Yukon

Results of a 2022 aerial survey of wolves (*Canis lupus*) in the Coast Mountains

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Government of Yukon
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Authors
Peter Knamiller, Treharne Drury, and Thomas S. Jung

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

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Summary

- There is general interest in knowing the population status of wolves (*Canis lupus*) in much of the Yukon given their intrinsic value and their role as the primary predator of ungulates, such as moose (*Alces americanus*) and caribou (*Rangifer tarandus*).
- In February 2022, we conducted an aerial wolf survey in an 8,884 km^2 study area in the Coast Mountains. The aim of our survey was to update the estimated population size and density of wolves in the area, and to assess population trends using both new survey results and information from similar surveys conducted in 2004 and 2009.
- Aerial snow tracking methods were used to find and follow wolf tracks and to estimate the number and size of wolf packs in the study area. A small sample of GPS-collared wolves enabled us to evaluate if our estimates based on snow tracking were accurate.
- Survey conditions were often challenging with high winds effecting the quality of the snow for aerial tracking. The survey was often delayed due to poor conditions. As a result, our search intensity was lower than in 2009, but comparable to that in 2004.
- We found 10 resident packs in the study area, with an average pack size of 5.5 wolves per pack. The population size of wolves in the study area was estimated as 60 animals (range = 57-63), which included an adjustment to account for lone wolves.
- Our confidence in the survey results is quite high because we were able to locate and visually observe most of the packs encountered and count the number of wolves in each pack. We do not believe that we missed any wolf packs during the survey.
- Wolf density was 6.7 wolves per 1,000 km^2, which is lower than the Yukon-wide average of 7.7 wolves per 1,000 km^2. Pack density was 1.13 packs per 1,000 km^2, which is slightly higher than the Yukon-wide average of 1.07 packs per 1,000 km^2. The difference being that the number of wolves per pack were slightly smaller in our study area than the Yukon average (5.5 versus 6.4 wolves per pack, respectively).
- Changes in study area boundaries and survey methodology make it challenging to come to strong conclusions on changes in the abundance of wolves in the Coast Mountains over time. However, the best available information indicates that the wolf population in the Coast Mountains study area has remained stable over the last 18 years, ranging from 49 to 64 wolves, which is likely within the range of natural annual variation.

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Introduction

Wolves (*Canis lupus*) are of intrinsic value to many Yukoners. They are also the chief predator of moose (*Alces americanus*) and caribou (*Rangifer tarandus*) across the territory. As such, there is explicit interest in knowing wolf population sizes and trends, as well as if they are causing declines in the abundance of their main prey (Government of Yukon 2012, Southern Lakes Wildlife Coordinating Committee 2012). In response to this interest, the Government of Yukon periodically conducts wolf surveys to assess the local abundance of wolves and, over time, changes in abundance. This information is valuable for informing adaptive management of wolves, their prey, and hunting (Government of Yukon 2012).

Caribou have been the focus of intensive, community-based recovery efforts in the Southern Lakes region since the mid 1990s (Southern Lakes Wildlife Coordinating Committee 2012). These efforts had resulted in substantial recovery of local caribou populations; however, at the same time, moose populations were in decline (Baer 2010, Jessup et al. 2014). Relative changes in the abundance of caribou and moose in the Coast Mountains led to concerns by local residents regarding the response of wolves to changes in their prey, and if this complex moose-caribou-wolf relationship had also changed.

As such, in 2019, a three-year wolf study began to assess the relative importance of caribou and moose in the diet of wolves in the Coast Mountains, as well as to provide a new estimate of the number of wolves in the area. Here, we focus on the results of an aerial survey conducted in winter 2022 to estimate the abundance, density, and distribution of wolves in a study area in the Coast Mountains. The diet component was previously reported (Government of Yukon 2023)

This is not the first survey of wolves in the Coast Mountains by the Government of Yukon. Four previous wolf surveys occurred in the area, specifically in 1983, 1988, 2004, and 2009. Wolf surveys conducted in 1983 and 1988 were part of the Coast Mountain wolf control program. At that time, the study objectives were to evaluate the effects of a three-year aerial wolf control program on wolf numbers and their primary food source, moose (Hayes et al. 1991). Lethal wolf control occurred between 1983 and 1985. During which, it was estimated that 60–80% of the wolf population was removed. However, in 1988, after a three-year recovery period, it was found that wolf populations had recovered to 11% below pre-control estimates in 1983 (Hayes et al. 1991). Subsequent surveys in 2004 and 2009 reported a decline in wolves in the study area (Baer 2004, 2010), which have been attributed to a smaller moose population (Jessup et al. 2014). Thus, an ancillary objective of this survey was to assess changes in the wolf population size to previous surveys conducted in the same general study area.

