# An update on the survival analysis of collared cows in the Bathurst and Bluenose-East Herds

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## Introduction

This report provides a brief update on ongoing survival rate analyses of collar adult female caribou for the Bathurst and Bluenose-East herds. The survival rate data will be analyzed further using the Bayesian integrated population model (IPM) that incorporates demographic data therefore allowing more refined survival rate estimates. The details of the IPM as well as survival rate estimation are given in the 2018 calving ground survey reports (Adamczewski et al. 2019, Boulanger et al. 2019) as well as the original paper on the OLS version of the IPM (Boulanger et al. 2011). These analyses will be presented in further detail in future reports.

**Methods and results**

Bathurst herd

Survival data for the Bathurst herd has been compiled up to June 2020 from collar fate data tracked by ENR in unison with monthly collared caribou location data. Monthly mortality rates as well as monthly sample sizes of collared females (mortalities/collars available) are shown in Figure 1 for 2009 to 2020. A cluster of mortality events in the summers of 2009-15 are suggested. Monthly mortality rates were lower from 2017-20.

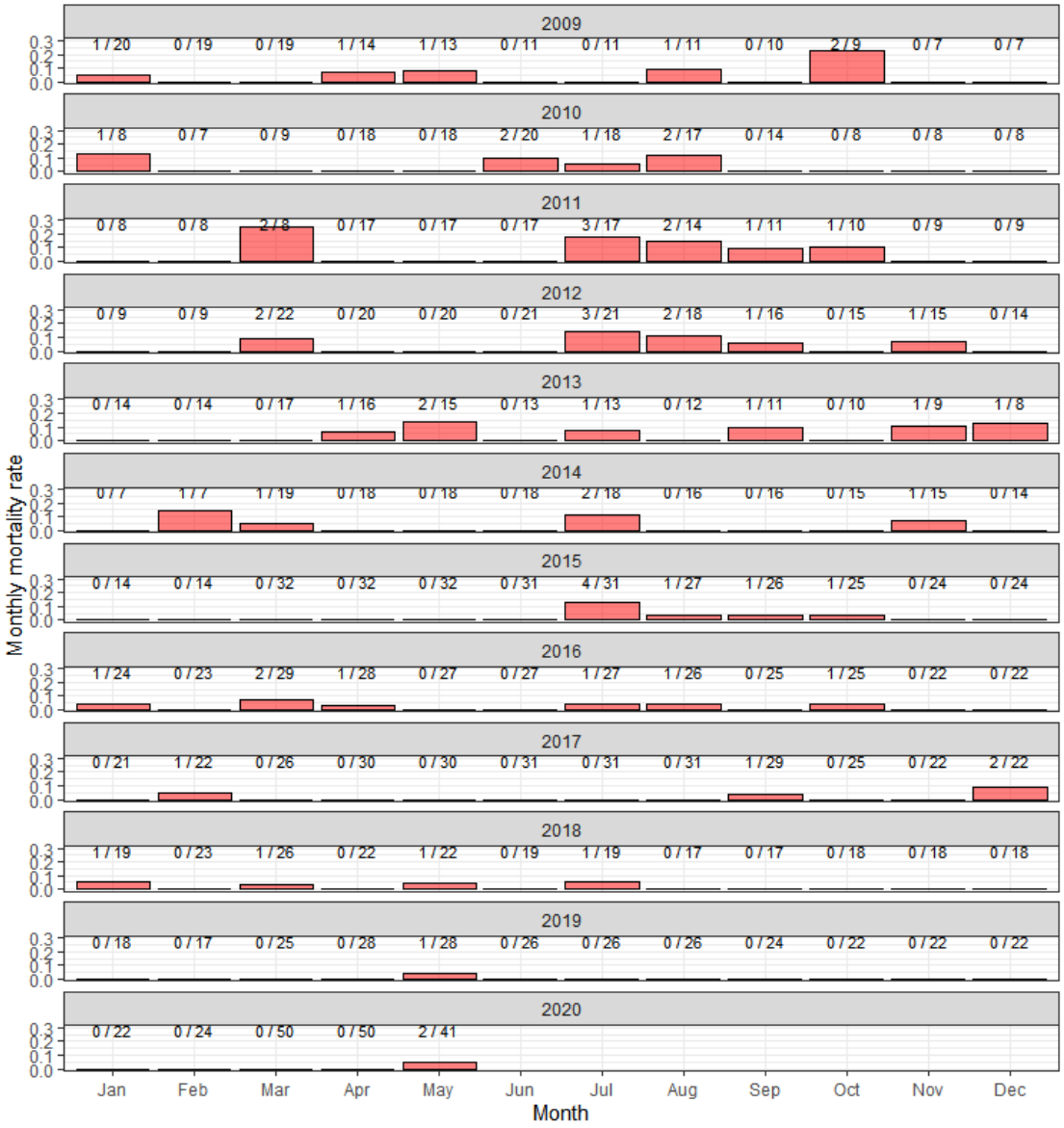


*Figure 1: Summary of monthly mortality rates from 2009-2020 for the Bathurst herd. The number of mortalities and the number of collars available (mortalities/collars available) is displayed for each month.*

