Alaska Industrial Development and Export Authority
Ambler Access Project

A Review of information on Caribou (*Rangifer tarandus*) in Relation to the Ambler Road Project in Northern Alaska October 28, 2025

Caribou in the Kobuk River 2011. Photo by Kyle Joly, National Park Service.

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Acronyms and Abbreviations

ADFG.....Alaska Department of Fish and Game

AIDEA .....Alaska Industrial Development and Export Authority

BLM.....Bureau of Land Management

CAH .....Central Arctic Caribou Herd

FMCH .....Fortymile Caribou Herd

NCH .....Nelchina Caribou Herd

NPS .....National Park Service

PCH.....Porcupine Caribou Herd

SEIS .....Supplemental Environmental Impact Statement

TAPS.....Trans-Alaska Pipeline System

TCH.....Teshekpuk Caribou Herd

WAH .....Western Arctic Caribou Herd

WAHWG ....Western Arctic Caribou Herd Working Group

Executive Summary

This report assesses the potential impacts of the proposed Ambler Road and other factors on caribou (*Rangifer tarandus granti*) with review of literature on caribou interactions with roads, other human activities, predators, and other natural factors.

The Ambler Road Project is a 211-mile proposed private road in northern Alaska that would extend west from the Dalton Highway to the Ambler mining district (see the map below). This is approximately four times the length of the 50-mile Red Dog Mine Road in Western Alaska and one quarter of the length of the 800-mile Trans-Alaska Pipeline System (TAPS) from Prudhoe Bay to Valdez, Alaska.

There is concern about potential impacts of the proposed road on caribou herd numbers, migration, and habitat use. The proposed Ambler Road is within the range of the Western Arctic Caribou Herd (WAH). The number of caribou in the WAH has changed substantially over time with 490,000 animals in 2003 and a decline to 152,000 animals in 2023. This decline occurred without the Ambler Road in existence and was possibly due to winter icing events and predation as seen for the Mulchatna Caribou Herd.

There would be little actual habitat lost due to the Ambler Road compared to the overall WAH range. The WAH calving and summer ranges are approximately 60 to 170 miles north and west of the proposed road (see the map below and Figures 7 and 8, 10 and 11, and 20 and 23). Winter range locations have varied among years (Figure 22); some caribou occur in the area of the proposed Ambler Road in winter, but it has not been a concentrated annual winter range area.

There is concern that the Ambler Road could block or delay WAH migrations. The caribou migration routes are annually variable, and much of the migration has been west and north of the proposed Ambler Road (Figures 20 and 24). The proposed road location has not consistently been in the annual migration routes used by the WAH. The annual caribou migration has traditionally crossed the Kobuk River at Onion Portage which is about 16 miles downstream and west of the proposed road (see the map below). Hunters and wildlife viewers have gone to Onion Portage to access caribou annually.

Studies at the existing Red Dog Mine Road in northwest Alaska reported that some WAH caribou crossed, and some caribou did not cross or were delayed crossing, the Red Dog Mine Road. Hunting from the Red Dog Mine Road and the capture and installation of collars on caribou could have instilled fear of humans, which contributed to some caribou avoiding the road. Therefore, it is not directly comparable to the proposed Ambler Road. Local residents report thousands of caribou crossing the Red Dog Road so it only affects caribou movements at some times (see Figure 24).

Inference from available information suggests it is unlikely the Ambler Road will block or delay caribou migration substantially. First, roads do not block caribou migrations in other areas. Other caribou herds regularly cross highways and roads during migrations in Alaska and Canada, including the Nelchina, Fortymile, Central Arctic, and Porcupine herds (Figure 5). Second, traffic

will be limited to mining vehicles which will follow protocols to avoid impacting caribou. Third, hunting will be prohibited on the proposed Ambler Road. Other mitigation measures can also facilitate caribou crossing the Ambler Road such as restricting traffic when migrating caribou approach the road and installation of overpasses or underpasses in appropriate locations.

