

Introduction

In 2017, we developed a modeling approach to assess the effectiveness of wolf removal within the range of the Bathurst Caribou herd. In 2020, 80 wolves were removed between late winter and early spring from the range of the herd that included overlap with the Bluenose East herds to the west and the Beverly herd to the east.

In this update, our objective is to project the possible implications of the current wolf management on the productivity of the Bathurst and Bluenose East herds.

Modelling approach

We modelled the BAH and BNE populations between 2015 – 2024, spanning the last two census years (2015 and 2018). We applied the same population structure and demographic rates to both populations. Initial population sizes reflected the population estimates in 2015; 20,000 for the BAH and 38,600 for the BNE. Figure 1 depicts the age and sex mortality rates that resulted in projected values in 2018 closely matching population estimates from the 2018 population estimate.

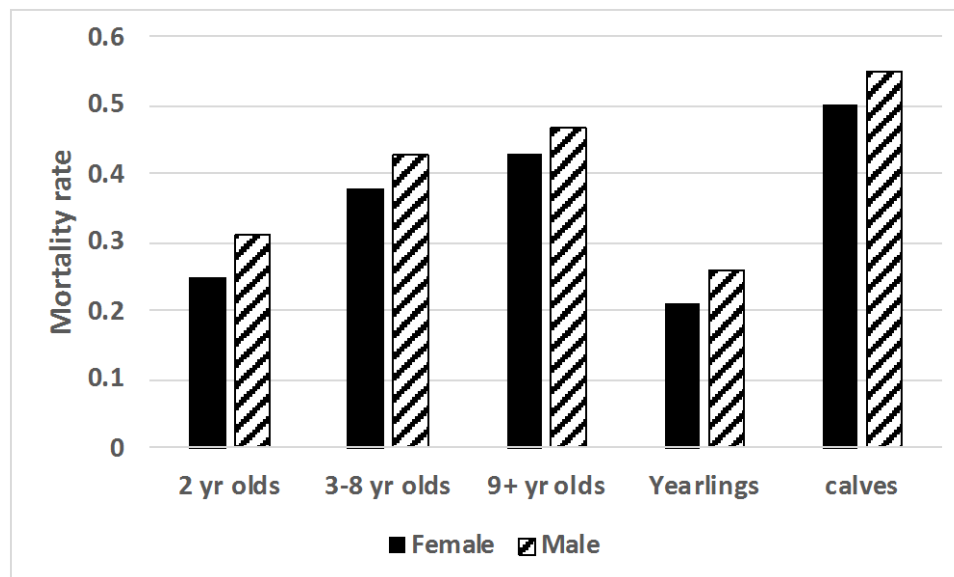


Figure 1. Age/sex mortality rates used in the model

Assumptions

- projected potential mortality rates 2015-2024 – assuming no annual change
- assume wolf predation applied proportional to cohort (age and sex) based on the modelled 2019 population structure
- assume each wolf consumes 29 wolves each year
- assume 60% of annual mortality due to wolves and all removal effects are additive rather than compensatory
- assume 33 wolves from BAH and 60 wolves from BNE and 6 wolves from BEV were removed (*SEE BELOW) in 2020

- Figure 2 shows the modelling process:

