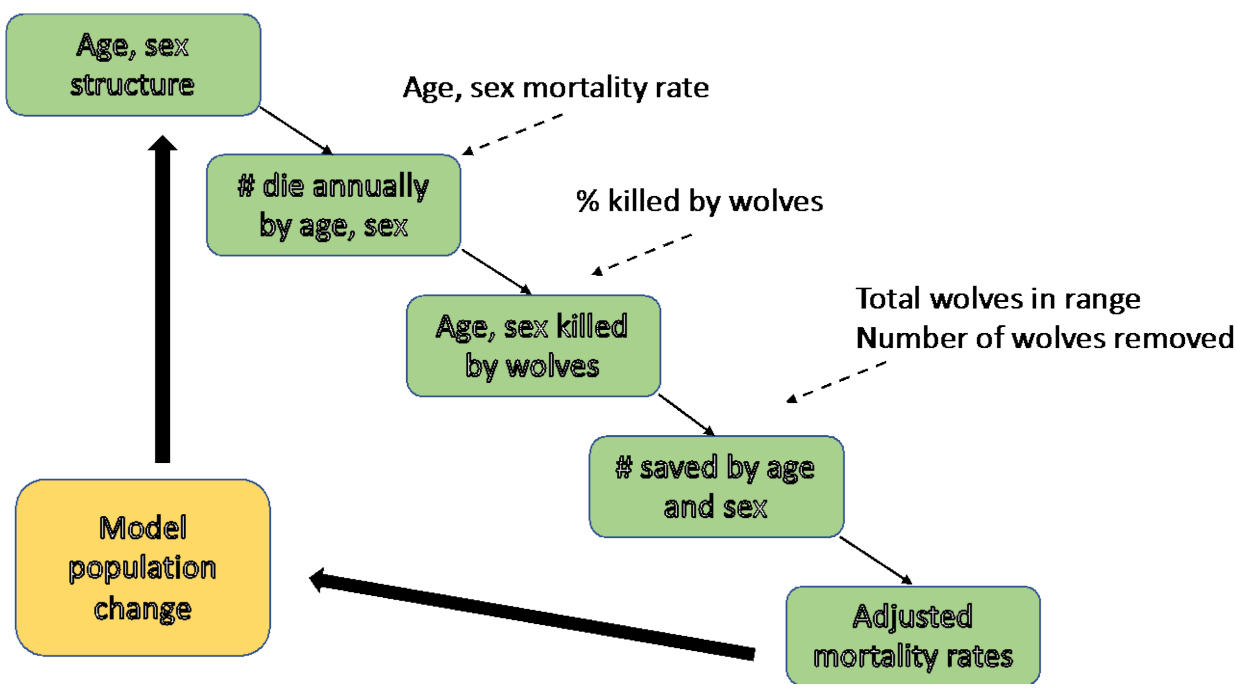


Figure 2. Steps required to set up the input to the CCE model on wolf removal impacts on age and sex mortality rates.