Natural factors have more significant impacts on the WAH than are likely from the proposed Ambler Road. Natural factors include predators, wildfires, habitat, winter weather, snow depth, and icing events that can result in caribou mortality. Caribou mortality varies by year, but is primarily from predation, habitat, winter weather and icing, and hunting.

Predation can cause considerable mortality depending on predator numbers and deep snow that can facilitate predation. Government biologists and local subsistence hunters in western Alaska regularly report substantial predation by bears and wolves that affect the numbers and availability of caribou to hunters (Table 2). Bears and wolves kill significant numbers of caribou calves.

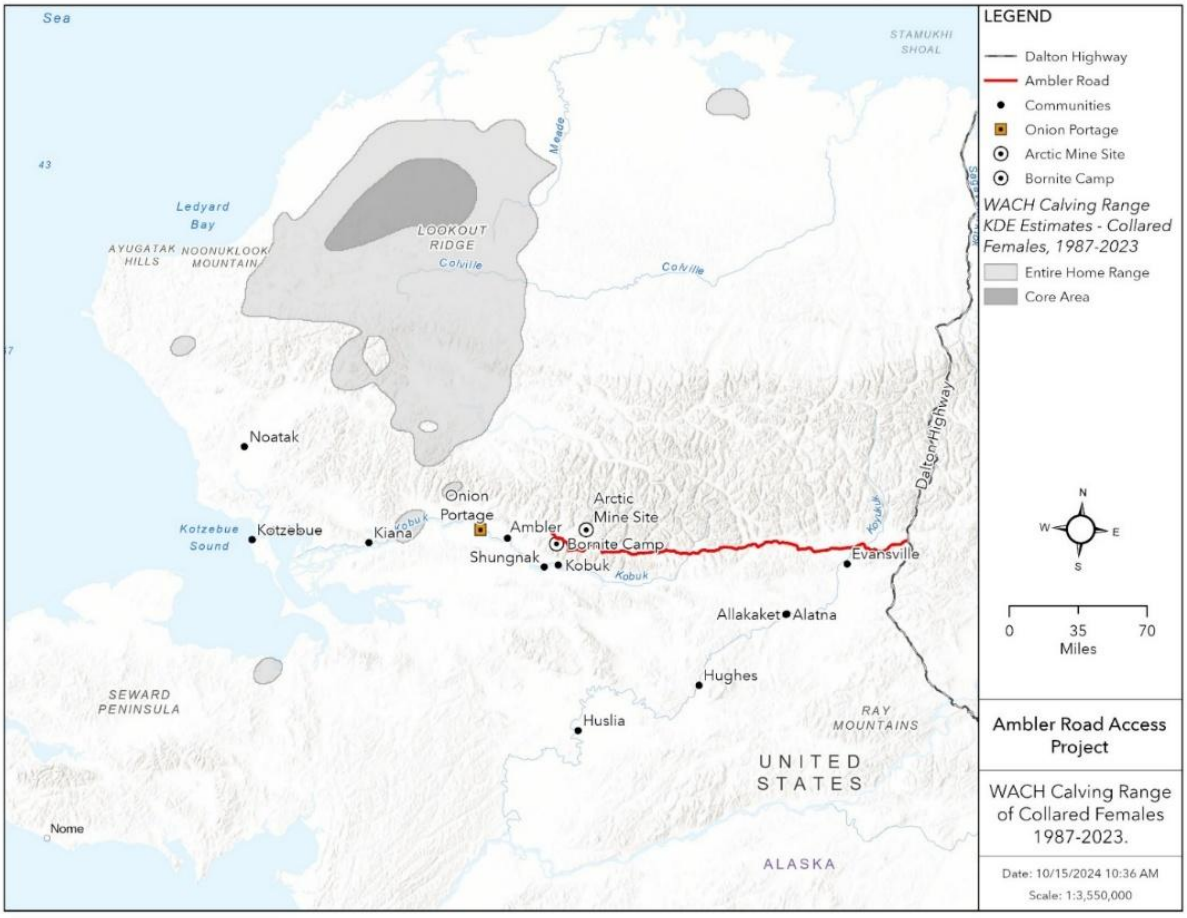
Significant caribou mortality can also occur in winters with severe icing events in which there are warm, wet conditions followed by freezing.

