Project Report

1. **NWRT Project Number: 0000000014**

2. **Project title: Grizzly bear DNA mark-recapture sampling in the Kitikmeot region of Nunavut**

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Note: Results from all three years (2021, 2022 and 2023) analyses will be provided in the final report which is anticipated to be available in spring 2025.

Summary:

1. we explored potential designs to survey the larger Kitikmeot region to estimate the population density of barren ground grizzly bears in the Kitikmeot region of Nunavut using hair-snag posts to collect bear DNA. The area of interest broadly surrounds the calving grounds of the Bluenose East and Bathurst caribou herds. Part of the region was surveyed in 2008–09 by Dumond et al. (2015). The calving grounds of the Bluenose East caribou herd lie within the 2008–09 study area, and the calving grounds of the Bathurst herd lie to the east of that study area near Bathurst Inlet.
2. The new fieldwork was planned to update the earlier results and to sample the east of the region for the first time. We arbitrarily divided the western mainland portion of the Kitikmeot Region into 3 approximately equal-sized 'sectors' corresponding to sampling areas sampled in 2021, 2022 and 2023 (Fig 1).

3. We surveyed grizzly bears within the western mainland Kitikmeot Region in 2021 with the objectives of providing a more precise estimate of bear abundance and examining population trend since the previous estimate of 2008-2009 using DNA hair snagging methods. The 2021 survey used tripods rather than single posts, with tripods clustered in sub-grids instead of evenly dispersed. In 2021, we sampled a 38,795 km^2 core study area, and extrapolated abundance estimates to the 54,200 km^2 target management area, essentially the western third of the western mainland portion of the Kitikmeot Region, which encompassed most of the late spring and summer range of the Bluenose-East barren-ground caribou herd.

4. Overall population density of grizzly bears in 2021 (6.6 bears/1,000 km^2) was non-significantly higher than in 2008–2009 (5.6 bears/1,000 km^2; with overlapping confidence intervals [CI]), and the sex ratio appeared more female-biased than before (61% vs 54%, respectively). We estimated the population of grizzly bears in the target management area at 219 females (CI = 161–299) and 141 males (CI = 98–200).

5. We sampled 3 sub-grids in July/August 2022, across the larger regional study area, encompassing calving/post calving grounds of the Bluenose-East and Bathurst caribou herds. We collected 905 hair samples during the 3 sampling sessions. WGI excluded 7 samples (1%) as non-grizzly bear, 29 (3%) because of inadequate material, 103 (11%) hair samples based on our sub-selection rules (limiting the number of samples sent to WGI from each station), and 256 samples (28%) that failed multilocus genotyping. The 510 successful samples were assigned to 56 individual grizzly bears (30 F:26 M).

6. We sampled 3 sub-grids in July/August 2023 and the third year of the project is completed in August 2023. We collected 983 hair samples and submitted these samples for genetic testing to identify individual grizzly bears.

7. Given the very large scale of the project, results from all three years (2021, 2022 and 2023) analyses will be provided in the final report which is anticipated to be available in spring 2025.

Introduction:

Grizzly bears (*Ursus arctos*) are listed as a species of Special Concern in Canada under the Canadian *Species at Risk Act* (SARA) and are an important part of subsistence hunting by Inuit for economic, social and cultural purposes. Habitat fragmentation and loss due to development and anthropogenic mortality were considered the primary threats during the SARA listing process (COSEWIC 2012). While this is true for most parts of the species' Canadian range, the range fragmentation and habitat loss issues that affect southern or western grizzly bear populations may have limited application to barren-ground grizzly bear in Nunavut. Comparatively, barren-ground grizzly bears occupying central Arctic tundra roam over larger areas and experience relatively little contact with humans (McLoughlin et al. 2003a, 2003c; Jessen 2017) and directional climate change has been improving habitat for bears in Nunavut (McLoughlin and Stenhouse 2021). Local knowledge, harvest records and research indicate an increase in numbers and range expansion eastward and northward (Clark 2007, Dumond et al. 2015, Jessen 2017, Awan et al. 2019, Barrueto et al. 2023). There are limited baseline data on grizzly bear distribution and density within Nunavut, in part because of the cost and challenge of surveying bears at low densities in remote areas.