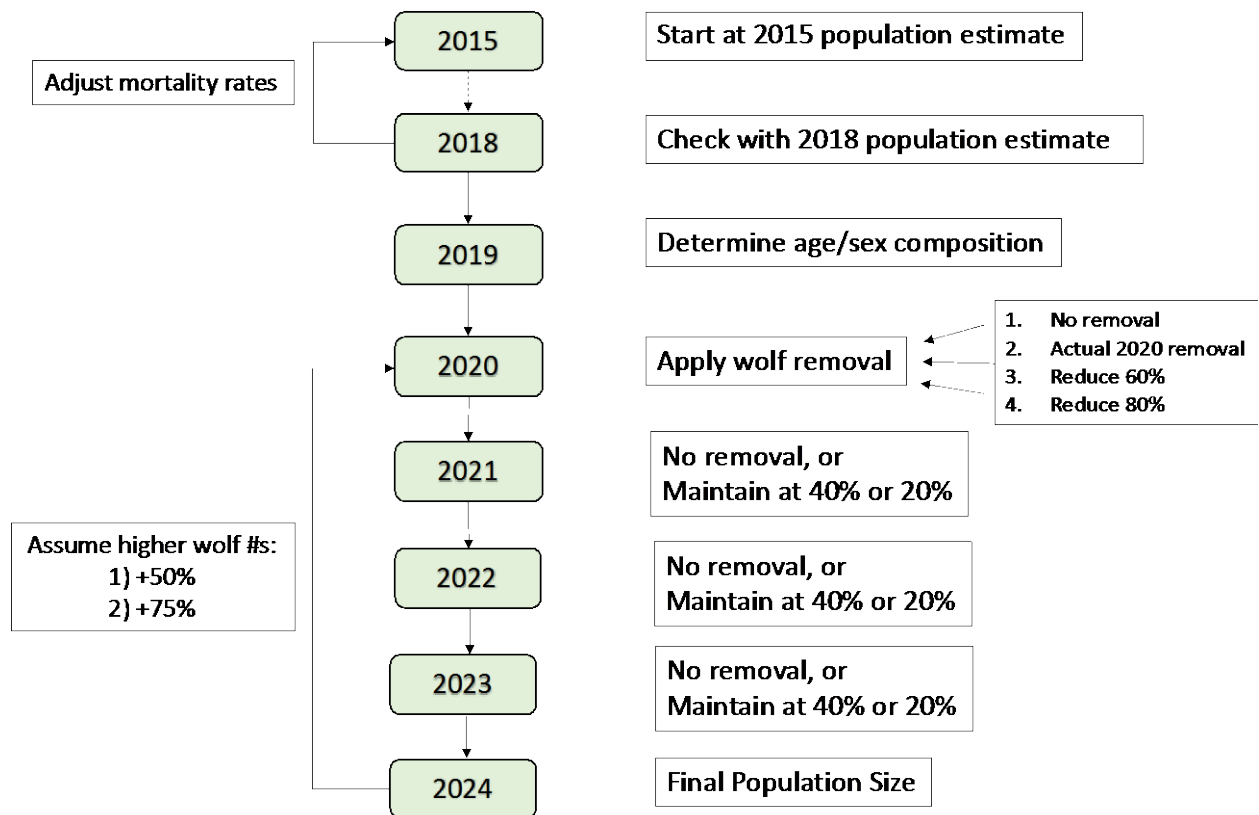


Figure 2. Modelling the impacts of wolf removal on the BAH and BNE herds

Scenarios

For each herd the model was run for 10 scenarios (Figure 2, Table 1).

Table 1. Scenarios used for modelling wolf removal on population projection for the BAH and BNE herds

No control	No wolf control
Actual	2020 actual reduction projected at maintaining 40% from 2021-2023
Actual +50% wolves	as above with 50% more wolves
Actual +75% wolves	as above but with 75% more wolves
Maintain at 40%	reduce wolves by 60% in 2020 and maintain at 40% level next 3 years
40% +50% wolves	as above with 50% more wolves
40% +75% wolves	as above but with 75% more wolves
Maintain at 20%	reduce wolves by 80% in 2020 and maintain at 20% level next 3 years
20% +50% wolves	as above with 50% more wolves
20% +75% wolves	as above but with 75% more wolves

We developed an algorithm for implications of actually having more wolves in the herds' ranges than estimated in 2020 (48 BNE and 122 BNE). Our approach was to treat the current estimate as

the “base population” responsible for killing caribou – i.e. each wolf killing 29 caribou per year. Then the “extra” caribou (50% and 75%) was applied to “water down” the removal. In other words, if every one of the 122 and 48 wolves ate 29 caribou, removing 1 wolf saves 29 caribou as is reflected in the 4 base runs 1) no control, 2) actual 2020 removals, 3) maintain 40%, and 4) maintain 20%. However, adding more wolves into the system implies not all wolves eat 29 caribou – some packs stay south and don’t rely on caribou in summer, some packs stay north and don’t rely on caribou during the winter and some packs take more advantage of alternative prey available. Thus, randomly taking wolves when there are 50% or 75% more wolves on the landscape means each wolf on average doesn’t eat 29 caribou; rather taking a wolf only saves 19 and 16.5 caribou respectively, thus lowering the impact of taking removing wolves.

