SR-23-18

Plain language summary of the DNA capture-recapture population survey of black and grizzly bears in the Beaver River watershed, Yukon

August 2022

Plain language summary of the DNA capture-recapture population survey of black and grizzly bears in the Beaver River watershed, Yukon

Government of Yukon
Fish and Wildlife Branch
SR-23-18

Authors

John Boulanger[1], Murray Efford[2], Jodie Pongracz[3]

1 Integrated Ecological Research, Nelson, British Columbia, Canada **2** Dunedin, New Zealand, **3** Fish and Wildlife Branch, Government of Yukon

Acknowledgements

We would like to thank the First Nation of Na-cho Nyak Dun (FNNND) for collaborating with us on this project. Several staff from both the Fish and Wildlife Branch and FNNND assisted with field planning and data collection including Treharne Drury, Laurelie Menenlon, Bryan Moses, Tyler Ross, and Stephan Walke. In addition to assisting with the aforementioned, Joël Potié and Mark O'Donoghue also helped to develop the project, secure funding, and review results. Thanks to Steve Buyck for reviewing the work. Thanks to Don Reid and Chrystal Mantyka-Pringle and the Wildlife Conservation Society for financial and in-kind support with project design and start up. We also thank rotary pilots Matthew McCulloch, Andrew Robertson, and Troy White for their safe and efficient flying. This project was made possible with funding from Environment and Climate Change Canada (Aboriginal Fund for Species at Risk) and Yukon Environmental and Socio-economic Assessment Act Implementation Funding.

© 2023 Government of Yukon

Copies available from:

Government of Yukon
Fish and Wildlife Branch, V-5
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone 867-667-5721
Email: environmentyukon@yukon.ca
Online: Yukon.ca and open.yukon.ca

Introduction

This document describes results from a DNA mark-recapture study focused on grizzly bears, but inclusive of black bears, in the Beaver River watershed.

Currently, little is known about how many bears there are in the Beaver River Land Use Planning area, an area that has significant mineral potential. The area lies within the Traditional Territory of the First Nation of Na-Cho Nyak Dun, and is defined by the Beaver River watershed plus adjacent areas to the southwest. It offers pristine habitat, has little disturbance, and very little access. A recent proposal to build a 65 km, all-season access route (the "Tote Road") in the area has been submitted by the exploration company ATAC to support advanced mineral exploration. This has driven work towards the development of a land use plan for the area. A planning committee composed of First Nation of Na-Cho Nyak Dun and Government of Yukon delegates is currently gathering information about the planning area.

There is interest in knowing more about black bear and grizzly bear populations in the Beaver River Planning area. For this reason, in late 2019, a hair snag study sampling design to estimate bear densities was developed. Fieldwork followed in the summer of 2020. Hair was collected from snag stations, and sent to Wildlife Genetics International, a company that specializes in extracting DNA from wildlife samples. Results from DNA extraction were received in early 2021 and identified individuals by species and sex. From these results, a mark-recapture analysis was used to estimate the numbers of black bears and grizzly bears in the study area.

The project aimed to provide current information on black bear and grizzly bear numbers and where they occur on the landscape. This was also an opportunity to test the survey design with a view to repeat it in the future, after road and mine development, to examine any changes that may have occurred.

This report summarizes the information we gathered and presents estimates of how many black bears and grizzly bears there are in the Beaver River study area based on mark-recapture analysis. This provides basic information needed to determine what factors influence where bears reside on the landscape.

Study area

The study area was centred on the proposed Rackla Gold Project site and its access road (Fig. 1). The centre of the study area was near latitude 64°N, about 96 km northeast of Mayo. The southwestern edge of the study area was 4 km from Keno City, and the eastern edge of the study area was approximately 50 km from the Northwest Territories border.