In the Kitikmeot Region, grizzly bears are harvested by Inuit for subsistence (domestic) use and to address 'problem' animals (i.e., defense of life and property), and by sport-hunters for trophies. There is no limit on the subsistence harvest, and sport hunts are regulated by quota for the region. In the late 1980s, a quota system was put in place for grizzly bears by the government of Northwest Territories (NWT), in both the Kitikmeot and Kivalliq regions. Each region was allocated 10 tags annually for sport hunts or the sale of hides. More recently, the Government of Nunavut (GN) determined that the current regulations required a decision from the Nunavut Wildlife Management Board (NWMB) in order to allow sport hunting tags to be issued in those same regions (GN 2017). In 2018 in the Kitikmeot Region, the NWMB set an annual quota of 10 grizzly bear tags for non-resident/non-resident foreigner sport hunts (Awan 2021). Based on an apparent increase in bear numbers, Kitikmeot communities requested an increase in sport hunt quotas. In 2019, the GN Department of Environment (ENV) accepted and implemented a NWMB decision to increase the grizzly bear sport-hunting limit in the Kitikmeot Region to 15 grizzly bear tags, with further evaluation once there is more information on grizzly bear population size.

Hunters from different Kitikmeot communities have reported an increase in grizzly bear-human conflicts, primarily property damage at cabins and meat caches (Awan 2021), and bear mortalities associated with mineral development projects. There was concern that most areas lacked current information on bear density, especially to assess the cumulative effects of various human-caused mortalities and increasing development on the land that may cause the grizzly bear population to decline in Nunavut. Barren-ground grizzly bears in the central Canadian Arctic have very large spatial requirements (McLoughlin et al. 2002) and later ages of maturation than elsewhere, making them susceptible to over-harvest given their overall low productivity and a slow recovery potential

(McLoughlin et al. 2003b, McLellan et al. 2017). Over the long term, with increasing development, and unregulated harvest, there may be cause for increased conservation concern.

Recent barren-ground caribou (*Rangifer tarandus groenlandicus*) calving ground surveys in the Kitikmeot Region have reported high numbers of grizzly bear sightings (GBWBMFWG 2021, Adamczewski 2022, Boulanger et al. 2022). Inuit hunters have suggested predation as a potential cause contributing to the current caribou decline (Kugluktuk Angoniatit Association 2019) and an increasing grizzly bear population has been identified as a threat to caribou recovery (GBWBMFWG 2021, Kugluktuk Angoniatit Association 2019). Sighting rates for grizzly bears recorded during calving ground surveys have consistently been high on the Bluenose-East calving ground (Poole et al. 2014, GBWBMFWG 2021). The decline of caribou herds throughout the central Arctic has led to management actions on caribou harvest and wolf (*Canis lupus*) (WRRB 2019, Nishi et al. 2020, NWMB 2020). Understanding of grizzly bear abundance and population dynamics and its potential impact on caribou populations is required for caribou management and to estimate grizzly bear harvest quotas in the western Kitikmeot Region.

The grizzly bear population in the western Kitikmeot Region was sampled intensively in 2008–2009 using a nearly uniform grid of posts for DNA hair sampling, resulting in an estimate of ~5.0 bears/1,000 km^2 (95% CI = 3.5–9.1 bears/1,000 km^2; Dumond et al. 2015). Re-analysis and modeling of the Dumond et al. (2015) data resulted in a revised but similar estimate of 5.6 bears/1,000 km^2 (95% CI = 4.5–7.0 bears/1,000 km^2). To examine grizzly bear population trend since 2008–2009 and to provide a more precise estimate of bear abundance within the Kitikmeot Region, we arbitrarily divided the western mainland portion of the Kitikmeot Region into 3 approximately equal-sized ‘sectors’ corresponding to sampling areas completed in 2021, 2022 and 2023 (Fig. 1). In collaboration with the Kugluktuk Angoniatit Association, we sampled hair in 2021 in the western sector using clusters of sampling stations and a different design for hair snagging. The central sector was samples in 2022 and eastern in 2023. We test the effectiveness of the revised sampling design to obtain a more precise estimate of bear abundance with lower sampling effort. The results of this study should also apply to other tundra grizzly bear studies that require density estimates.