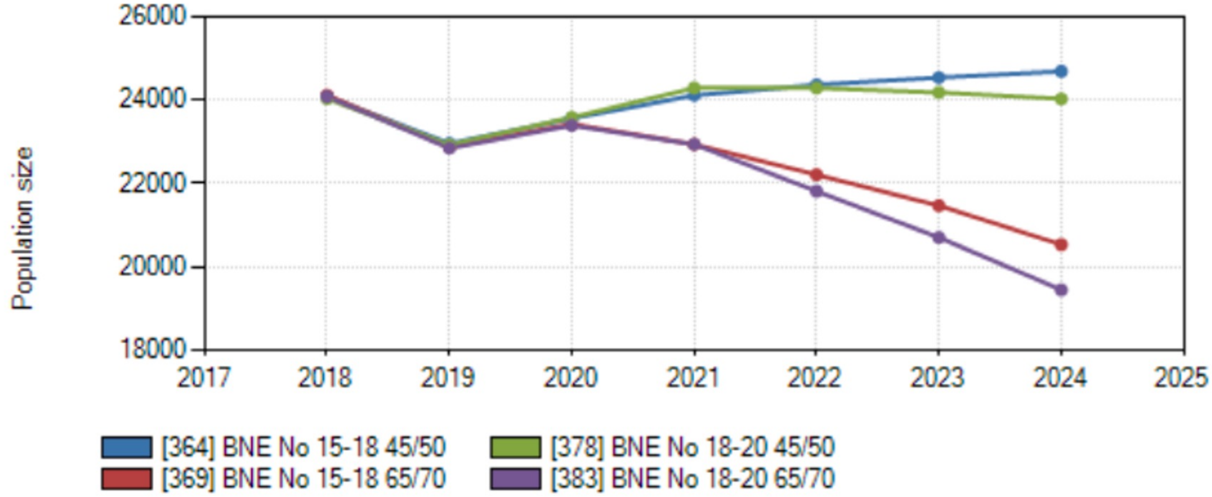
RESULTS

Table 1 presents the final population size of the 24 scenarios completed. The results are organized by colour code representing the 3 removal strategies adopted. There was a 2-fold difference in population size in both herds from the worst-case scenario compared to the best-case scenario.

Table 1. Final population size in 2024 for the 24 scenarios through the CCE. Scenario names are divided into three parts; first removal scenario ("No" No wolf control; "60%" and "80" refer to removal strategies - maintaining wolves at 60% and 80% of current numbers); second is the projected mortality applied to 2021-2024 years, either average 2015-2020 ("15-20") or 2018-2020 ("18-20"), and third two calf mortality options ("45/50" and "65/70") for 45%/50% and 65%/70% females and males respectively (see Figure 1).

Bathurst		
Scenario	average	sd
No 15-20 65/70	9985	342
No 18-20 65/70	11113	366
No 15-20 45/50	12284	433
No 18-20 45/50	13575	494
60% 15-20 65/70	15279	490
60% 18-20 45/50	15462	560
60% 15-20 45/50	16342	579
60% 18-20 65/70	16980	557
80% 15-20 65/70	17363	625
80% 18-20 65/70	18238	654
80% 15-20 45/50	18862	650
80% 18-20 45/50	19988	692
Bluenose East		
Scenario	average	sd
No 18-20 65/70	19439	664
No 15-20 65/70	20528	618
No 18-20 45/50	24036	803
No 15-20 45/50	24698	780
60% 18-20 65/70	31375	947
60% 15-20 65/70	32326	1006
60% 18-20 45/50	32532	967
60% 15-20 45/50	35872	1152
80% 18-20 65/70	36124	1131
80% 15-20 65/70	36831	1112
80% 18-20 45/50	39196	1243
80% 15-20 45/50	39970	1355

Figure 3 shows the results of projecting both the BAH and BNE herd numbers to 2024 assuming that no wolf control is initiated. Thus, Figure 3 represents applying the 2 levels of calf mortality and 2 levels of post 2020 adult cow mortality. Under average calf mortality rates (45% females/50% males) in both herds, numbers are projected to stabilize or increase in the future. The difference in the BNE herd of using 2015-2020 versus 2018-2020 average mortality in the future make little difference in the projection. Given the improved survival of females in recent years for the BAH, using the 2018-2020 average into the future results in a significant increase in the herd compared to the 2015-2020 mortality rates. However, if we apply a calf mortality rate of 65%F/70%M both herds are projected to decline, regardless of the mortality rate scenario for adult females.