Number of wolves removed in 2020 from BAH, BNE and BEV herds

- 99 wolves were removed from BAH range including those taken from BAH/BNE overlap and BAH/BEV overlap. Two methods - aerial removed and on-the-ground harvesting were employed.

Aerial removal

- 16 BAH and 25 BNE

Harvest

- 13 BAH / BNE overlap
 - assume same ratio as aerial, therefore 5 BAH and 8 BNE
- 6 BAH / BEV overlap
 - assume 50:50 chance, therefore 3 BAH and 3 BEV
- 20 unknown location
 - assume similar to the 19 known harvest locations, therefore 14 BAH / BNE overlap and 6 BAH / BEV overlap
 - applying same logical for known overlap cases then 9 BAH, 8 BNE and 3 BEV
- 19 wolves harvested south of great Bear Lake – assumed all to be from the BNE range
- **Total by Herd**
 - **BAH 16 + 5 + 3 + 9 = 33**
 - **BNE 25 + 8 + 8 + 19 = 60**
 - **BEV 3 + 3 = 6**

Results

Assuming no wolf control and that current population declines continue, the estimated size of the BAH and BNE herds are currently (2020) projected to be 6044 (BAH) and 11678 (BNE). Further by 2024 numbers drop to 2225 and 4299, respectively (Figures 3, 4 and 5). With the most aggressive wolf control (reduce 80% in 2020 and 3 years maintained at 20%) and assuming current wolf population estimates are accurate, potential population sizes in 2024 could be 11323 and 7012. Thus, the wolf control would essentially stabilize the herds after 4 years of wolf removal.

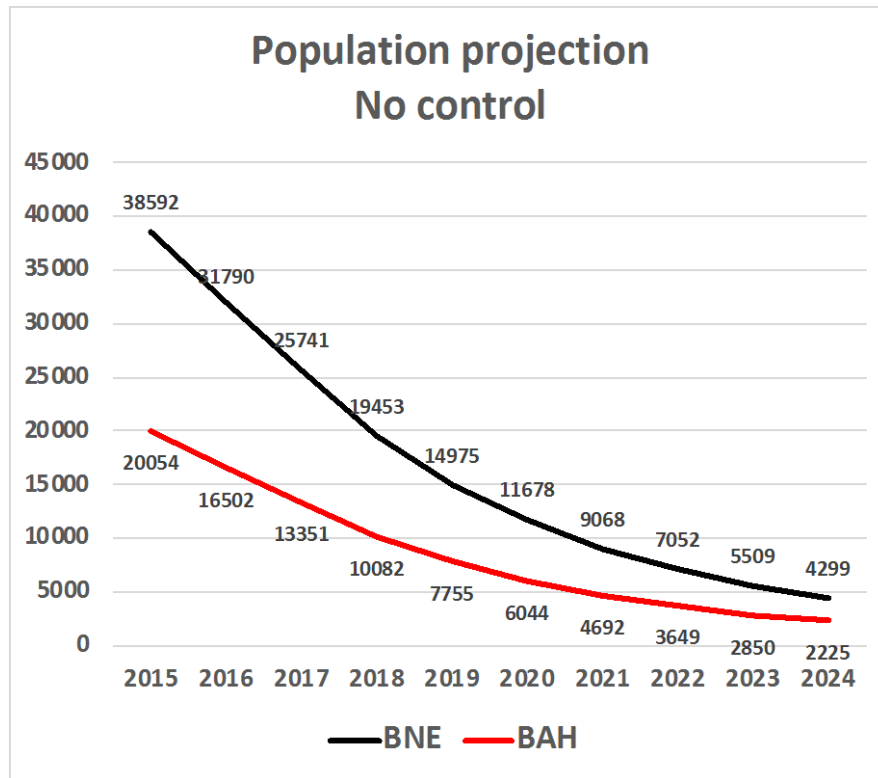


Figure 3. Population projection for the BAH and BNE herds 2015-2024 assuming no wolf control