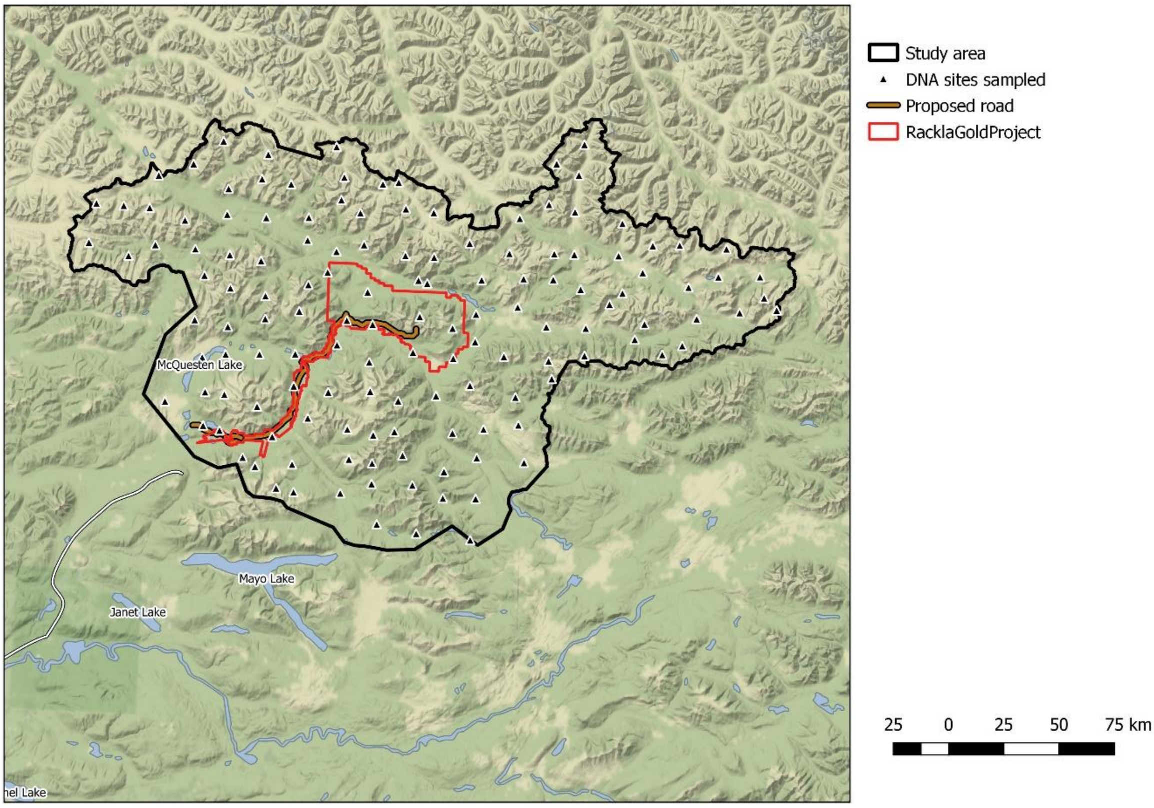

Fig. 1. Beaver River watershed DNA study area with sample sites. Also shown is the Rackla Gold Project area with the proposed access road.

Methods

Spatial capture–recapture models

The name of the method used to estimate black bear and grizzly bear population sizes is 'spatially explicit capture–recapture (SECR)' analysis. SECR is a method commonly used to estimate how many bears there are in a specified area when there is incomplete information. In the Beaver River study area, we expected that some bears were present from which we were not able to snag hair, and there were some hair samples from which we were not able to extract DNA. Both situations could result in bears being in the area but not detected. We also expected that some bears may use areas mostly within the Beaver River watershed, while others use areas mostly outside the watershed. The SECR method adjusts for these gaps in our knowledge.

SECR is a modeling approach that treats each bear population as a set of points that are arranged in space like points on a map. Each point represents a bear's centre of activity or the centre of a bear's home range. We then distribute hair snag stations across this same landscape (see Figure 1). The chance that a particular bear leaves a hair sample at a particular hair snag is assumed to differ depending on how far the hair snag station is from the centre of the bear's home range. We assume that the chance of a bear leaving a hair sample at a snag station near the centre of their home range is high, and that the chance decreases with distance from the home range centre. The key to SECR modeling is to understand how this chance changes with distance, and this is what we estimate using the model.