Methods

Study Area

Our study area included parts of the Traditional Territories of five First Nations, including those of Carcross/Tagish, Kwanlin Dün, Ta'an Kwäch'än, Taku River Tlingit, and Champagne and Aishihik. We surveyed 8,884 km^2 of the Coast Mountain range, an area bounded by Kusawa Lake in the west, the Alaska Highway to the north, Marsh and Little Atlin lakes in the east, and the Yukon/British Columbia border to the south (Figure 1). The 2022 survey area was the same as that used for the 2009 survey by Baer (2010) to allow for a direct comparison. However, it was slightly smaller than that used in 2004 (Baer 2004) and larger than that used in 1983 and 1988 (Hayes et al. 1991).

The study area was in the Coast Mountain ecoregion, which was characterized by deep valleys and rugged mountains. There was a decrease in elevation in the northern part of the study area, compared to the south. Trees included white spruce (*Picea glauca*), black spruce (*Picea mariana*), lodgepole pine (*Pinus contorta*), trembling aspen (*Populus tremuloides*), and balsam poplar (*Populus balsamifera*). The ecoregion also contains the Southern Lakes complex, which is a group of large, interconnected lakes, transecting the study area. In winter, these lakes provide important movement corridors for wolves and in summer serve as potential home range borders. Snow above the treeline was consolidated by wind and temperature fluctuations, and alpine ridges were typically blown free of snow throughout the winter. In forested valleys, snow depth ranged from 20–70 cm (Hayes et al. 1991).

Moose, caribou, and thinhorn sheep (*Ovis dalli*) were distributed in most of the study area. Moose densities were lower west of the Alaska and Atlin highways (approximately 158 moose per 1,000 km^2) than east of the highways (280–300 moose per 1,000 km^2; Taylor et al. 2011, Clarke et al. 2013, Jessup et al. 2014). Caribou populations in the study area included the Ibex and Carcross herds, but population estimates at the herd-level are not available. However, for all four herds in the Southern Lake area (Ibex, Carcross, Laberge, and Atlin herds), abundance was recently reported to be approximately 4,000 caribou (Southern Lakes Caribou Recovery Program 2022).

Aerial Survey

Similar to the last wolf survey conducted in the Coast Mountains by Baer (2010), we used a minimum count aerial snow tracking method. This method aimed to identify each wolf pack in the study area and then count the number of members of each pack. A pack was considered any group of two or more wolves.