Survival rates were estimated for the caribou year that starts in June of each year and ends in May of the following year. Figure 3 provides annual survival rates using the Kaplan-Meir survival rate estimator. Sample size of average collars available per month are given next to estimates. An increase in survival is suggested especially in 2019 and 2020.

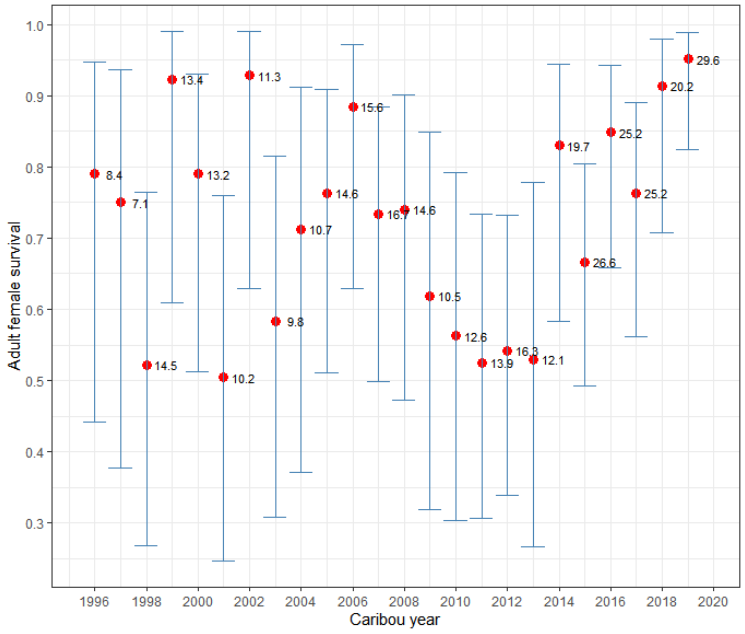


*Figure 2: Annual survival rate estimates for the Bathurst herd. The mean number of collars available each month is shown beside each estimate.*

It is also possible to estimate seasonal survival rates as the product of monthly survival for each season. Estimates suggest an apparent increase in calving-summer season (June-October) with less apparent trends in winter/spring migration (November-May). Note that these estimates have been converted to an annual scale to facilitate comparison. As with the annual survival rate estimates in Figure 2 the sample size of collars is displayed next to each data point.

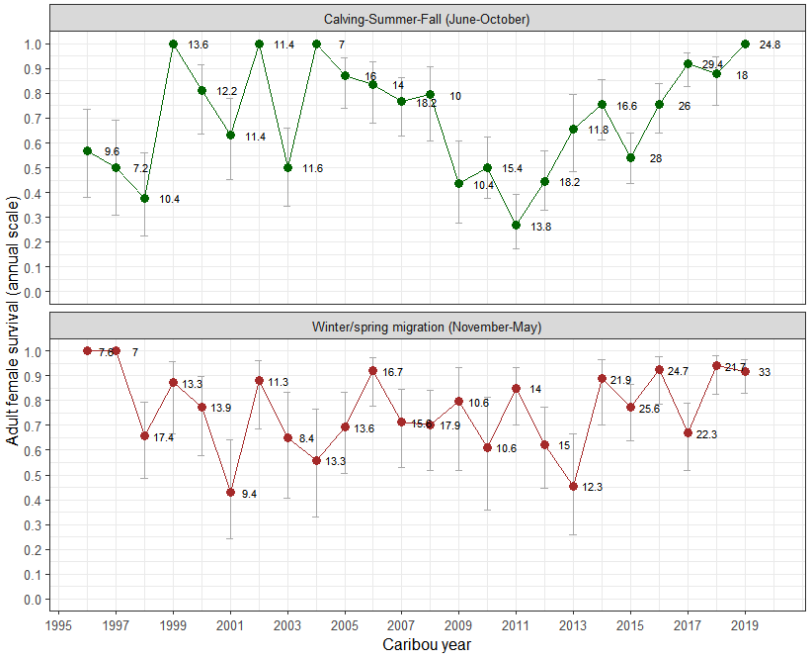


*Figure 3: Seasonal survival rate estimates for the Bathurst herd (note that they are on the annual scale for comparison purposes). The mean number of collars available each month is shown beside each estimate.*

Bluenose East herd

Monthly sample sizes of collars and mortality rates are displayed for the Bluenose East herd in Figure 4.