If we assume that the population occurs evenly over space, we can then estimate the number of bears in each area (density), which we usually present as the number of bears per 1,000 km^2.

Field methods and genetic analysis

We placed hair snag stations across the study area at 7 kms apart. There were 138 hair snag stations in total, covering an area of approximately 6,700 km^2. We built hair snag stations in a tripod shape, with lumber (Figure 2). Each station used six 2x4s, five feet in length, three of which were wrapped with barbed wire. These barbed-wired posts were the upright pieces of the tripod. Moss and vegetation were piled in the centre of each hair snag station. We then poured liquid lure, made from fish oil and rotten blood over the piles. Additionally, a handful of moss was collected and mixed with long-distance lure, then enclosed in felt and stapled to the top of each station. At some hair snag stations, we also put cameras on nearby trees; cameras were triggered by animal movements and helped us evaluate the number of visits to the stations. We had four hair collection sessions, during which we rebaited sites. Long-distance lures were also changed during each session. Specifically, we used the following lures: ground beaver castor, K9 triple take, predator long distance call, and bear tease. All these lures were produced by Forsyth Animal Lures Ltd. Hair snags stations were set up over 19–25 June 2020, and checked every 2weeks with the final check on 11–16 August 2020. At this final check, we also removed stations from the field.

Bears rubbed on various areas of the hair snag station as well as on the ground and surrounding trees. We collected hair from these sites following a specific procedure. All samples were sent to Wildlife Genetics International for analysis.

In total, we collected 2,115 hair samples. While some samples failed during the genetic analysis, we did obtain individual identifications for 1,079 samples (including information on whether these individuals were male or female, and black or grizzly bears).

Fig. 2. Example of a hair snag station in the Beaver River watershed.

Spatial detection model

The model considered that the ability to detect a bear when it was there (referred to as *detection*) could have varied:

- by session,
- over time,
- if bears either avoided all hair snag stations encountered (trap shyness) or visited them all (trap happiness), or
- if bears responded to a particular hair snag station by avoiding or favouring it (trap happy).

The aim is to consider this variation and find the model that best fits what we observed in the Beaver River watershed. We also examined male and females separately because their home range sizes differ. Results

Data summary and checks

The number of bears detected in each session increased over time for both black bears and grizzly bears and for both males and females (Table 1). Most grizzly bear males and females, and black bear females were detected more than once on the grid, but most male black bears were only detected once. The number of new black bears detected for each session was constant. For grizzly bears, the number of new female bears detected each session decreased noticeably through the summer which tells us we effectively sampled them.

Table 2. Summary data for black bears and grizzly bears surveyed with hair snags at Beaver River, Yukon in June–August 2020.

	Session							
	Females				**Males**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Black bears								
Number detected	6	17	22	24	12	14	15	22
New bears detected	6	13	13	9	12	10	11	7
Total individuals detected to date	6	19	32	41	12	22	33	40
Grizzly bears								
Number detected	12	15	19	19	11	11	12	18
New bears detected	12	10	3	1	11	6	4	6
Total individuals detected to date	12	22	25	26	11	17	21	27

Figure 3 (below) shows where bears were detected on the grid during all 4 sessions. If a bear was detected at more than one station, a line represents this bear's movement. Bear occurrences were evenly spread across the study area (Figure 3). The number of bears detected and the number of redetections (bears detected that had already been seen) are listed above each figure. For black bears, the number of individuals detected was greater than redetections; however, for grizzly bears the number of redetections outnumbered new individuals detected.