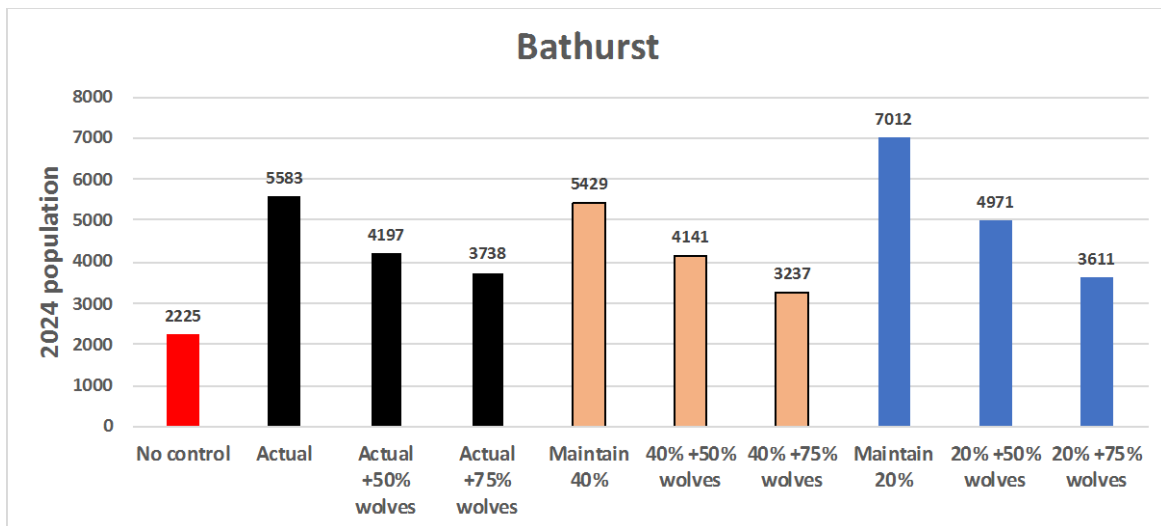


Figure 4. Estimated population size of the BAH in 2024 based on 10 wolf management scenarios

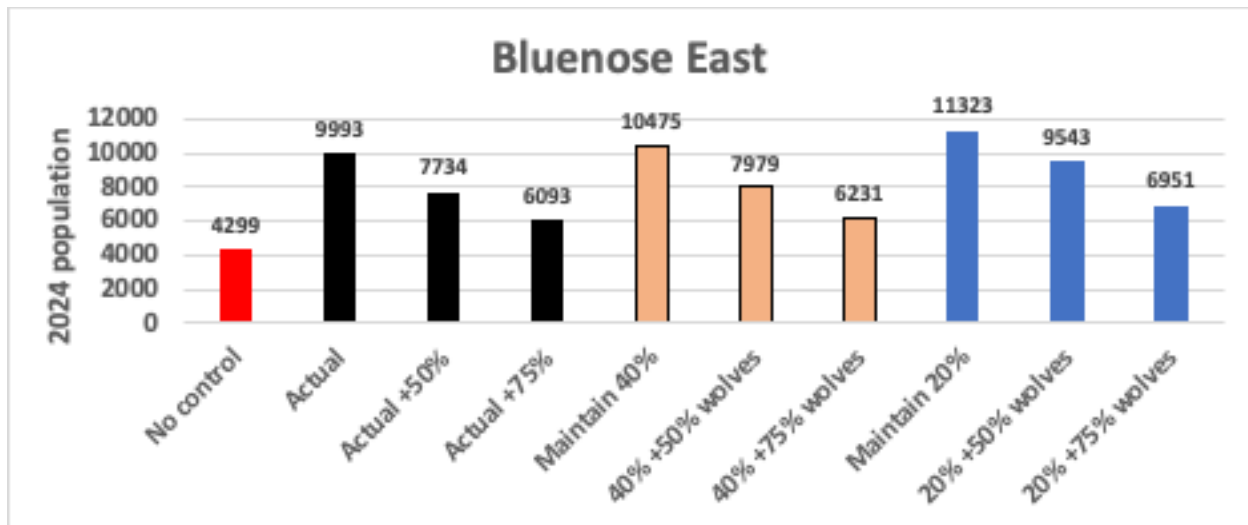


Figure 5 Estimated population size of the BNE in 2024 based on 10 wolf management scenarios

Discussion

In this analysis we projected the BNE and BAH populations from 2015 – 2022 largely based on known rate of decline in both populations between 2015 and 2018. Projecting to 2020 provides a pre-control population size for both herds. The rate of decline applied in the model was 23% which is similar to the BNE decline and ~ 6% lower than the observed BAH decline (29%) – the reason we did not try to model the 29% decline observed in the BAH herd was the suggestion that an important part of that decline was not due to mortality but attributed to emigration to the BEV/AHI herd. Assessing implications of wolf control in this model does not take into account emigration.