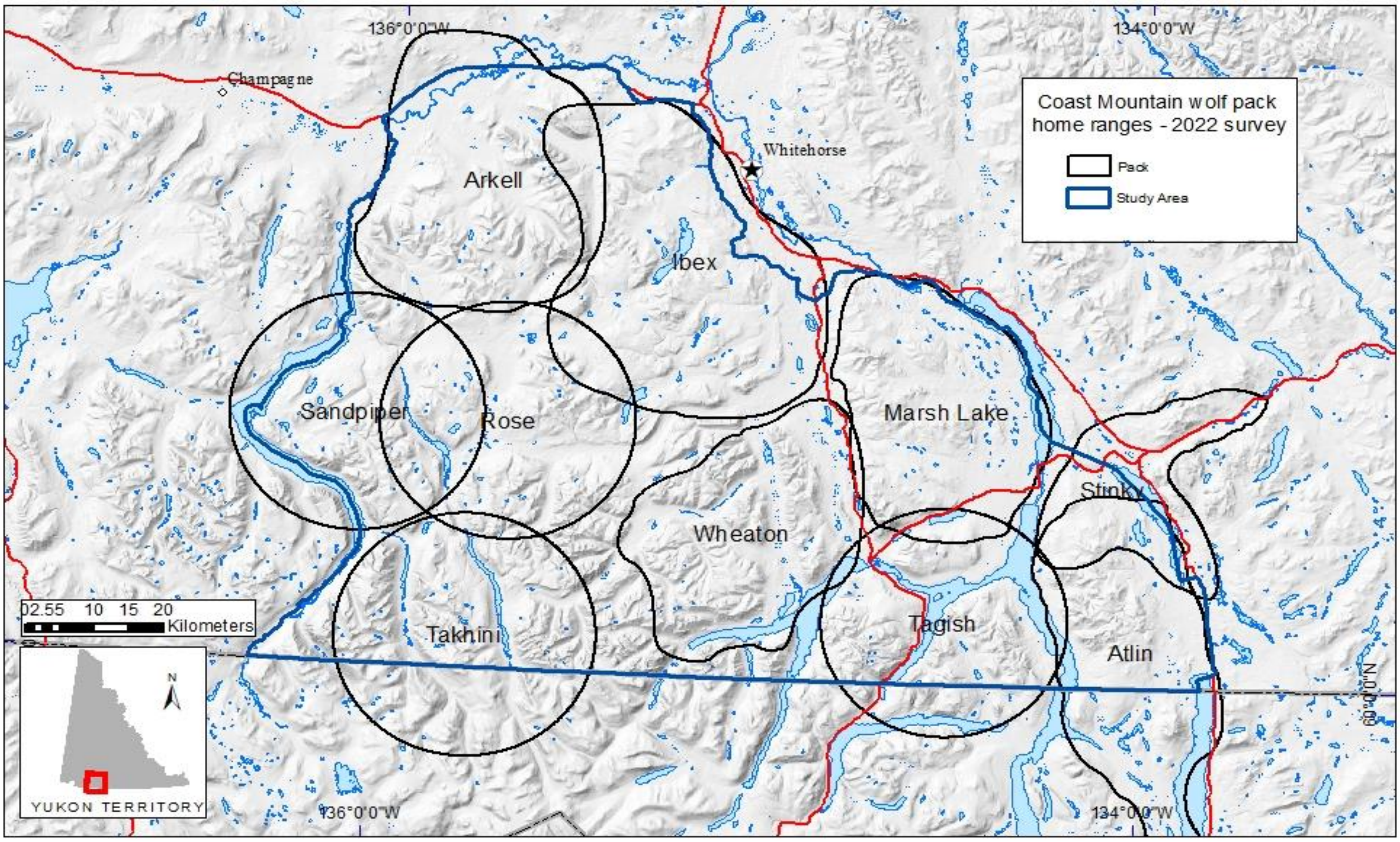

Figure 1. Location, names, and home ranges of wolf (*Canis lupus*) packs in the Coast Mountains identified during an aerial survey during February 2022. Circular home ranges indicate generalized, theoretical pack boundaries to represent 1,000 km^2. Noncircular home ranges (Arkell, Ibex, Marsh Lake, Stinky and Atlin) are derived from GPS collar data. Collared packs were collared for >1 year except for the Wheaton pack, which was collared for 10 months. Collars were active from Dec 2019 to Aug 2022.

Between 8-25 February 2022, we used a Bell 206 JetRanger to fly loose transects to locate wolf tracks in the snow. The crew consisted of a pilot, a navigator seated beside the pilot, as well as two observers in the rear. This is different from the four previous wolf surveys conducted in the Coast Mountains, which were done in a small, single engine aircraft with a crew consisting of only the pilot and a navigator (Hayes et al. 1991, Baer 2004, 2010). A helicopter was used in our study to increase our ability to locate wolves by being able to fly much lower and slower; thus, enhancing our ability to locate, follow, and count and classify individual wolves, especially in areas with dense forest cover. Moreover, the helicopter permitted two additional observers compared to the small airplane used in previous surveys in our study area which carried only the pilot and navigator.

Our crew consisted of a community observer, when available, as well as a minimum of two biologists with experience identifying wolf tracks in the snow from a helicopter, and experience tracking wolves from the air. The navigator had extensive experience tracking wolves in varied environments.

Flight lines focused on habitats with a high probability of intersecting wolf tracks, including lower elevation valleys, lakes, wetlands, frozen river courses and snow machine trails. Ridgelines were also searched, but only after a fresh snowfall and before winds diminished snow conditions for tracking. Normally, tracking wolves is done three days after a 5–10 cm snowfall. This allowed time for wolves to create enough tracks to enable detection by surveyors when flying over an area. However, high winds that blew away the snow were common in the Coast Mountains. Therefore, we began our surveys two days after an adequate snowfall. If tracks were not found, we returned to the area after an additional snowfall. If challenging tracking conditions persisted, we made a third and final attempt to resurvey the area once conditions improved.

During our survey, wolf tracks were followed until the tracks were lost due to extensive forest cover, rocky terrain, or drifting snow. Tracks were followed both forward and backwards to gain the greatest information on the extent of the pack's movements. If the majority (>50%) of a pack’s track fell within the study boundaries it was included in the final wolf population estimate. Conversely, if >50% of the tracks were outside the study boundary, the pack was excluded from the final estimate. Additionally, because wolf pack home ranges are unknown, the more understanding we had pertaining to the extent of the pack's movements, the better we were at assessing the home range size for each pack. Additionally, knowing the full extent of each pack's tracks reduced the chance of double counting. For example, if wolf tracks were only tracked forward (following the animals), surveys on different days could locate the same track, but at an earlier stage of the segment.

Survey flight paths were recorded on an iPad, using the Avenza Map App, and as a backup on a handheld GPS unit. Once discovered, we recorded wolf tracks by marking the tracks every 200 m. Wolf tracks and visual observations were recorded as waypoints. Additionally, when we encountered a pack, we recorded the colour of each wolf (grey, black, or white). Colour composition of pack members can assist in distinguishing individual packs, helping to reduce the chances of double counting packs or individuals in a pack.

Wolf packs typically travel in single file when in deep snow. Once they encounter shallow snow they tend to spread out, each on a single trail. These “trail splits” are used to establish pack size during the minimum count surveys (Figure 2; Baer 2010). Sometimes, if the surveyors are lucky, they encounter the pack and can directly count the animals.