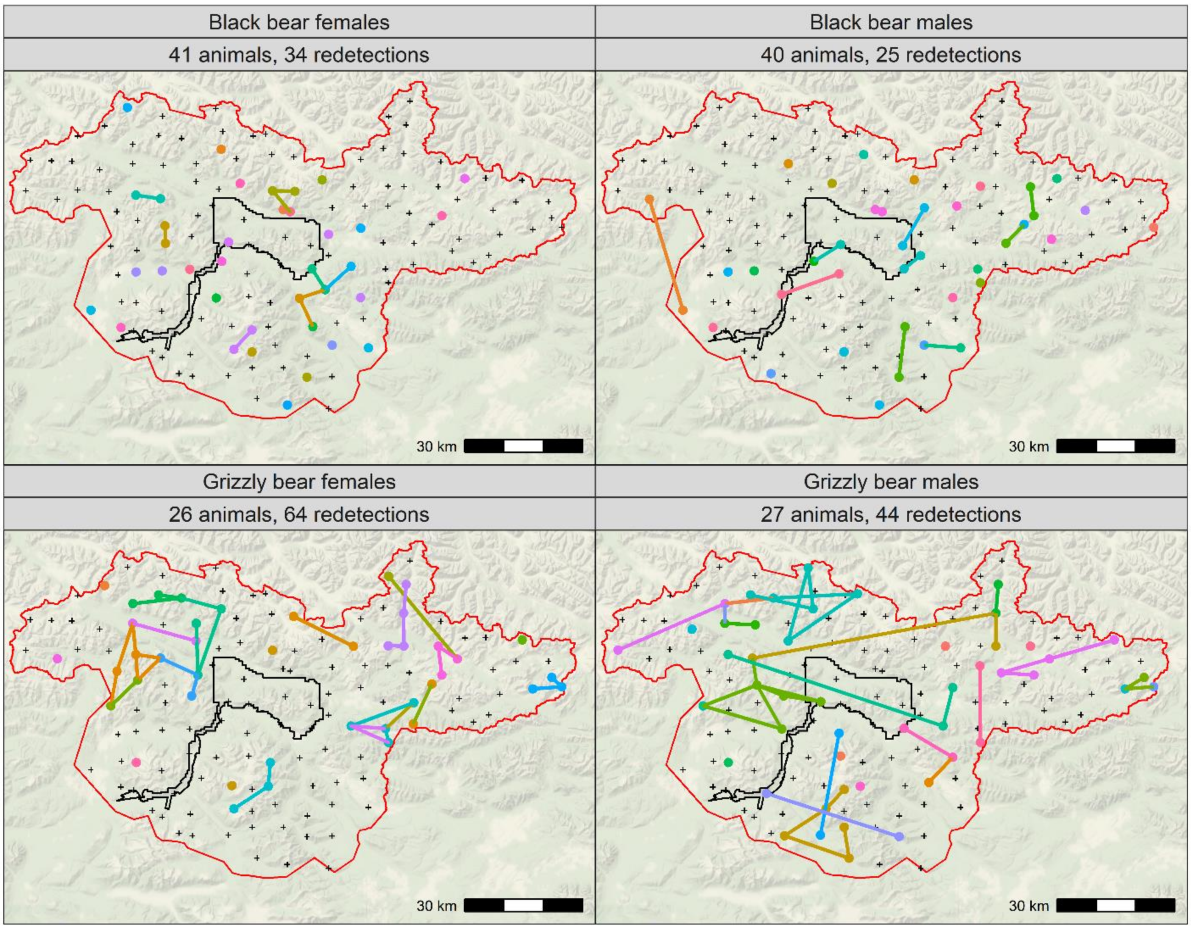

Fig. 3. Detections of black and grizzly bears at 138 hair snag stations in the Beaver River watershed. Hair snag stations are represented by a + symbol and are approximately 7 km apart. Individual bears are represented by different coloured points, and lines represent movements of bears that were detected at multiple stations. The Rackla Gold Project area and the proposed road are outlined in black.