Project Objectives:

- Conduct DNA inventory for larger area of the Kitikmeot region and estimate density across the regional study area
- To determine grizzly bear abundance, harvest rates, population trends, landscape use, and population structure
- Provide field work training, technology skills transfer and employment to Hunters and Trappers Organization (HTO) members and increase collaboration between government and resource users.

Materials and Methods:

Study area:

As an overall design for sampling grizzly bears, we arbitrarily divided the western mainland portion of the Kitikmeot Region into 3 approximately equal-sized 'sectors' corresponding to sampling areas completed in 2021, 2022 and in 2023 (Fig. 1). The 2021 study occurred in the 54,275 km^2 western sector, the approximately western one-third of the western mainland portion of the Kitikmeot Region which we defined as a target management area region of interest. The boundaries of the target management area were somewhat arbitrary except for the sea coast to the north, and extended into the NWT border to the southwest because of the layout of the sampling grid and alignment with sampling conducted in 2008–2009 (Dumond et al. 2015). This area roughly coincides with the calving, post-calving, and summer ranges of the Bluenose-East caribou herd (Nagy et al. 2011, Boulanger et al. 2022). The central was sampled in 2022 and eastern in 2023.

The study area was a mix of low and high Arctic landscape features from near tree line in the south to the coast in the north. Topography, vegetation, and climate are detailed in Dumond et al. (2015). Grizzly bears were typically active from the second half of April–early May (den emergence) to mid-late October (den entrance; McLoughlin et al. 2002).