As part of the larger Southern Lakes Wolf study (2019–2022; Government of Yukon 2023), 13 GPS satellite collars were deployed among wolves in seven packs. Home ranges for six of these packs fell within our survey area. At the time of the survey, three packs remained actively collared. We conducted the aerial survey independent of the collar data; however, in two cases involving collared wolves, we could only determine pack size based on tracks due to poor tracking conditions. Therefore, we used radio telemetry to relocate the packs and count the number of animals observed to confirm our estimate based on track splitting.

Figure 2. Photograph of wolf (*Canis lupus*) "trail splits". Photo by A. Baer.

Estimating Population Size and Density

We estimated the number of wolves in the study area by calculating the total number of wolves among the resident packs. To do so, we used two values from the survey: the number of packs in the study area, and the number of wolves in each of the packs.

To establish a minimum count for each pack we used counts of wolves from clear splitting of tracks or visually observing animals. As such, minimum estimates were objective. Additionally, we also determined a "maximum" estimate based on “trail splits,” where incomplete splits occurred because two or three animals were using one of the observed split trails. These were often subjective. Maximum counts were also obtained when we could confirm the entire wolf pack was present. This typically occurred only in open landscapes. The size of each pack was then derived by using the midpoint of the minimum and maximum number of individuals in each pack.

Once we completed the aerial survey, we used data from GPS-collared wolves (n = 6 packs) to assign home ranges to the packs identified during the aerial survey. For areas where wolves were not collared, tracks and packs observed are assigned theoretical home ranges based on the average home range size of Yukon packs (1,000 km^2; see Figure 1).

We summed the individual pack sizes to estimate the number of wolves in the study area. Added to this value was a correction factor for lone wolves, which we did not track during the aerial survey because they are not territory holders. Following previous surveys, we added 10% to the estimated population size to account for lone wolves (Baer 2010).

We calculated the density of wolves in the study area by dividing the estimated population size by the size of the study area. Similarly, we calculated the density of wolf packs in the study area by dividing the number of packs by the study area.

To evaluate trends over time, we compared the estimated population size, wolf density, and pack density with those calculated from similar surveys done in 1983, 1988 (Hayes et al. 1991), 2004 (Baer 2004), and 2009 (Baer 2010).

Results and Discussion

Survey Effort and Conditions

It took eight days of field effort between 8-25 February 2025 to complete the aerial survey. A total of 44 hours of helicopter time were flown, of which 35.7 hours were while actively surveying for wolves, and the rest was ferrying to and from Whitehorse or fuel caches. We generally surveyed for 4–6 hours per day (Appendix 1). Ground coverage was 248 km^2 per hour (Figure 3), which is slightly less thorough than the wolf survey average in the Yukon of 270 km^2 per hour. A First Nation or other community member was part of the tracking team on each day we conducted a survey.

Due to weather conditions that were not optimal for an aerial wolf survey (e.g., old snow, high winds, poor light, etc.), our survey was delayed several times (Appendix 1). For instance, on 4–5 February there was a fresh snowfall of 10–15 cm; however, this was proceeded by three days of high winds, which delayed the start until 8 February. We found good tracking conditions at lower elevations that day, but at higher elevations significant wind resulted in poor survey conditions. On 11 February, high winds again resulted in blowing snow, diminishing our ability to track wolves, halting our survey. From 21–25 February, we had a stretch were most days provided adequate survey conditions and we completed our survey.

We found that our ability to detect wolves or follow and count their tracks in helicopter with multiple observers, was likely increased compared to had we used an airplane with one observer, like in previous surveys (Hayes et al. 1991, Baer 2004, 2010). The use of four surveyors was advantageous, it allowed for three observers and a data recorder. This contrasts with an airplane, which only allows for one observer and a data recorder. In addition, much of the study area was mountainous, rugged terrain. Unpredictable weather, extreme wind events, and poor snow tracking conditions, made for challenging flying and resulted in survey delays. These are common conditions associated with aerial surveys, making a helicopter a much more effective and safer platform for conducting aerial surveys of wolves and other large mammals in the Yukon's mountains (Smits et al. 1994).