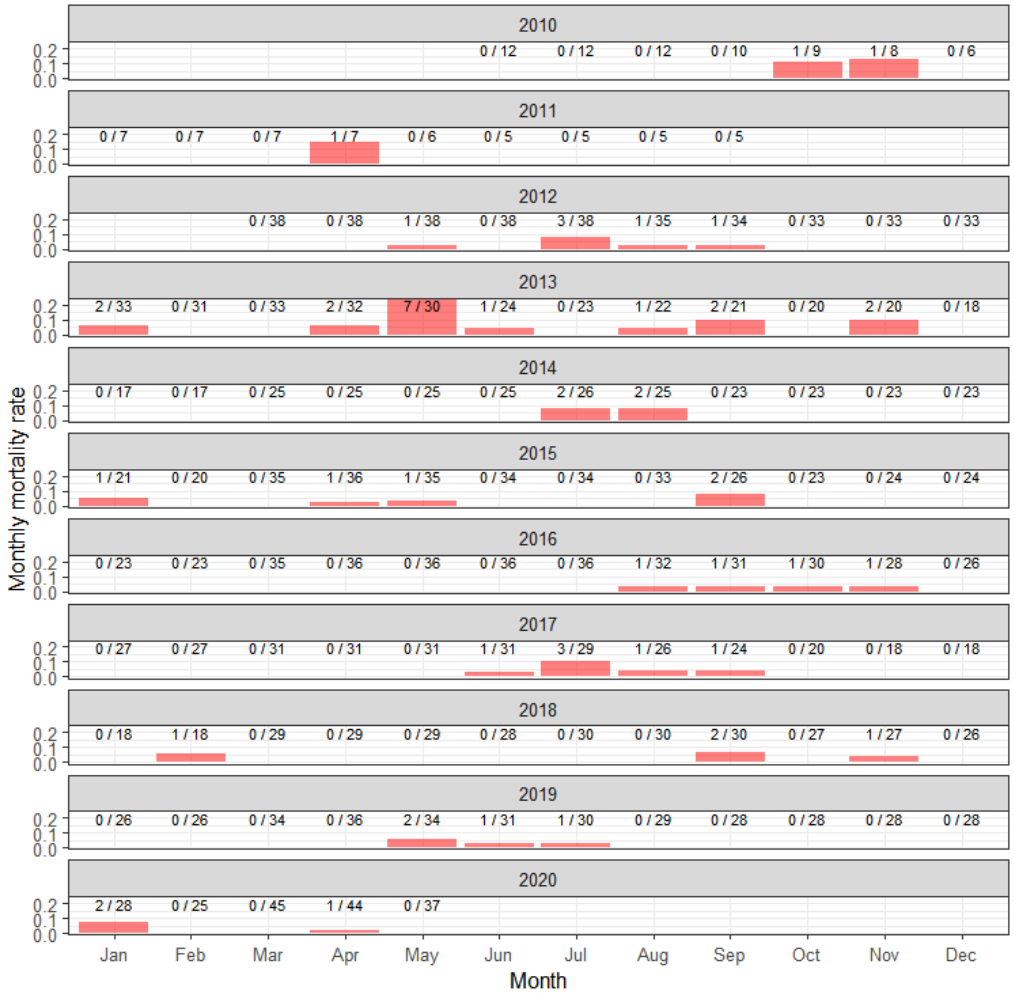


*Figure 4: Monthly mortality rates for the Bluenose-East herd. The number of mortalities and the number of collars available (mortalities/collars available) is displayed for each month.*

A plot of annual survival rates suggests a stabilization of rates at 0.85 for 2018 and 2019 (Figure 5).

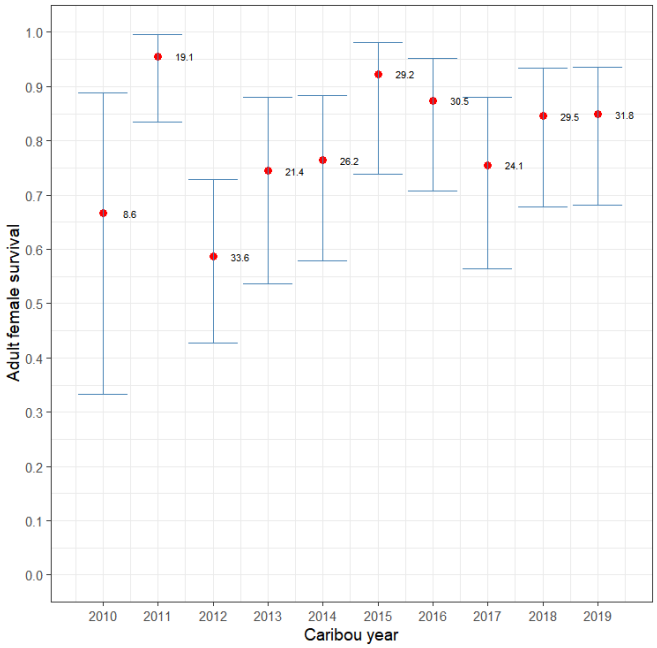


*Figure 5: Annual survival rates for the Bluenose-East herd. The mean number of collars available each month is shown beside each estimate.*