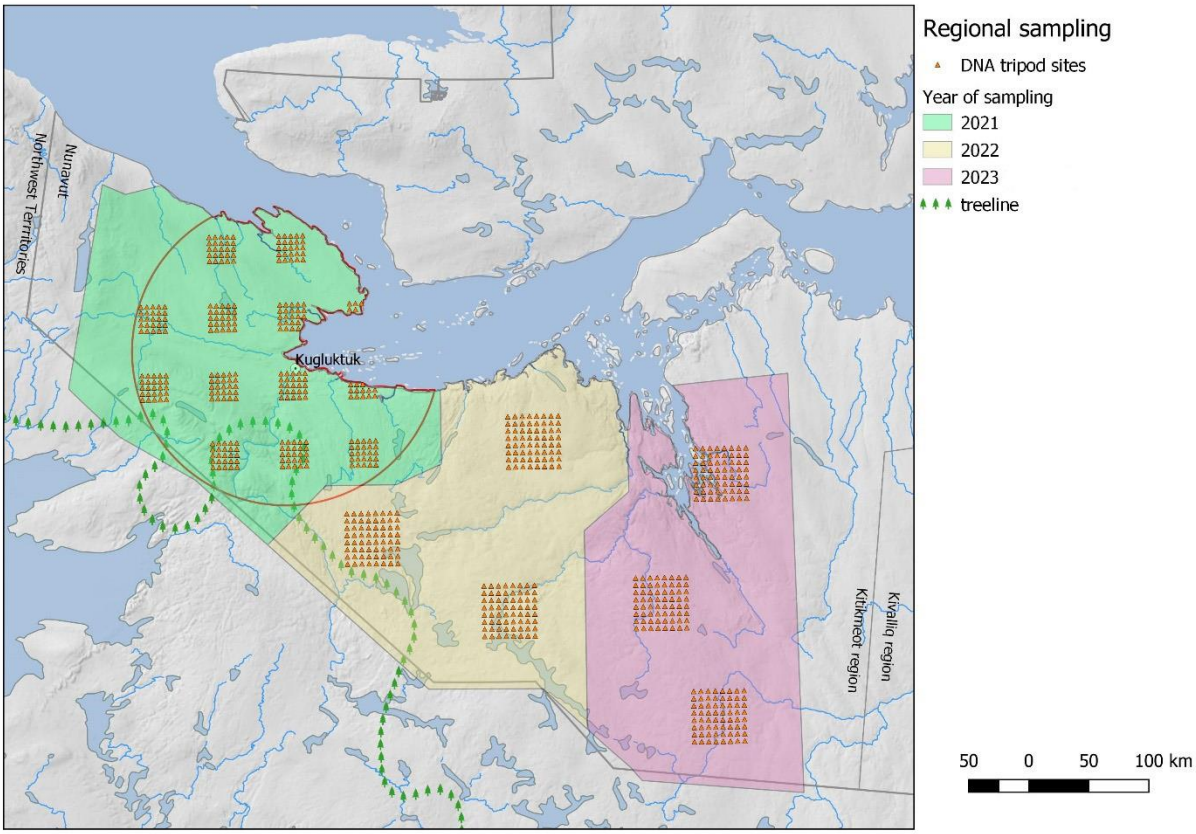

Figure 1. Division of Kitikmeot Region into sectors sampled for grizzly bears in 2021 (western; 54,200 km^2), 2022 (central; 51,500 km^2, and in 2023 (eastern; 50,800 km^2). Red crosses mark the used or proposed locations of hair snag stations (tripods). Straight edges to the west and south are the NWT/Nunavut border. Also shown is the border of the Kivalliq and Kitikmeot regions to the east.

Low densities of moose (*Alces alces*) and moderate densities of muskoxen (*Ovibos moschatus*) live year-round in the area. Smaller prey species included Arctic hare (*Lepus arcticus*), Arctic ground squirrels (*Spermophilus parryii*), voles and lemmings (Muridae), ptarmigan (*Lagopus* spp), and migratory bird species (Gau et al. 2002, L'Hérault et al. 2016). Carnivores in the area included wolf, Arctic fox (*Vulpes lagopus*), red fox (*V. vulpes*), wolverine (*Gulo gulo*), occasional reports of black bears (*U. americanus*) around tree line and rare occurrence of polar bears (*U. maritimus*) along the coast.

We deployed wooden tripods with their legs wrapped in barbed wire sub-grids within the study area. In 2021, each sub-grid nominally comprised 25 tripods at 5-km spacing and 2022 and 2023 sub-grid nominally comprised 64 tripods at 6-km spacing. We checked the stations 3 times at approximately 2-week intervals by helicopter between 21 July and 29 August 2021, 20222 and 2023.

We adapted the hair-snagging tripod design from earlier studies conducted on the Arctic tundra (Izok Lake – K. Poole, Aurora Wildlife Research, unpublished data and Boulanger 2013; Hope Bay – Rescan

2012), and updated methods of Awan et al. (2019). We developed a video to illustrate the methodology (https://www.youtube.com/watch?v=uZ5FEFVrMas). Each tripod comprised of six 2" x 4" pieces of rough lumber 5' 3" (160 cm) in length and secured at the corners with 3/16th (0.47 cm) aircraft cable. We wrapped the 3 upright 2" x 4" legs with double-stranded 15 gauge high-tensile 5" (13 cm) barb-spacing barbed wire to trap hairs from grizzly bear interacting with the tripod. Tripod materials were prepared prior to deployment in Kugluktuk (barbed wire wrapping, cutting aircraft cable and felt, etc.) and Cambridge Bay and shuttled by snowmobile to the sampling grids by Kugluktuk hunters in 2021 and 2022. We assembled the tripods in the grid cells using a Bell 206B-LR helicopter for transportation (Fig. 2).

Figure 2. Tripod deployment and check on the sub-grids, western Kitikmeot Region.

We placed non–reward commercial trapping lures (Long Distance Call and Beaver Castor; O'Gorman Lures, Montana, USA) on a piece of felt attached to the top of the tripod and poured ~200 ml commercial fish oil (Forsyth Lures, Alix, AB) on top to attract the bears. We recorded the GPS position of each tripod. During the sampling, we collected all visible hairs with forceps from the tripod and from the surrounding ground. We cleaned the barbed wire using a propane torch to burn any remaining hair and moved the tripod about 10 m to avoid cross-contamination between sessions. We installed a fresh set of lures after every check. We air-dried collected hairs in labelled (station number, tripod leg and date) individual paper envelopes and stored them at room temperature. We recorded the number of caribou, muskoxen, and other species sighted or wildlife signs observed during the tripod set-up and checks and while flying between tripods.