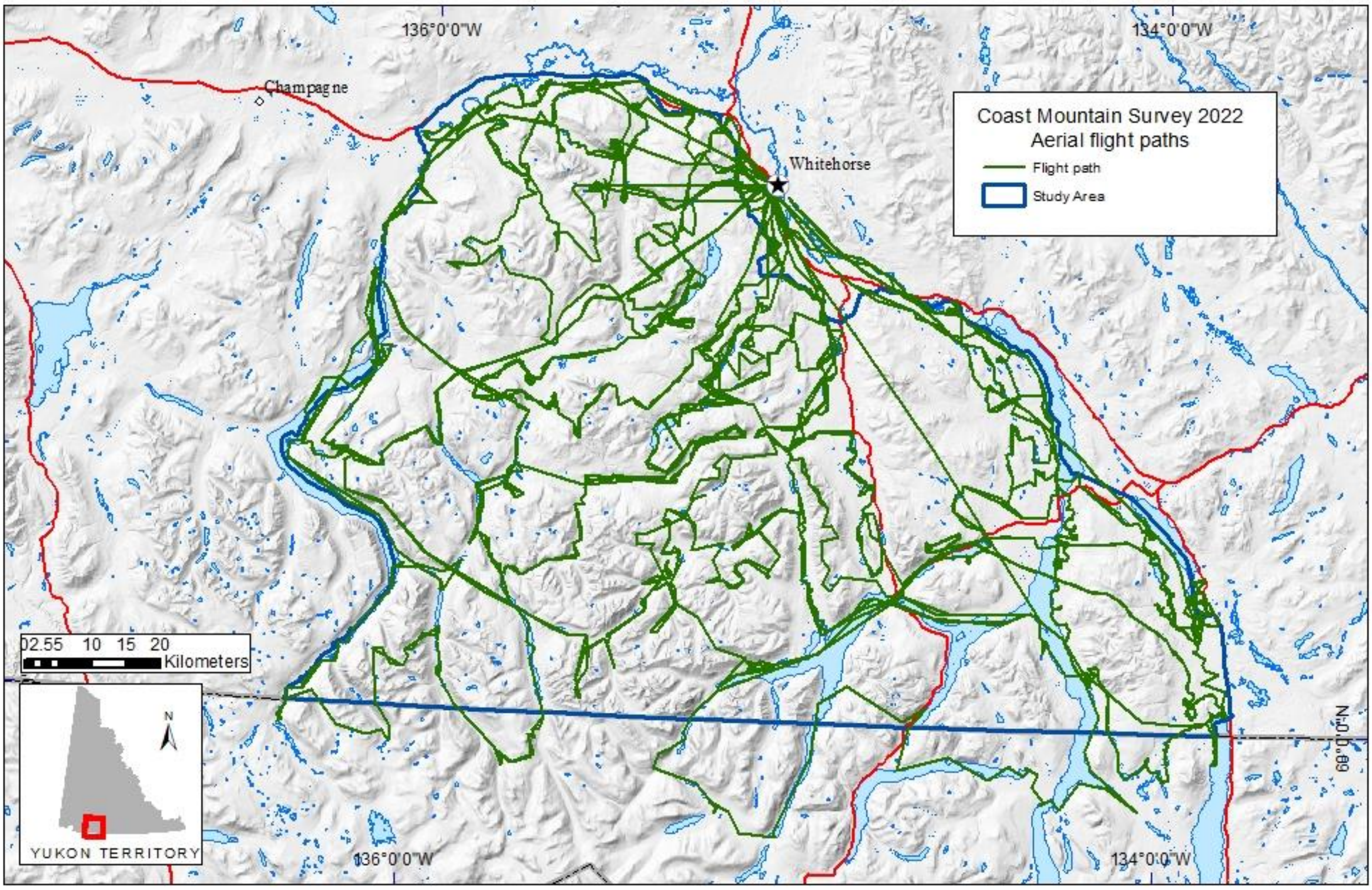

Figure 3. Flight paths from an aerial survey of wolves (*Canis lupus*) in the Coast Mountains during February 2022.

Estimated Population Size and Density

We located 10 wolf packs in the study area, which resulted in an estimated population size of 52 to 57 wolves (Table 1). However, to account for lone wolves we added 10% to this estimate, resulting in an adjusted wolf population size estimate of 60 animals (range = 57.2 to 62.7) in our study area.

Using a population estimate of 60 wolves in our study area, we calculated the wolf density as 6.7 per 1,000 km^2, (range = 6.4 – 7.1) which is below the Yukon average of 7.7 per 1,000 km^2. Pack density was calculated as 1.13 per 1,000 km^2, which is similar to the Yukon average of 1.07 per 1,000 km^2 (Table 2).

Table 1. Estimated number of wolves (*Canis lupus*) in each pack observed in the Coast Mountain study area during February 2020.

Wolf Pack	Minimum size	Maximum size	Observation Type*
Little Atlin	5	8	T
Rose Pack	3	3	T,V
Kusawa	8	9	T,V
Ibex	3	3+	T,V
Arkell	8	8	T,V,C
Marsh Lake	6	6	T,V,C
Sandpiper	4	4	T,V
Wheaton	7	7	T,V
Tagish	5	5	T,V
Stinky	3	4	T,V
Totals	**52**	**57**	

* V – Visual, T – track sign, C – collar assisted observation

Confidence in Estimates

We obtained visual observations for 9 of 10 packs we tracked (Table 1), and we were confident that we obtained precise total counts for six of these. For three we were less certain and therefore, a range was given. In these cases, the range was based on a combination of wolves seen and counts of their tracks. For one pack (Little Atlin) we were unable to observe the members, so a range estimate was made based solely on track splits.