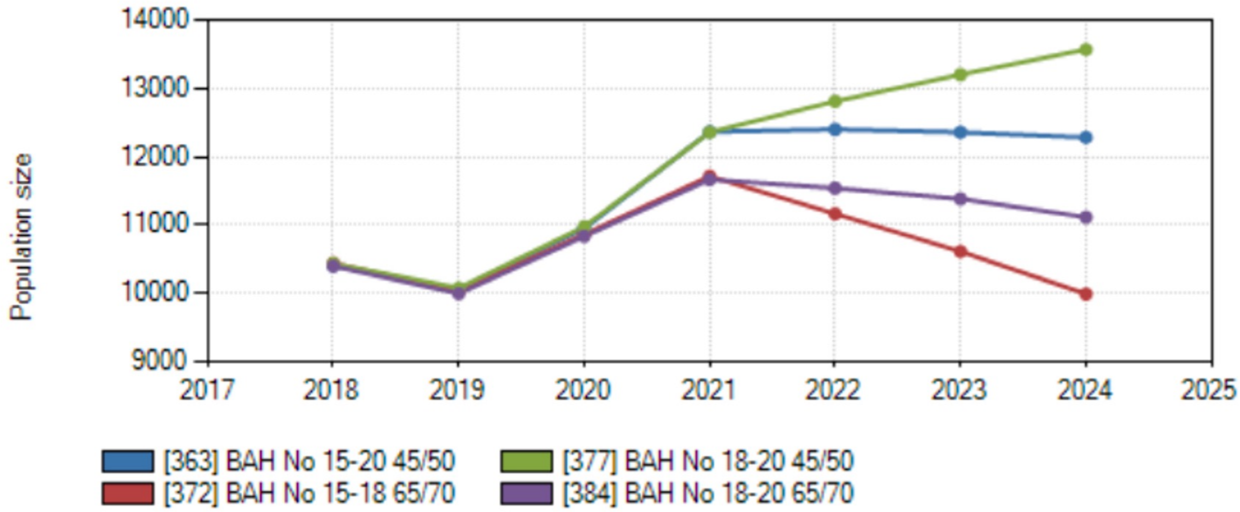
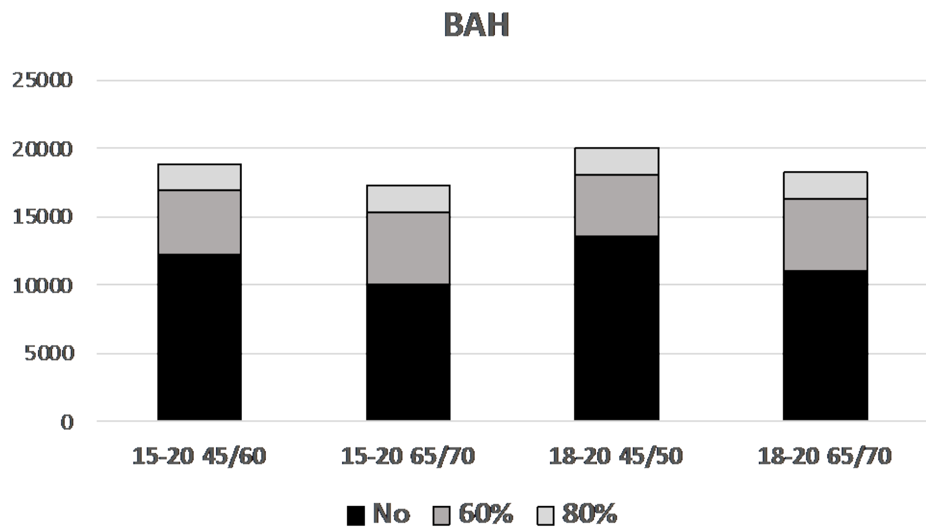


Figure 3. Results of modelled scenarios for BNE (upper graph) and BAH (lower graph) comparing the four "NO" removal scenarios).

Figure 4 summaries all the runs of the CCE. For the BNE herd maintaining wolves for 4 years at 60% below 2019 wolf estimates increased caribou population size, on average, by 50% while the 80% level of wolf removal increased caribou numbers by 72% above no wolf control levels. For the BAH, maintaining wolves at 60% below current numbers increased average caribou population size by 43% while caribou population size increased on average by 60% when implementing the 80% wolf removal strategy.