Genotyping

Analysis of microsatellite DNA allows individuals to be identified from hair (from remote hair snagging) and tissue (from harvested bears). Hair and tissue samples were genotyped and assigned individual identities by Wildlife Genetics International (WGI; Nelson, BC) using 8 microsatellite markers and a sex marker, and passed through 3 phases of scrutiny: first pass, cleanup and error-check. Potential genotyping errors were rigorously checked as described by Paetkau (2003, 2004).

From the hair samples we analyzed up to 2 samples per tripod leg (X, Y, Z), plus up to 2 from the ground per session/tripod. If the maximum of 8 samples was not reached, we selected up to 2 additional samples (e.g., from the ground or tripod top). We conducted 2 rounds of extraction. In the first round we used a stringent quality threshold as used in other barren-ground grizzly projects (Awan et al. 2019), limiting analysis to samples with 30 underfur or ≥2 guard hair roots. In the second round we revisited collection events from which no sample had yet been extracted, or from which all samples from the first round of extraction had failed the first pass of genotyping. We purified DNA from the remaining samples using QIAGEN DNeasy Blood and Tissue kits with the tissue protocol. We preferentially used 10 clipped guard hair roots, as available, or 30 whole underfur hair if needed to supplement the available guard hairs.

Project Schedule:

Project: Grizzly bear DNA mark-recapture sampling in the Kitikmeot region of Nunavut of density and trend for grizzly bears in the Western Kitikmeot using DNA mark-recapture methods.			
Output or Step	Start Date	End Date	Person days
study design	completed	completed	-
Community consultations, Wildlife Research Permit Applications	completed	completed	15
Order fuel, wood posts, barb wire and shipping	Completed	Completed	-
Fuel and wood posts caching	completed	completed	10
Collection of samples from harvested animals			On Going
Hair snare posts set up on the land	completed	completed	22
Check Grizzly bear posts (3 checks)	completed	completed	60
Hair samples DNA analysis	Nov 2022	Mar 2023	100
Fuel drum cleaning	Feb 2023	Mar 2023	20
Genetic results and preliminary analysis of the data	Apr 2024	Sep 2024	40
Data analysis, reports, communication to co-management partners	Nov 2024	Sep 2025	100

Preliminary results/discussion:

Overall population density of grizzly bears in the western sector in 2021 (6.6 bears/1,000 km^2) was non-significantly higher than in 2008–2009 (5.6 bears/1,000 km^2; with overlapping confidence intervals [CI]), and the sex ratio appeared more female-biased than before (61% vs 54%, respectively). The 2021 sampling results are detailed in Awan et al. (2023).

In 2022, we sampled 3 sub-grids across the larger regional study area, encompassing calving/post calving grounds of the Bluenose-East and Bathurst caribou herds (Fig 1). We collected 905 hair samples during the 3 sampling sessions. WGI excluded 7 samples (1%) as non-grizzly bear, 29 (3%) because of inadequate material, 103 (11%) hair samples based on our sub-selection rules (limiting the number of

samples sent to WGI from each station), and 256 samples (28%) that failed multilocus genotyping. The 510 successful samples were assigned to 56 individual grizzly bears (30 F:26 M).

In 2023 field season, we sampled 3 sub-grids in the Goose Lake, George Lake and Bathurst Inlet area and a total of 983 grizzly bear hair samples were collected at the posts and submitted to Wildlife Genetics International (WGI), Nelson, BC for individual grizzly bear identification. Given the very large scale of the project, results from all three years (2021, 2022 and 2023) analyses will be provided in the final report which is anticipated to be available in spring 2025.

Reporting to Communities/resource users:

Final report of the first-year survey (2021) was shared with the co-management partners in July 2023. Results of the 2021 sampling and update of the 2022 sampling was provided to KrWB in fall 2022 and 2023 sampling update was presented to Kugluktuk HTO in Aug 2023.

Field Team:

Malik Awan	GN ENV
Jonathan Niptanatiak	Kugluktuk HTO member
Perry Klengenberg	Kugluktuk HTO member
John Franklin Kaodloak	Kugluktuk HTO member
Eustace Kadlun	Kugluktuk HTO member

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