Subsistence hunting takes about 10,000 to 15,000 caribou per year and sport hunting takes less than 1,000 caribou per year (2%-5% of the caribou harvest, Figure 17).

Predation, habitat, weather, icing events, and hunting should be considered when assessing the potential impacts of the Ambler Road on the WAH. The knowledge of local residents (Traditional Ecological Knowledge-TEK) can contribute to understanding these factors.

The available information suggests the Ambler Road is unlikely to have significant impacts on the WAH caribou because:

> The proposed Ambler Road is not in the majority of the WAH traditional migration routes, especially in recent years. Primary migration routes have often been west and north of the proposed Ambler Road. The number of collared WAH caribou moving across the proposed Ambler Road route during fall migrations and winter has been small in past years.
>
> The primary factors that negatively impact the Western Arctic Caribou Herd are predation by bears and wolves and winter weather and icing events. Impacts of the Ambler Road on caribou will likely be minor compared to these other factors.
>
> Caribou regularly cross highways and mining roads during migrations elsewhere in Alaska and Canada.
>
> The Ambler Road will be closed to the public with only mining vehicle traffic, and no hunting will be permitted on or from the road.
>
> The proposed Ambler Road will not be in most of the WAH traditional winter range. A small proportion of the WAH has occurred within 3.1 miles of the proposed road in winter.



Western Arctic Caribou Herd Calving Range 1987 to 2023. The proposed Ambler Road is shown as the red line. Note the location of Onion Portage which has been a primary caribou migration route west of the proposed road.

Author and Contributor Credentials

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Background

The Ambler Road Project is an approximately 211-mile proposed private road in northern Alaska going west from the Dalton Highway to the Ambler mining district. This is approximately four times the length of the 50-mile Red Dog Mine Road in Western Alaska and one quarter of the length of the 800-mile Trans-Alaska Pipeline System (TAPS 2001) from Prudhoe Bay to Valdez, Alaska.

The Supplemental Environmental Impact Statement (SEIS, Bureau of Land Management, BLM 2024) describes the Ambler Road Project and its potential environmental impacts. A concern is the effect of the road on caribou (*Rangifer tarandus granti*) herd numbers, movements, migration, and habitat use. The proposed Ambler Road falls within part of the WAH winter range and is generally not in the major migration routes. Dau (2015, 2023) and BLM (2020, 2023, 2024) describe the status of, and factors affecting, the WAH. The number of caribou in the WAH, was 152,000 animals in 2023 and has changed substantially over time, including a decline since 2003 (ADFG 2023, Rosen 2024, WAHWG 2024). See ADFG (2023) and Figure 1 regarding the WAH population trends.

There are many studies and reports that describe potential impacts of roads on caribou, and some are reviewed in this report. Potential impacts of the Ambler Road Project on caribou include habitat loss, disturbance and displacement, and delaying or diverting movements and migration.

Because caribou are a major subsistence resource for residents in and near the project area, potential impacts of the proposed road on caribou distributions and movements are important, and all relevant variables that could impact population dynamics in impact assessments should be considered (Betini et al. 2017, Plante et al. 2017). Many factors affect caribou numbers, movements, and distribution, including wildfires, habitat, predators, weather, human developments, and subsistence and sport hunting. It is important to acknowledge that animals can

habituate to specific conditions. For example, moose (*Alces alces*) in Anchorage, Alaska, where they are not hunted, generally do not avoid roads, while moose in hunted areas are more wary of people and human activity. Caribou of the Central Arctic Caribou Herd (CAH) have habituated to oil field roads and activity on Alaska's North Slope in the summer (Cronin et al. 1997, 2000, Haskell and Ballard 2008), although they are hunted at other times of the year in other areas.