Male grizzly bears made large movements across the study area, and this included movements across the Rackla Gold Project area (Figure 5). There were no grizzly bear detections within the Rackla Gold Project area. Male grizzly bears moved up to 60 km whereas females moved up to 20 km (Figure 4). In comparison, black bear movements were within the 10 km range for females, and within the 20 km range for males.

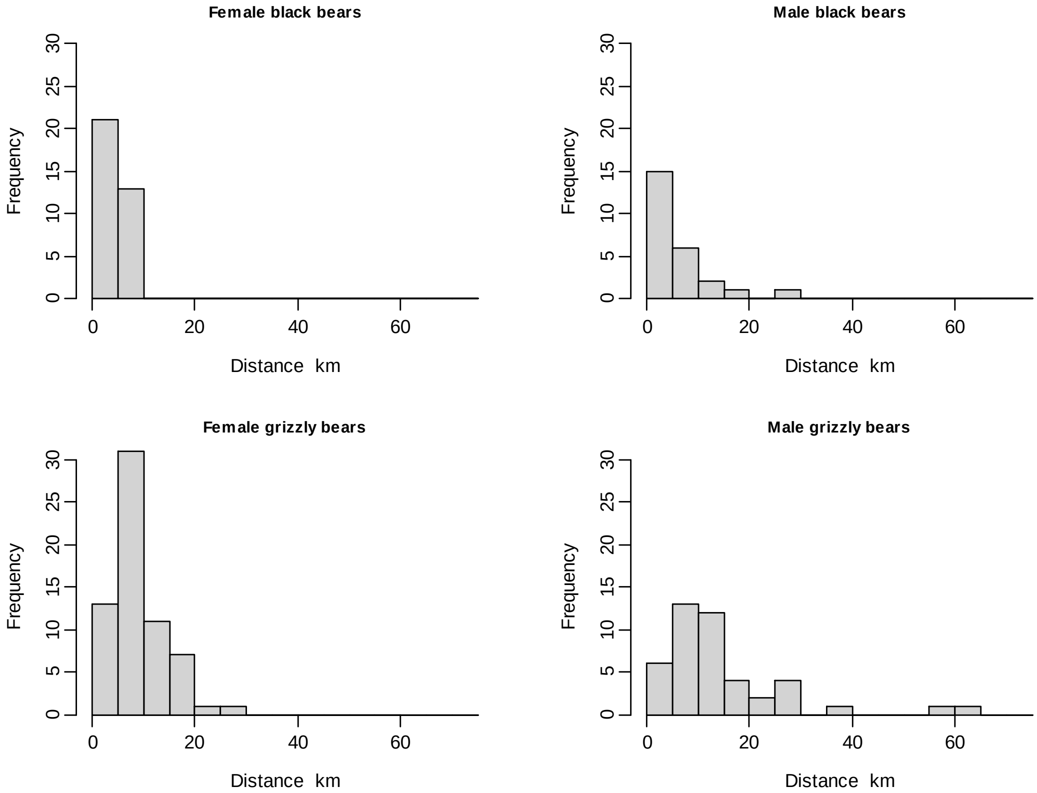

Fig. 4. The distance moved between consecutive locations, and the number of bears for each observed species and their sex.

Average detections for each species (Figure 5) suggests a higher number of black bears were present in the vicinity of the Rackla Gold Project.