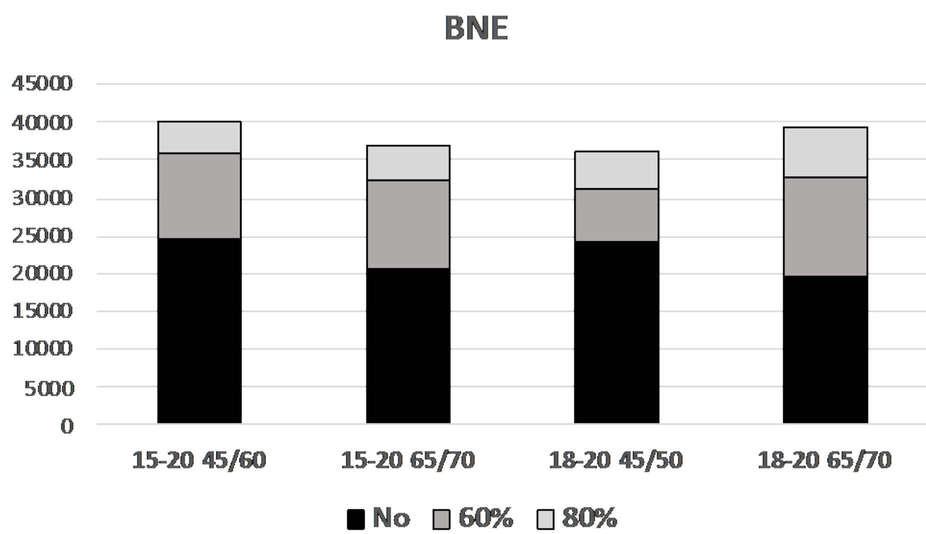


Figure 4. Stacked bar diagram of results of all 24 runs of the CCE model for the BAH and BNE. Each bar represents the three wolf removal strategies. The black bar is final population size with no removal; darker grey bar is the increase in population size from a 60% removal and the lighter grey bar the gain for an 80% removal.

In the following three exercises, we refer to the “effectiveness” of a wolf removal program. In this case “effectiveness” means the % increase in a population size from a *no control* scenario. Thus, if our *no control* scenario projected a 2024 population of 10,000 caribou, but by reducing and maintaining wolves at 60% below current wolf numbers resulted in 15,000 caribou, the program effectiveness would be 50% (15000/10000 *100).

We tested the possibility that wolves were not responsible for 60% of the calf deaths, given the high calf mortality and the indication that many of the calves are lost post-calving and early summer. We know accidents, disease, stillborn, and other predators play a role in early calf mortality. Therefore, for the BNE scenario using 2015-2020 mortality values in 2021-2024 and high calf mortality of 65% F and 70%

M, we projected the BNE population, assuming only 25% of the calves were taken by wolves. Thus, by reducing wolves we would not necessarily be benefitting the calf cohort as much as when we assume 60% of calf mortality is due to wolves. Figure 5 shows that if wolves were only responsible for 25% of total calf mortality, the 60% wolf reduction scenario would be 16% less effective, while the 80% wolf reduction scenario would be 24% less effective.

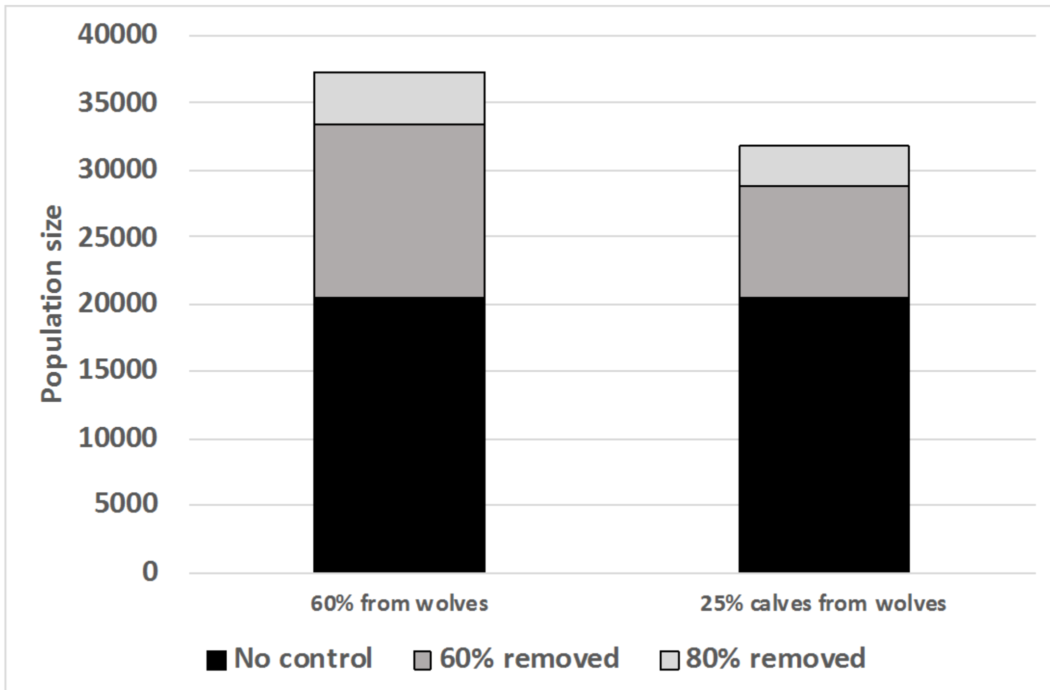


Figure 5. Comparison of final population size for the BNE if 60% of calf mortality due to wolves compared to 25%, for three wolf removal strategies.