Given above, we had a high sighting rate (90%) compared to previous surveys in the Coast Mountains, where 30–44% of the packs were observed (Table 2). Observing wolves, and knowing their pelt colours, improved our confidence in our estimate because it helped us distinguish packs and between pack territories. Moreover, GPS-collared animals from six packs assisted in assigning home ranges to all the packs and their tracks across the landscape. Assigning theoretical home ranges to packs with no collared animals, resulted in the complete detection of wolf home ranges across the study area, with no voids. We felt confident that no wolf packs were missed or double counted.

The high observation rate (90%) is attributed to several factors. First, some observers had worked on collaring wolves in the same area (Government of Yukon 2022). Knowledge gleaned from collaring operations was internalized by the observers. Knowledge of wolves' home ranges and their travel corridors and core use areas gave us an advantage. Secondly, having skilled observers, including an experienced pilot, helped with track detection, keeping on their tracks in the snow, and, ultimately, finding and counting wolves. Thirdly, we were fortunate to occasionally have excellent tracking conditions. The benefit of good snow and light conditions for aerial tracking wildlife in winter cannot be over emphasized.

That said, in two cases (the Arkell and Marsh Lake packs) we were unable to follow tracks due to poor snow conditions and only partial track counts could be made. To overcome this, we returned later the same day and used radio tracking to relocate the packs to obtain visual confirmation. We found that the size of both packs based on visually observing animals (Arkell = 8 wolves; Marsh Lake = 6) fell within the range we estimated using track counts alone (Arkell = 7–9 wolves; Marsh Lake = 6–7).

Although our confidence was high, it is worth noting when estimating the number of wolves in the Ibex pack we were less certain that all animals were observed. The Ibex pack was located near the Whitehorse landfill. As such, there were many tracks, making it a challenge to be certain we saw all wolves. We did attempt to follow the freshest tracks, which led us to three wolves found in dense forest. When last observed in March 2021, the Ibex pack consisted of seven wolves. (Table 2). As such, we may have missed some wolves. We attempted to relocate this pack on a subsequent day but were unsuccessful.

We located the tracks of two packs that were considered outside of the study area. They moved in-and-out of our study area, so we did not consider them resident and include them in our estimates. Specifically, a pack of three were located along the northern part of the study area. A second pack was just outside the southern boundary of our study, near Partridge Lake. After following tracks, we assessed these packs as being peripheral to our study area.

Finally, our survey spanned 17 days, which is not ideal, as surveys should be completed within the shortest period possible to ensure that double counting of packs does not occur. As the effects of climate change make weather less stable and more unpredictable, future surveys should consider the use of multiple aircraft to shorten the survey windows and make the most of optimal survey conditions when they occur.

Table 2. Comparison of five wolf (*Canis lupus*) surveys in the Coast Mountains, spanning 1983 to 2022, as well as average values from 23 previous wolf surveys from across the Yukon. Data for 1983 and 1988 are from Hayes et al. (1991), and those from 2004 and 2009 are from Baer (2004, 2010).

Year	Area surveyed (km^2)	Mean pack size	Number of packs	Wolf density (1000 km^2)	Pack density (1000 km2)	Estimated population size	% Packs seen
1983	7,699	8.6	10	12.3	1.3	94.6	No data
1988	8,264	5.9	14	10.9	1.7	90.2	42
2004	9,029	5.9	10	7.1	1.11	64.4	30
2009	8,884	4.9	9	5.5	1.01	48.9	44
2022	8,884	5.5	10	6.7	1.13	60	90
Yukon Average	12,719	6.4	n/a	7.7	1.07	n/a	55.4

Table 3. Changes in wolf (*Canis lupus*) population metrics from five aerial surveys in the Coast Mountains, spanning 1983 to 2022. Calculations are based on the first survey estimate in 1983 and between surveys from 1988, 2004, 2009 and 2022.

Year	Pack density change from 1983	Wolf density change from 1983	Average pack size change from 1983	Average pack size change from prior survey	Wolf density change from prior survey	Pack density change from prior survey
1983	-	-	-	-	-	-
1988	30%	-11%	-31%	-31%	-11%	30%
2004	-15%	-42%	-31%	0%	-35%	-35%
2009	-22%	-55%	-43%	-17%	-22%	-9%
2022	-13%	-45%	-37%	+11%	+23%	+11%

Population Trend

Comparing among the five wolf surveys conducted between 1983 to 2022 in the Coast Mountains is difficult because of changes in the extent of the survey areas and changes in methodology. Presumably, the use of a more maneuverable and slower flying helicopter compared to an airplane, as well as the two additional observers, and the advantage of having GPS-collared animals in most packs, means that our survey had several key advantages compared to previous surveys. Thus, we should have had more accurate estimates of wolf abundance, and missed counting wolves less, than in earlier surveys.