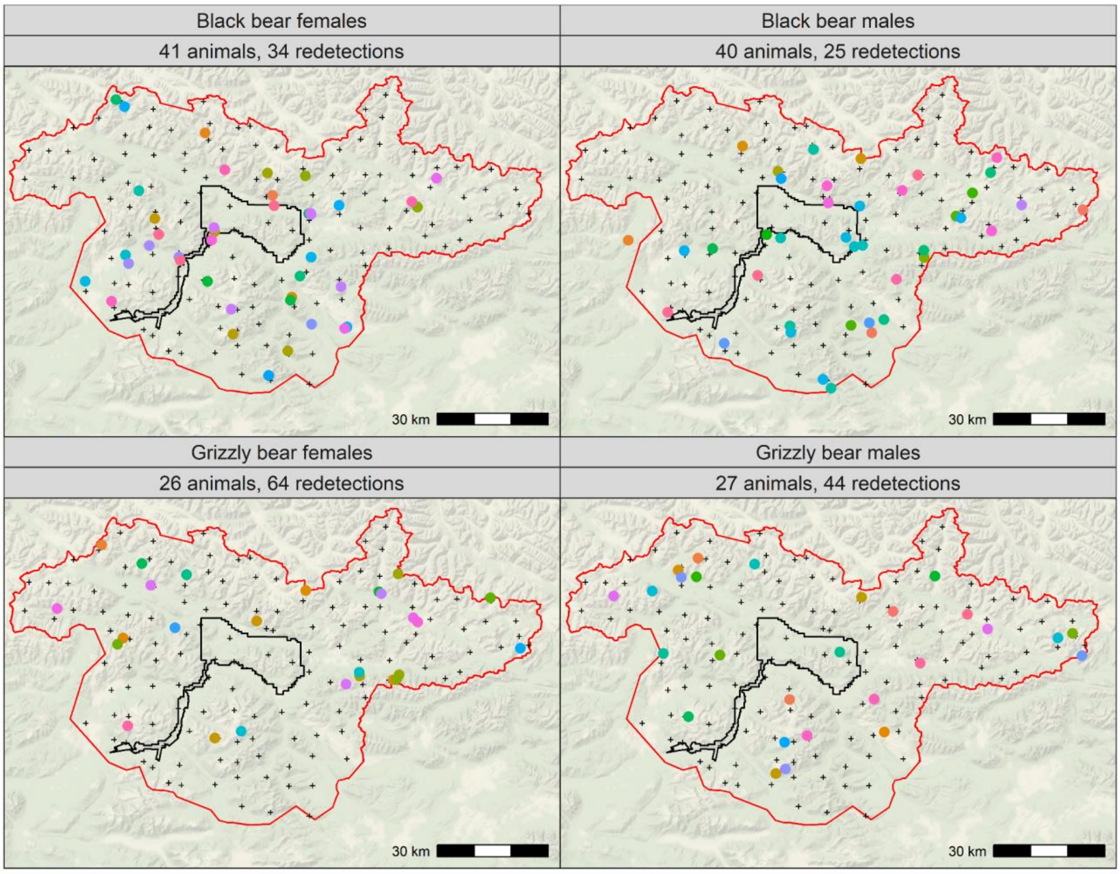

Fig. 5. Average detection locations of black and grizzly bears at 138 hair snag stations in the Beaver River watershed. Hair snag stations are represented by a + symbol and are approximately 7 km apart. Individual bears are represented by different coloured points. Points are staggered around hair snag sites to show multiple detections of individuals at a single site. The Rackla Gold Project area is shown by a black polygon. The number of individuals detected, and the number of redetections is also listed above each plot.

Spatial detection model

Many models were identified, tested, and ranked based on how they best represented the data. Models considered:

- how detectable a bear was at the centre of its home range,
- the distance over which a bear's detection changed, measured from the centre of its home range to its periphery. (The idea is that a bear is more likely to be detected at a hair snag station near the centre of its home range, and this ability decreases as hair snag stations become further from the centre),
- whether the bear was male or female,
- whether the bear was trap-happy or avoided traps,
- that bears may have different responses based on the individual,

- that detection may change over time, or in-between sessions (for example, bears may become more difficult or easier to detect over time, or detection may differ between sessions).

For both species, the strongest models:

- allowed for variation due to sex (whether it was male or female), including consideration of the differing distances for male and female home ranges.
- included consideration of how bears responded to a particular hair snag station by avoiding it or by visiting it many times (trap happy).

The strength of the learned response to traps (whether a bear avoided a site or was trap happy) was surprisingly large. Previous detections at a hair snag station increased the chances of a bear being detected by 9 times for black bear and 3.5 times for grizzly bear.