Taking the same approach, we ran a scenario, instead of 60% of non-calf mortality attributed to wolves, we assumed that only 30% were attributed to wolves. Figure 6 shows that if wolves were responsible for 60% of calf mortality then the program would be 16% less effective and if wolves were only responsible for 25% of total calf mortality, then the program would be 24% less effective. Figure 6 shows that if only 25% of the calf deaths were attributed to wolves and 30% of the non-calves, the 60% wolf reduction scenario would be 38% less effective, while the 80% wolf reduction scenario would be 51% less effective.

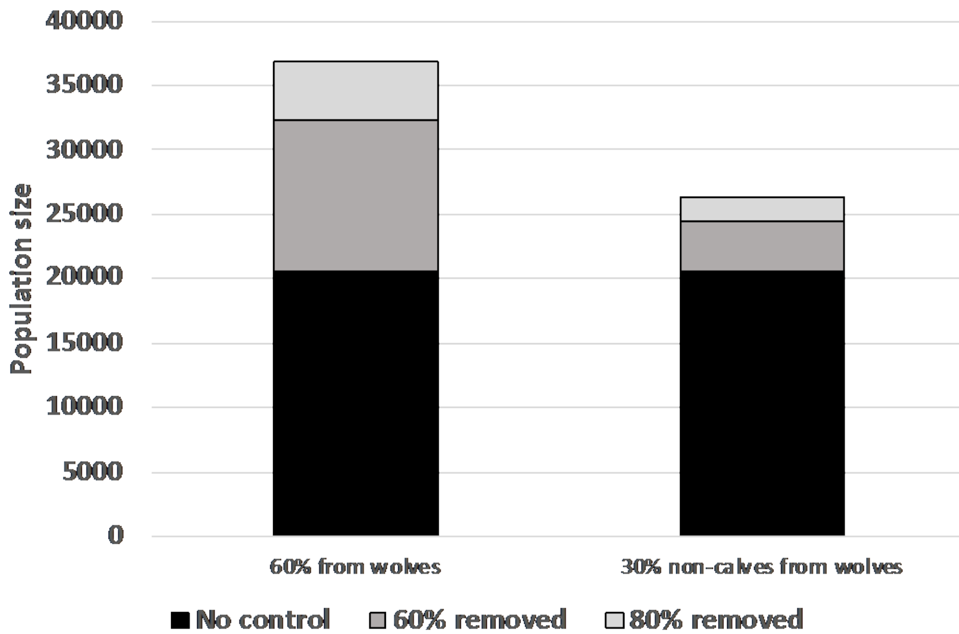


Figure 6. Comparison of final population size for the BNE if 60% of calf mortality due to wolves compared to 30% for non-calves and 25% for calves, for three wolf removal strategies.

Emigration of the Bathurst herd has been a factor identified since the 2018 population estimate surveys. In our final model exercise, we compared the same BNE scenario to a scenario where 15% of the herd emigrated out of their range and were therefore not available to predation in that range. In the model therefore we introduced an emigration factor that essentially reduces that caribou available for wolves and the fate of those emigrants are not tracked. Thus, we did not reduce the population size based in our emigration factor. From Figure 7, compared to a non-emigration scenario, the effectiveness was reduced by 11% and 13% from the non-emigration scenario for 60% and 80% wolf removal scenarios respectively.