Impacts of the proposed Ambler Road cannot be predicted with certainty, and other variables (predators, hunting, weather, animals' past experience with humans) must also be considered. This report makes inferences about impacts based on existing information, such as the SEIS (BLM 2024). Climate change is a potential factor affecting caribou habitat (Haskell and Ballard 2004, Joly et al. 2021) and is beyond the scope of this report. Insights on road ecology and multiple hypotheses for impact assessments have been discussed previously (Betini et al. 2017, Teixeira et al. 2020).

An interesting consideration is that many of the studies of caribou in the last 30 years have relied on radio collars, including GPS telemetry collars, to determine caribou locations and movements (e.g., Wilson et al. 2015, Baltensperger and Joly 2019, Johnson et al. 2020, Fullman et al. 2025). However, telemetry collars and the capture required to install them can influence the fitness and behavior of caribou and other species (Kock et al. 1987a, 1987b, 1987c, Haskell and Ballard 2007, Rasiulis et al. 2014, Cronin 2024), so other data (e.g., observations by local residents, Traditional Ecological Knowledge-TEK, Polfus 2010, Polfus et al. 2014) should also be used to corroborate telemetry data.

Another important insight for wildlife in northwest Alaska was provided by the well-known naturalists Aldo Leopold and Frank Darling in the mid-1900s (Leopold and Darling 1953) as described by Simone Schleper (2022):

> ....."Applying a similar (ecological) approach in the North American Arctic, Darling and Leopold believed that Alaska presented a unique opportunity for comprehensive conservation projects that combined the development of natural resources for economic use with the protection of wildlife. Strict wilderness preservation based on climax ecology and the preservation of entire ranges, in their view, was an unrealistic endeavour.
>
> 'It is almost inevitable that after occupation of a country by technological, pastoral or agricultural man, we find ourselves struggling to preserve the animals of ecological climax status, such as bison, musk ox and caribou', Leopold and Darling wrote in their report. 'The opportunity to manage and produce game', however, remained if the land was maintained in ways that allowed for large mammals to thrive."

Leopold and Darling (1953) discussed many factors affecting caribou herds, including fire, domestic reindeer (*R. t. tarandus*), predators, and hunting. They noted that fragmentation of caribou habitat can result in smaller herds. Leopold is considered by many as the father of wildlife management (The Wildlife Society 2014).

The following summarizes some of the large literature on caribou with a focus on the Western Arctic Herd in northwest Alaska, whose range overlaps the western portion of the proposed Ambler Road in some years (Figures 6-11 and 20-24). The citations including the SEIS (BLM 2024), contain information that are incorporated by reference in this report.

Western Arctic Caribou Herd and the Proposed Ambler Road

The following sections describe the WAH population and several factors that currently impact the WAH and/or are topics of concern for future impacts to the WAH, including habitat loss, impacts of roads on caribou movements, displacement and disturbance, weather and icing events, predation, and hunting.

It is important to consider multiple factors when doing population-level impact assessments (e.g., Haskell and Ballard 2004, Betini et al. 2017). Predators, hunting, weather, habitat, disease (e.g., brucellosis), and interactions with reindeer are other considerations that might affect caribou populations (Leopold and Darling 1953, Dau 2015:14-12, WAHWG 2022). The literature on factors affecting caribou population dynamics is very large. We present information from selected literature, including the SEIS (BLM 2024), that should be consulted for detailed explanations, data, and additional references.

Caribou Population/Herd Numbers

Wildlife populations are the unit of management for which management objectives are defined regarding numbers and distribution (e.g., Cronin et al. 1998a, Dau 2015). Alaskan caribou populations are called herds and defined geographically by their calving areas.