The best fit models were used to estimate how detection changed at increasing distance from a bear's home range centre (graphed in Figure 6). Grizzly bears operate at a larger spatial scale than black bears.

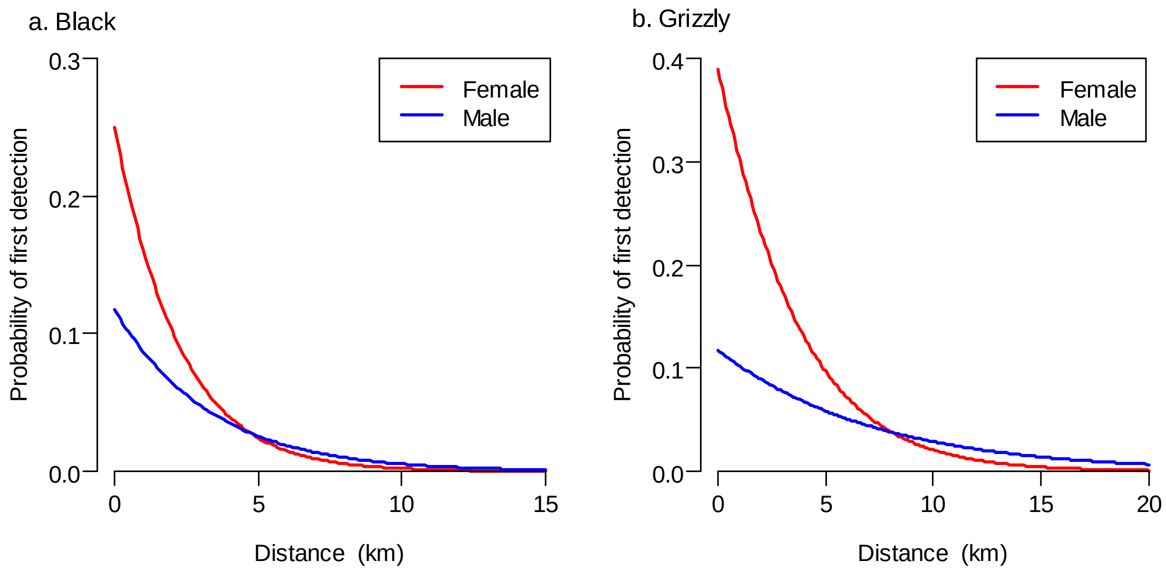

Fig. 6 Curves represent the probability of a bear being detected at a hair snag where it has not previously been detected at different distances from its home range centre.

Population density and proportions of males and females

More black bears were detected than grizzly bears, and the grizzly bears moved greater distances than black bears (Table 1 and Figures 3 and 4).

There are an estimated 25 black bears per 1,000 km^2 in the study area, and this means there are approximately 168 black bears that have home ranges centred in the study area (Table 2). The sex ratio for black bears was 50.6% female, nearly 50:50.

There are an estimated 6 grizzly bears per 1,000 km^2 in the study area, meaning there are approximately 41 grizzly bears that have home ranges centred in the study area (Table 3). The sex ratio for grizzly bears was 49.1% female, also nearly 50:50.

We associate a level of precision with each density estimate that is a measure of how confident we are about our estimates, given the variability in the data we collected. The precision of the density estimates should aim to be around 15%. For grizzly bears, the precision of the density estimate was 14.6%, and met the target value despite the low density of grizzly bears that exist in the study area. For black bears, the precision of the density estimate was larger at 19.8%. This is attributed to the underlying study design which employed distances for hair snag stations that were optimal for grizzly bears, but too large to acquire equally precise estimates for black bears.

Table 2. Estimated population density and sex ratio of black and grizzly bears in the Beaver River study area, Yukon, June–August 2020; 95% confidence intervals indicate the precision of estimates (based on our data, we are 95% confident that the actual density of bears was within this range).