Seasonal survival rates suggest perhaps a slight increase in summer rates and a decrease in winter rates, however, these trends should be verified using the IPM.

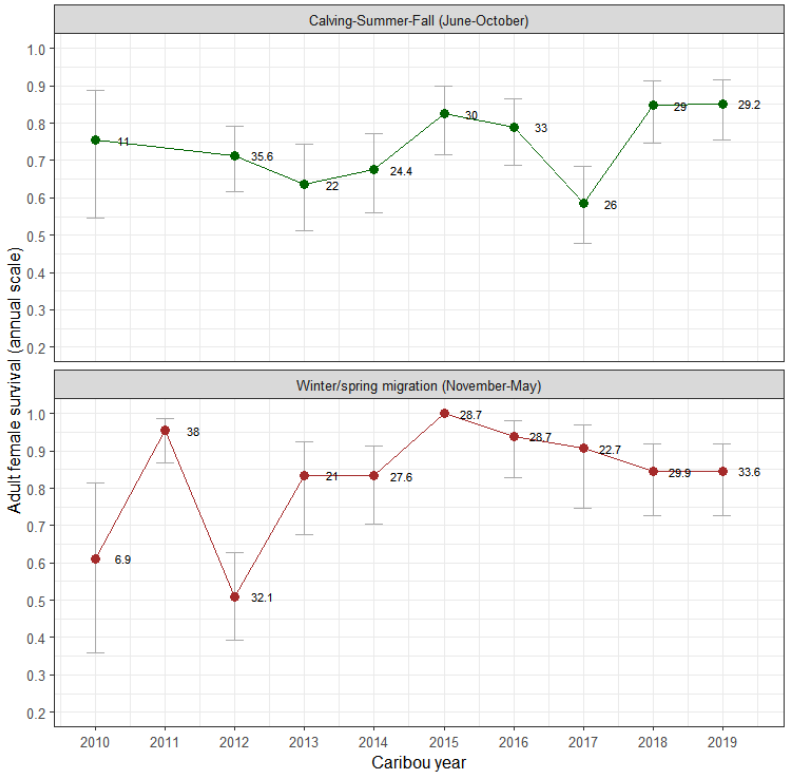


*Figure 6: Seasonal survival rates for the Bluenose-East herd. Note that rates are expressed on the annual scale. The mean number of collars available each month is shown beside each estimate.*

## Discussion

Some potential trends, such as an increase in recent survival rates for the Bathurst herd are suggested. However, we should treat these estimates cautiously given the relatively lower sample size of collars survival rates are based on especially in earlier years of the analysis.

The Bayesian IPM will further refine estimates by considering other data sources such as calving ground surveys, composition surveys, and survival rates from collared bulls. The basic way to conceptualize the IPM is that it considers the most likely survival rate estimates that will create the observed trends in all of the demographic indicators. Using this approach helps offset issues with any of the individual data sets (such as low collar sample size) and therefore produces refined estimates.

One of the most pressing questions is whether the apparent increase in survival rates will lead to a stabilization of trend or an increase. The other demographic aspect of the data set that needs to be considered is productivity (as measured by composition surveys). These two data sets will be considered in unison to allow an estimate of overall demographic trend as part of the IPM analysis.

Next steps

- The Bayesian model has been modified to allow monthly data for individuals rather than overall annual survival data therefore allowing assessment of seasonal trends. In addition, uncertainty in collar fates is being considered as part of the IPM analysis. Finally, survival rates from bulls is being incorporated into the model to enhance estimates for bulls which were previously based primarily on bull-cow ratios.
- Environmental covariates, herd overlap, and other covariates will be considered to further refine model predictions and explore factors influencing demography.

## Literature cited

Adamczewski, J., J. Boulanger, H. Sayine-Crawford , J. Nishi, D. Cluff, J. Williams, and L. M. LeClerc. 2019. Estimates of breeding females & adult herd size and analyses of demographics for the Bathurst herd of barren-ground caribou: 2018 calving ground photographic survey. ENR manuscript report No 279. Environment and Natural Resources, Government of Northwest Territories

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