In our application, major wolf removal was 2020, either reducing the estimated wolf population by 60%, 80% or what actually occurred in 2020. In the 3 years following (2021-2023), we project caribou population size assuming the wolves are maintained at 40% or 20% of pre-removal levels. Thus we do not model the recovery rate of wolves and therefore not the number of wolves that may need to be removed in 2021-2023. Annual recovery, and thus the effectiveness of the control program, will be impacted by the application of wolf removal: for example unless whole packs are removed or if alpha males and females are removed – packs may split, net reproduction may be higher and non-resident wolf packs may move in more readily due to lower territorial conflicts. In the Finlayson herd, Yukon reduced an intensively monitored wolf populations by 80% (~190 wolves) in year 1 and kept it at that number for the next 5 years (Hayes and Harestad 2000). In those subsequent years they took out an average of 50 wolves per year to maintain the wolf population at 20% pre-control levels. In-filling of packs occurred from one of four origins:

- Resident – existed at end of reduction period
- Colonizer – pairs or trios setting up territory from outside sources
- In-shifter – entire packs moved in from region
- Splitter – pack formed after splitting off established pack

The data available during this modelling analysis did not include how wolves were targeted with respect to discrete packs and specifically the different removal strategy of the aerial removal program and the harvest incentive program.

As stated, the above analysis is based on the assumption that the current population estimates for wolves in the ranges of the BNE and BAH are accurate. We expanded the analysis assuming that there are actually 50% and 75% higher. We decided that the best approach was to assume that the current estimate of wolves were responsible for all the wolf mortality and the extra wolves would represent non-caribou eating wolves and thus if wolf packs are randomly targeted, then their removal would not “save” any caribou and would only serve to reduce the effectiveness of the wolf removal program. To be effective wolf numbers have to be reduced by 65 to 80% of pre-control levels. Reviewing 24 North American studies. Adams et al. (2008) showed that wolf population growth rate was not impacted with removal rates at 30% or lower. In our application if wolf densities are 75% higher than estimated and the goal is maintaining wolves at 60% below pre-control densities, current removal numbers would only translate into a 34% reduction in wolf densities. At a goal of 80% that actual reduction would be 45%.

Hayes and Russell (1998), for the Porcupine caribou herd documented an average of 29 wolves per wolf per year, although killing rates varied wildly with one pack averaging 4 caribou/wolf/year and another killing 77 caribou/wolf/year. Our model did not vary kill rates reflecting this variability, thus we have to assume a wide variability in effectiveness in control measures depending on the average kill rates of targeted packs during the control period.

Another large unknown in this analysis is the percent of total adult caribou mortality attributed to wolves. The few estimates available for other studies on migratory tundra herds were documented when caribou population sizes were greater than 150,000. The territorial behavior of wolves limit their population densities over wide ranges, independent of prey abundance when prey populations are high. However, we assumed that as the caribou abundance declines dramatically the relative role of wolf predation on the herd increases. Our estimate of 60% adult mortality due to wolves is largely based on the current low population sizes of the BNE (9% of peak abundance) and BAH (2% peak abundance). The implication of overestimating the relative role of predation would be an overestimation of wolf control measures.

Adams, L. G., R. O. Stephenson, B. W. Dale, R. T Ahgook, and D. J. Demma. 2008. Population Dynamics and Harvest Characteristics of Wolves in the Central Brooks Range, Alaska. Wildlife Monographs 170. 25 pp.

Hayes, R.D., Harestad, A.S. 2000. Demography of a recovering wolf population in the Yukon. Can. J. Zool. 78: 36–48.

Hayes R.D. and D.E. Russell. 2000. Predation rate by wolves on the Porcupine caribou herd. *Rangifer* Special Issue 12: 51-58.