It should be recognized that caribou herds often have large changes in numbers of animals, geographic ranges, and migration routes (Bergerud 1974, ADFG 2023). For example, the George River Caribou Herd in Quebec and Labrador, Canada increased from 5,000 animals in 1954 to 472,200 caribou in 1984 (Messier et al. 1988), then experienced a 98% decline in numbers from 360,000 to 7,200 animals between 2001 and 2022. The decline is thought to be due to inadequate habitat to sustain the large population and illegal hunting (Northern Caribou Canada 2022). This herd also changed ranges substantially (Brodeur et al. 2023). Bergerud (1974) describes caribou population declines in North America caused by predation and hunting mortality.

Figure 1 shows the change in population numbers of the WAH over time. From 1970 to 1976 the WAH decreased from 242,000 to 75,000 caribou. From 1976 to 1990 the herd increased 13% per year. In 2003, the WAH was at its highest level with more than 490,000 caribou. After 2003, the WAH declined to 377,000 in 2007, 325,000 in 2011, and 235,000 caribou in 2013. High mortality in the winter of 2011–2012 and low recruitment in 2012 and 2013 contributed to this decline (Dau 2015). The population continued to decline to 201,000 caribou in 2016, increased to 259,000 caribou in 2017, and declined to 181,000 in 2021 (BLM 2020, 2023, 2024), 164,000 caribou in

2022 (Rosen 2024, ADFG 2023, WAHWG 2024), and 152,000 in 2023. Data showing predation and high adult female mortality and decreased recruitment are consistent with the decline in the WAH numbers as noted by Haskell and Ballard (2007).

Immigration and emigration are common between caribou herds in northern Alaska (Cronin et al. 1997, 2000, Bergerud 2000, Cronin 2017, Prichard et al. 2020a). The WAH often mixes with the Teshekpuk Lake Caribou Herd (TCH) and sometimes with the Central Arctic Herd (CAH) and with reindeer on the Seward Peninsula (ADFG 2017a). This mixing may affect the numbers of animals in the WAH. There is empirical evidence that emigration contributed to a decline in the numbers of caribou in the Central Arctic herd between 2013 and 2016:

> "From 2013 to 2015, extensive mixing occurred between the CAH (Central Arctic herd), Porcupine, and Teshekpuk herds after calving and during the winter. Several thousand caribou left CAH and joined other herds." (ADFG 2017a).

Other Arctic Alaska caribou populations also fluctuate like the WAH (Figures 2, 3, and 4). For example, the CAH and TCH fluctuated in numbers since the North Slope oil fields were established. It is interesting that the small decline in the CAH in the 1990s was attributed partially to oil field impacts on calf production (National Academies of Science, Engineering, and Medicine 2003); however, this decline was followed by a substantial growth (Cronin et al. 2000, Cronin 2017). In comparison, the TCH had a similar decline in the same time period without oil fields in the herds' range (Figures 2 and 3). Immigration and emigration are now known to affect the Arctic Alaska caribou herd numbers considerably (Cronin et al. 1997, ADFG 2017a, Prichard et al. 2020a), and is a possible explanation for changes in caribou herd numbers.

Habitat Loss

Spring, calving, and summer ranges of the WAH are north and west of the proposed Ambler Road. Satellite telemetry data indicate that past WAH winter range locations vary among years. Some caribou sometimes occur in the area of the proposed Ambler Road in winter, but it has not been an annual concentrated winter range area. The amount of WAH winter habitat that might be lost due to the Ambler Road is small (less than 0.005 percent of the 92.2 million-acre WAH range, BLM 2020, page 3-94). We used a 200-foot-wide buffer (100 feet on each side of the proposed road) to estimate that approximately 0.007% of winter range (using 1987 to 2023 data) habitat would be affected. Potential impacts of habitat loss from the Ambler Road are minor compared to other factors affecting the WAH.