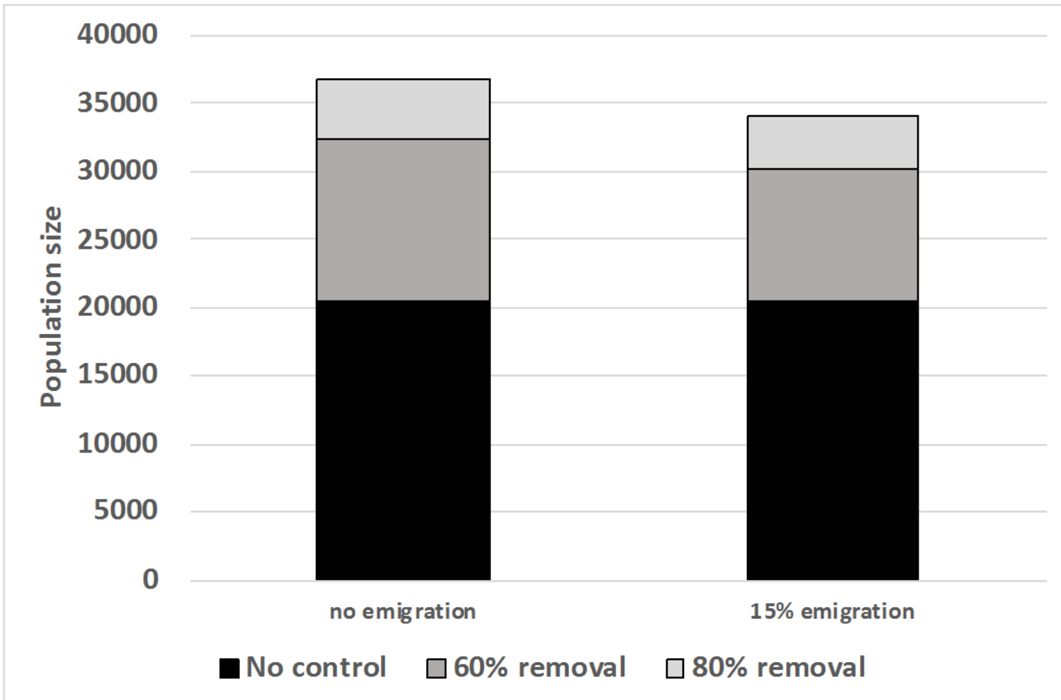


Figure 7. Comparison of final population size for the BNE if emigration was not a factor compared to a 15% annual emigration rate.

DISCUSSION

Assuming calf mortality averages 45% females and 50% males the model projects that both herds have stabilized at minimum and have increased if the mortality rates match the average for the last three years in the BAH and the last five years for the BNE herds. However, if calf mortality rates are closer to 65%F and 70%M, both herds will decline after 2020, more so in the BNE herd (Figure 3).

From our original projections almost half of the wolf predation was targeted on calves. This is a direct result of the relatively low mortality rates on non-calves in recent years and the high and perhaps increasing mortality on calves. Thus, by assuming that wolves are responsible for 60% of all mortality, naturally much of that mortality is calves. If these results are to be considered, there are implications for what questions to ask and on how to implement a wolf reduction program. The majority of calf mortality appears to be on post-calving and summer ranges.

The success or failure of a wolf removal program is based on our best knowledge of the system. Our analysis shows that under the assumptions we applied, specifically that 60% of all mortality is due to wolves, both herds benefitted on average by 46% by maintaining wolves at 60% below current levels and benefited by 66% by maintaining wolves at 80% below current levels. However, to set realistic population targets, we need to assess the possibility that the 60% of mortality across all age/sex classes is not realistic. To test this, we ran a BNE scenario assuming that 60% of all cohort mortality was due to wolves except calves. In that exercise we assumed that only 25% of calf mortality was due to wolves and the remaining 75% was attributed to other predators, accidents, disease, peri-natal death. In that scenario the effectiveness of both the 60% wolf reduction and 80% wolf reduction were reduced by 16% and 24% respectively.

- Are there really enough wolves on these ranges to be responsible for the apparent high calf mortality and, if not,
- how are calves dying?

We ran the same scenario but assumed that wolves were responsible for only 30% of all non-calf mortality instead of 60%. As mortality rates drop, as we have seen in the BAH in the last two years (92% and 95% survival), we can assume that "fixed" sources of mortality (e.g. accidents, disease, senescence) might be responsible for a higher percentage of the total mortality. To test that, we re-ran the scenario described above for the BNE and assumed that wolves were only responsible for 25% of calf mortality and 30% for all non-calf mortality. In that scenario the benefit to BNE population size of both the 60% wolf reduction and 80% wolf reduction was reduced by 38% and 51% respectively compared to our original projections.

- do we know enough to separate predation versus non-predation mortality?
- How much variability by individual packs and/or seasonal range is there in % caribou in wolf diets?