	Black bears		**Grizzly bears**	
	Estimate (# bears/1,000 km^2)	**95 % Confidence Interval**	**Estimate (# bears/1,000 km^2)**	**95 % Confidence Interval**
Population density	25 bears	17.1–36.8	6 bears	4.45–7.92
Number bears centred in study area	168 bears	114–247	41 bears	31–54
Sex ratio (proportion of females) %	50.6 % female	39.9–61.3	49.1 % female	36.0–62.3

Discussion

Our estimated grizzly bear density of 6 bears / 1,000 km² in the Beaver River watershed is one of the lowest observed in areas south of the northern treeline. It is much lower than densities observed in interior British Columbia and for Alberta populations which were in the range of 19–49 bears / 1,000 km^2 in mountainous areas and 10–17 bears / 1,000 km^2 in lower elevation boreal plateau and boreal plains habitats. Grizzly bear density in the Beaver River watershed is also lower than those estimated for the Yukon Coastal Plains (~10–12 bears / 1,000 km^2), the Southern Lakes region of Yukon (10 bears per 1,000 km^2), and the Mackenzie Delta area of the Northwest Territories (10 bears per 1,000 km^2). It is, however, higher than the grizzly bear density estimate in the Kivalliq area of Nunavut (3.5 bears / 1,000 km^2).

Our estimate of grizzly bear density is much lower than previously established estimates that were based on expert opinion and are currently being used for management purposes. For example, within the area that overlaps the Beaver River watershed, expert opinion estimated grizzly bear densities to be 12.8 and 14.3 bears / 1,000 km^2 in what were formerly known as the Mayo Lake-Ross River and Wernecke Mountains ecoregions, respectively. Today, these areas would roughly correspond to the Yukon Plateau North and Mackenzie Mountains ecoregions. Such differences highlight the need for robust science-based population estimates across the Yukon landscape.

The current study is one of only a few that estimate densities for both grizzly bears and black bears at the northern edge of their range. Black bear density in the Beaver River watershed is estimated to be 25 bears / 1,000 km^2, approximately four times that of grizzly bears. This type of difference has been documented elsewhere. For example, black bear populations in interior Alaska have been estimated to range upward from 89 black bears / 1,000 km^2, and to be 3 times denser than those of grizzly bears in the surrounding areas (Susitna River Basin). In central-northern British Columbia, grizzly bear densities in the Parsnip plateau were estimated to be ~17 bears / 1,000 km^2 while black bear densities were 257 bears / 1,000 km^2. In the Parsnip mountains grizzly bear densities were slightly higher at 49 bears / 1,000 km^2 but still less than black bear densities which were determined to be 100 bears / 1,000 km^2. In general, black bears are more abundant where grizzly bears are in low densities or absent.

It has been suggested, when black bears exist at high densities on the landscape and their diet overlaps with grizzly bears, the competition can negatively affect grizzly bear populations. Adding to this competitive advantage, black bears also keep their cubs for a shorter duration than grizzly bears and use much smaller ranges than grizzly bears. Collectively these characteristics make them more productive than grizzly bears, and when grizzly bear populations are at low densities, competition with black bears could keep them from increasing.

The even sex ratio for grizzly and black bears in the Beaver River is not unusual. Population studies elsewhere (e.g., Glacier National Park) have also found even sex ratios.

Nevertheless, there are areas where sex ratios did differ. Previous grizzly bear population work in the Yukon noted slightly more females (61% and 54-55% in the Yukon Southern Lakes and North Slope regions). DNA mark-recapture population studies in Alberta also found areas where female grizzly bear densities were higher than those of males, and other areas where the opposite was observed.

Lastly, this study used wooden hair snag stations, which are widely used in northern regions because they are easy to set up in areas that do not have trees. During our first and second check sessions, we noticed signs that bears had visited sites but had not left hair samples. We have no way of knowing whether these bears were detected in other sessions or at other stations during the same session. Our analysis does not assume that all bears that visited sites were detected, so we do not believe that missed samples would lead to an underestimate of population size.