That said, given available data, there appears to have been a decline in wolf abundance since the 1980s (Table 3, Figure 4). Since the 1983 population estimate, the wolf population has declined in pack density, average pack size and wolf density (Table 3, Figure 5).

However, compared to the last survey in 2009, our population estimate indicates an 11% increase. The increase can be attributed to a rise in average pack size and, notably, the addition of one pack. However, it is difficult to say if the increase represents a significant trend or only normal variation. Pack membership can change dramatically from year to year, and a pack may lose more than 20% of its members in any given year (Baer 2010).

In summary, wolf population estimates for the Coast Mountains study area have remained similar over the last three surveys (2004, 2009 and 2022), ranging from 49 to 64 wolves. Estimates for pack size and wolf density remain below the Yukon average. Pack density, however, was slightly above the Yukon average.

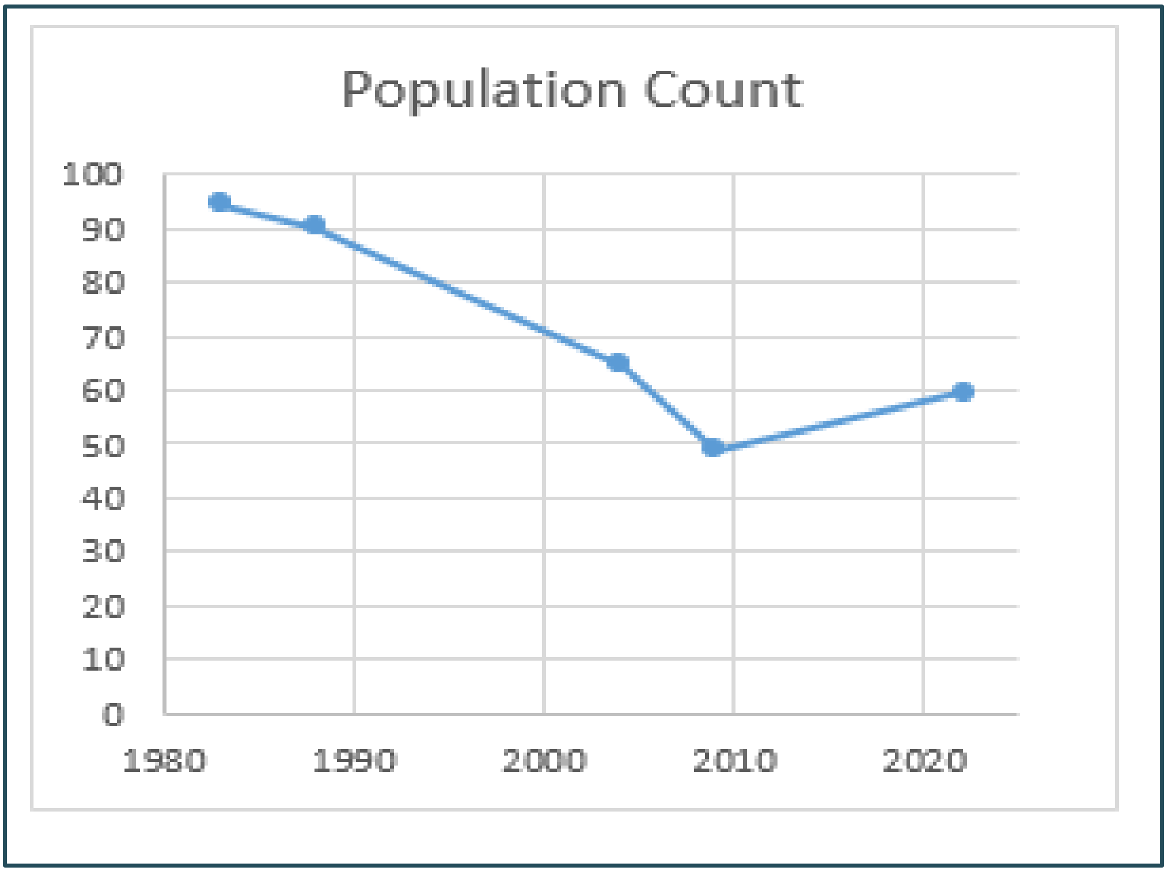

Figure 4. Estimated population size of wolves (*Canis lupus*) in the Coast Mountains study area during 1983 to 2022.