We were asked to include emigration into our considerations of wolf removal. Our treatment of emigration was very simple; not making caribou available to be predated in a single BNE run. That exercise assumed 15% emigration each year during the wolf control program. We also assume that the 15% is constant across all age/sex classes. Further we made no assumptions to the possibility that there was immigration from other herds. Given those assumptions the benefits of the wolf removal program were reduced by 11% and 13% for the 60% and 80% wolf removal strategies. Emigration may be a real factor in the management of the BAH and BNE herds. We would pose these questions:

- did wolves predate on the emigrants before they left,
- our quantification of emigrations is largely based on adult females (collars) – typically it is bulls and immature caribou that wander, if 15% females leave, how many immature caribou, calves and bulls leave?
- Are there immigrants? 15% of a small herd migrating out would be more than offset by 5% of a larger herd migrating in. Do we have enough collars on adjacent herds to be certain about how much emigration took place from those herds?

Models are only as good as the assumptions that go into them. The actual population projections in this report may not be precise (actually predicting future population size), but they do offer insights into how different factors may result in relative changes from base projections (no wolf control). It is important to keep in mind that a successful model application is best measured by the extent to which the model gives insight, stimulates discussion, inspires innovation, and/or helps guide decision-making (Kofinas et al 2016).

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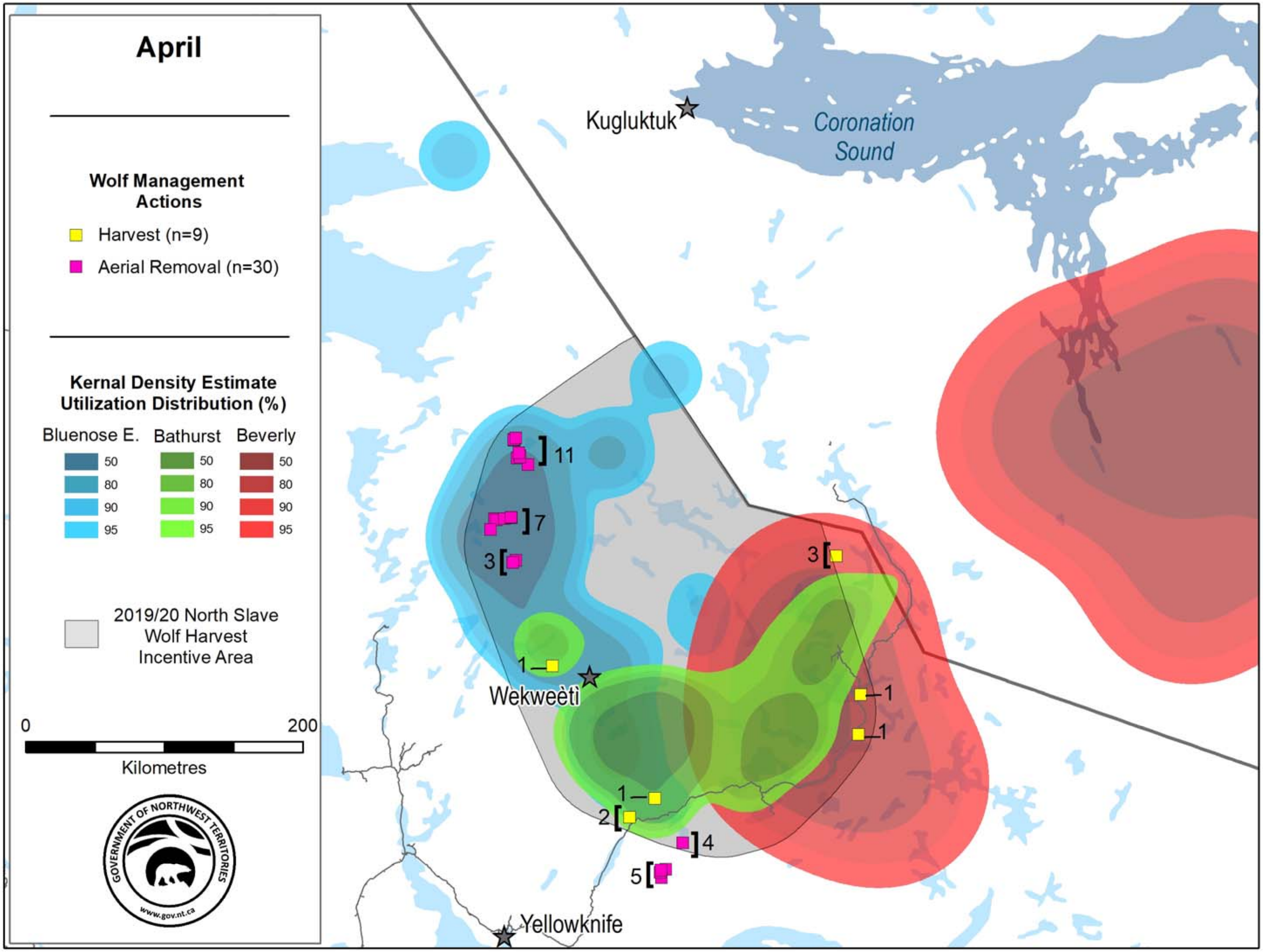
Summary of Aerial Removals on the BNE and BA winter ranges in 2020