Ranges and Migration

The WAH range varies over time. Spring, calving, and summer ranges are not generally in the area of the proposed Ambler Road. The range maps (Figures 6-11 and 20-24) show caribou distribution and seasonal ranges obtained from satellite-collared WAH caribou from 1987 to 2023. The shading on the maps represents the core habitat (50% contour line, distribution of the majority of collared caribou) and entire home range areas (95% contour line, distribution of the peripheral habitat of

collared caribou) calculated from kernel density estimators. Kernel density estimation is a non-parametric statistical method used to visualize the distribution of data in space continuously. Habitat ranges are created as extrapolations of those kernel density estimators to visualize where a collared animal spent its time. The resulting habitat ranges (core habitat and entire home range) indicate where the collared cows occurred on the landscape (Peron 2019). The data for the maps were obtained from the National Park Service (NPS) and the Alaska Department of Fish and Game (ADFG).

Fall migration and winter ranges are relevant because these periods are when caribou are most likely to encounter the proposed Ambler Road. These ranges have been variable over time and are represented in the final SEIS in maps with satellite-collared caribou movements and occurrences presented as track lines and shaded densities (BLM 2024 Maps 3-23a and 3-23b). These maps summarize large amounts of data and general information. Migration and winter ranges are shown in Figures 22 and 24.

Quantitative data on winter and migration ranges are provided in tables in the final SEIS. The percentage of the WAH collared caribou within 3.1 miles of the proposed Ambler Road Alternative A in winter from 1987 to 2022 was 4% or less (BLM 2024 Appendix E, Table 22, page E-22). This quantification shows that a small proportion of the collared WAH caribou has occurred close to the proposed Ambler Road route in winter.

Regarding migration movements, the map in the final SEIS (BLM 2024 Map 3-23a) shows caribou movement tracks that overlap the proposed Ambler Road. As with the winter range, a more quantitative view is useful. The percentage of WAH collared cow caribou crossing the proposed Ambler Road Alternative A route in the winter averaged only 4.8% over the 13 years between 2010 and 2022 (Table 1).

The WAH crossed the Kobuk River, south and west of the proposed Ambler Road for many years, but in recent years (2020-2022) a relatively small proportion of the herd migrated south of the proposed Ambler Road and the Kobuk River (ADFG 2023). The herd has recently wintered west and north of the proposed Ambler Road on the Seward Peninsula and Brooks Range (ADFG 2023):

> ....."Fewer caribou are migrating across the Kobuk River during their fall migration. For years, over 80 percent of the collared caribou would cross the Kobuk heading south to their wintering grounds. In recent years, only about one-third have crossed the river, with less than six percent of collared caribou crossing in 2020. Most Western Arctic Herd caribou have remained in the Brooks Range during winter where they are difficult to access. Besides fewer caribou migrating, the caribou are also migrating later in the year. … we see differences pop up immediately when comparing winter (caribou) collar locations. While the bulk of the Western Arctic Herd used to overwinter south of the Brooks Range on the Seward Peninsula – near communities like Deering, Buckland, and Shishmaref – most of the herd stayed north of the Brooks Range from 2018 – 2022. There was no centralized

> group, with many different smaller portions of the herd scattered across the North Slope and Brooks Range."

The Kobuk River is south and west of the proposed Ambler Road, which indicates that recently most of the WAH has not migrated or overwintered near the proposed Ambler Road. See Joly et al. (2016) for additional information on caribou in the area of the proposed Amber Road.

The final SEIS (BLM 2024:3-135-3-137) notes that the WAH winter ranges and migration routes vary considerably over time and that the eastern part of WAH historic winter and migration ranges overlaps approximately 50 miles of the western portion of the proposed Ambler Road area. Caribou used this area more extensively in the 1980s than in the last 15-20 years. The proposed Ambler Road area has not been the primary WAH winter and migration range in recent years.