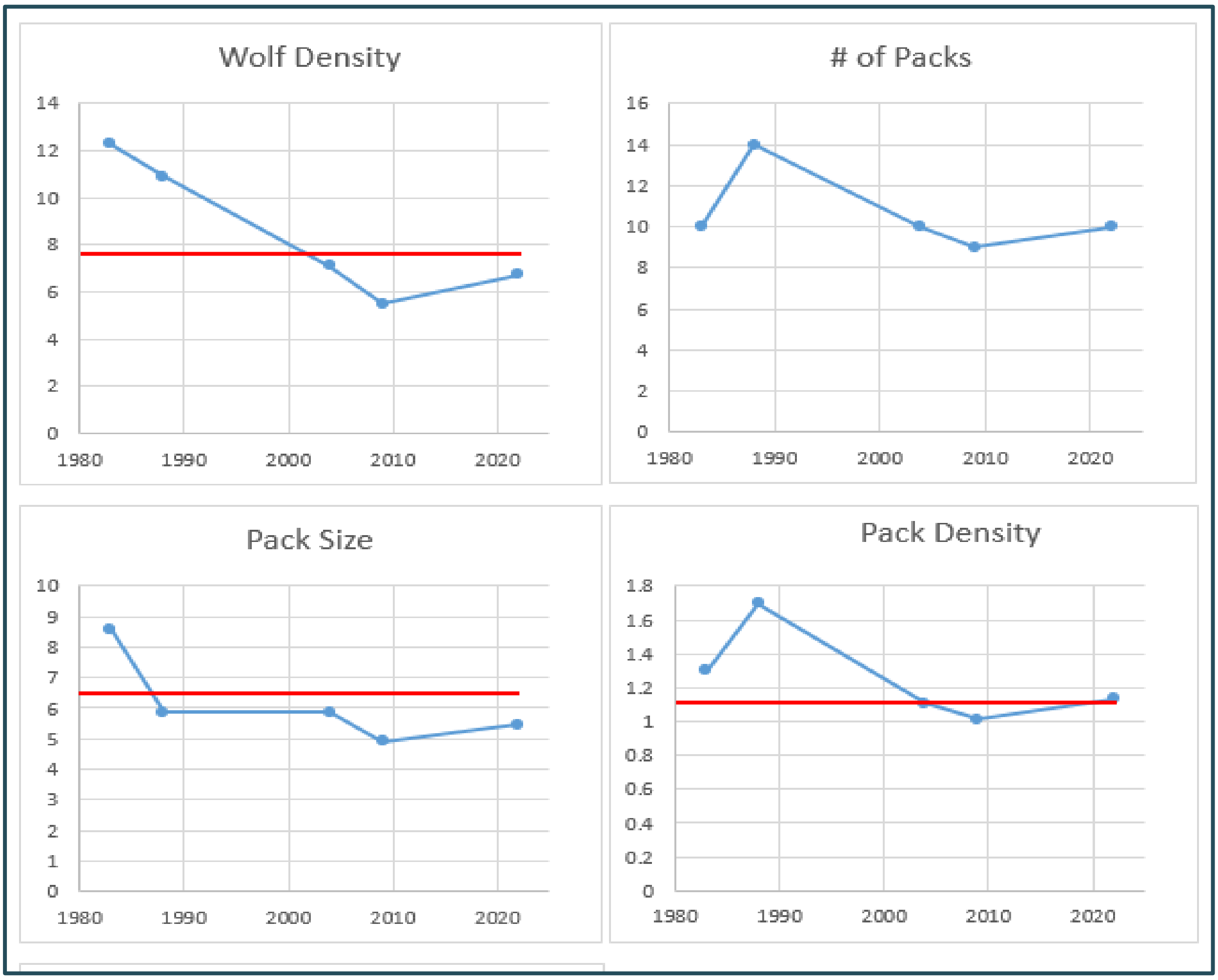

Figure 5. Trends in wolf (*Canis lupus*) abundance and density across five surveys in the Coast Mountains between 1983 and 2022. Data from 1983 and 1988 are from Hayes et al. (1991), and that from 2004 and 2009 are from Baer (2004, 2010). Densities are the number of wolves or packs per 1000 km2. The red lines are the averages from 23 wolf surveys in the Yukon.

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Appendix

Daily snow and wind conditions and flight times for an aerial survey of wolves (*Canis lupus*) in the Coast Mountain during February 2022.

Date	**01-Feb**	**02-Feb**	**03-Feb**	**04-Feb**	**05-Feb**	**06-Feb**	**07-Feb**	**08-Feb**	**09-Feb**	**10-Feb**
Snow (cm)/ wind	-	4 - 7	-	10	4	Extreme winds gusting 60km across SA.				
Survey hrs	-		-	-	-	-	-	4.9	4.5	4.5

Date	**11-Feb**	**12-Feb**	**13-Feb**	**14-Feb**	**15-Feb**	**16-Feb**	**17-Feb**	**18-Feb**	**19-Feb**	**20-Feb**
Snow (cm)/ wind	1-3	-	Strong winds 50km		-	-	-	4 - 10		
Survey Hrs	-	-	3.8	-	1.5	-	-	-	-	-

Date	**21-Feb**	**22-Feb**	**23-Feb**	**24-Feb**	**25-Feb**
Snow (cm)/ wind	-	Winds 50km	-	-	-
Survey Hrs	7.4	-	7.1	5.9	6.1

Total survey hours 45.7