Herd Assignment	***Date***	***Pack Number***	***Number of Wolves in Pack***	***Number of Wolves Removed***
Bluenose East	22-Apr-20	1	2	2
Bluenose East	22-Apr-20	2	1	1
Bluenose East	22-Apr-20	3	6	6
Bluenose East	22-Apr-20	4	1	1
Bluenose East	23-Apr-20	5	2	2
Bluenose East	25-Apr-20	6	2	2
Bluenose East	25-Apr-20	7	5	3
Bluenose East	26-Apr-20	8	3	3
Bluenose East	26-Apr-20	9	1	1
Bathurst	27-Apr-20	10	6	5
Bathurst	29-Apr-20	11	4	4
Bathurst	4-May-20	12	1	1
Bathurst	4-May-20	13	2	2
Bathurst	10-May-20	14	3	3

Animal ID	Initially Assigned Herd	Month	Daily Locations	Percent of Daily locations within 95% Kernal Density 95% Utilization Distribution			
				Bathurst	Beverly	Bluenose East	outside all 95% KDE UD
WF-NS20-01	Bluenose East	June	30	-	-	-	100.0
		July	31	-	-	29.0	71.0
		August	31	-	-	71.0	29.0
		September	30	-	-	83.3	16.7
WF-NS20-02	Bathurst	June	30	-	-	-	100.0
		July	31	-	-	-	100.0
		August	31	-	-	-	100.0
		September	30	-	-	-	100.0
WF-NS20-12	Bluenose East	June	30	40.0	-	-	60.0
		July	29	65.5	-	-	34.5
WF-NS20-18	Bluenose East	June	30	-	-	3.3	96.7
		July	31	-	-	90.3	9.7
		August	5	-	-	-	100.0
WF-NS20-21	Bluenose East	June	30	-	-	-	100.0
		July	31	-	-	-	100.0
		August	31	-	-	-	100.0
		September	30	-	-	-	100.0
WF-NS20-22	Bluenose East	June	30	-	-	-	100.0
		July	29	-	-	-	100.0
		August	31	-	-	-	100.0
		September	26	-	-	-	100.0
WF-NS20-23	Bathurst	June	30	-	-	-	100.0
		July	31	-	-	-	100.0
		August	31	-	-	-	100.0
		September	30	-	-	-	100.0
WF-NS20-26	Bluenose East	June	30	-	-	93.3	6.7
		July	30	-	-	80.0	20.0
		August	31	-	-	6.5	93.5
		September	14	-	-	-	100.0
WF-NS20-27	Bluenose East	June	30	-	-	-	100.0
		July	30	53.3	-	-	46.7
		August	30	93.3	73.3	-	6.7
		September	30	100.0	100.0	-	-
WF-NS20-29	Bathurst	June	30	-	-	-	100.0
		July	31	-	-	-	100.0
		August	31	-	-	-	100.0
		September	30	-	-	-	100.0
WF-NS20-30	Bluenose East	June	30	6.7	70.0	-	23.3
		July	31	41.9	9.7	-	48.4
		August	31	87.1	51.6	-	12.9
		September	30	70.0	46.7	-	30.0



April
Wolf Management Actions
Harvest (n=9)
Aerial Removal (n=30)
Kernal Density Estimate Utilization Distribution (%)
Bluenose E.
Bathurst
Beverly
50
80
90
95
2019/20 North Slave Wolf Harvest Incentive Area
0
200
Kilometres
GOVERNMENT OF NORTHWEST TERRITORIES
www.gov.nt.ca
Kugluktuk
Coronation Sound
Wekweèti
Yellowknife
11
7
3
1
3
1
1
1
2
4
5