The WAH fall migration (Figure 24) crosses the Kobuk River at Onion Portage in many years where caribou are harvested by hunters. Biologists captured swimming caribou and installed radio collars on them at Onion Portage in the past. This area is west of the western end of the proposed Ambler Road, 16 miles downriver from Ambler. Many people observe the migration through Onion Portage:

> ....."Down river from Ambler lies a stretch of river that has been the meeting ground for the Iñupiat, and their ancestors, for well over 8,000 years to harvest caribou that are migrating through. This extremely important spot along the Kobuk River is known as Paatitaaq. It means "onion" in Iñupiaq-the language of the Iñupiat (the Indigenous people who live and subsist in the Northwest Arctic of Alaska) …Paatitaaq continues to be a place that people from around the Northwest Arctic meet up and harvest caribou as the herd migrates through, primarily in the fall." (National Park Service 2025).

> ....."Twice a year, around 240,000 caribou from the Western Arctic Herd march through Onion Portage on the Kobuk River…This trail isn't just for the caribou—it's been a lifeline and cultural backbone for Alaska Native tribes and draws in hunters, science geeks, and nature groupies eager to soak in this living masterpiece." (National Parks Insights 2025).

The proposed Ambler Road has not overlapped the major migration routes that have been used in recent years by the WAH. Regardless, simply having a road in the Ambler Road area does not mean that migration will be impacted. It is important to recognize that caribou regularly cross other roads during migrations in Alaska including the Central Arctic Herd (ADFG 2017a, TAPS 2001), the Fortymile Herd (ADFG 2000), the Nelchina Herd (Wilson et al. 2015, ADFG 2021), and the Porcupine Herd (Johnson and Russell 2014). The ranges of these herds in relation to highways are shown in Figure 5. These herds demonstrate that caribou cross roads during migrations.

Also, the proposed Ambler Road will have mitigation measures to reduce potential impacts (BLM 2024) including no public access and no hunting from the road. Other possible measures include

restricting mining vehicle traffic when migrating caribou approach the road (Wilson et al. 2015:3, Howarth 2025), and installation of overpasses or underpasses in appropriate areas (Dickie 2017, Vartan 2019).

Caribou Movements and Migration Across Roads

A potential impact of the proposed Ambler Road is blocking or delaying caribou in the southward fall migration (BLM 2024:3-146 to 3-148). This is not necessarily a negative impact, as caribou negotiate many natural obstacles like rivers and terrain during migrations. However, blocking or delaying migration could affect subsistence hunters' access to caribou depending on the natural variation of migration routes. Minimizing impacts of the proposed Ambler Road on caribou migrations is a legitimate management objective.

It is important to recognize that the proposed Ambler Road could potentially impact only a portion of the traditional WAH migratory range, specifically the western half of Alternative A (BLM 2020, 2023). This indicates that the number of road miles of migratory range impacted could be approximately 211 miles x 0.5 = 105.5 miles (170 km). This distance is approximately twice as long as the length of the Red Dog Mine Road near Kotzebue (49.6 miles). The Red Dog Mine Road has similar traffic rates (98 vehicles/day, 4/hour) as proposed for the Ambler Road (80 to 168 vehicles/day). This traffic rate for the Ambler Road assumes that 4 mines are operating simultaneously. The Red Dog Mine Road also has a similar width (36 feet Red Dog Road, 32 feet Ambler Road) as the proposed Ambler Road. Neither road has, or is planned to have, vertical structures (e.g., fences, power lines, pipelines) at this time.

The number of collared WAH caribou moving across the proposed Ambler Road Alternative A route in fall and winter during and after migration has been small (Table 1). The WAH crossed the Kobuk River, south and west of the proposed Ambler Road for many years, but in recent years (e.g., 2020-2022) relatively few caribou migrated south of the proposed Ambler Road and the Kobuk River (ADFG 2023). The percentage of WAH collared cow caribou crossing the proposed Ambler Road Alternative A route in the winter was 4.8% over the 13 years between 2010 and 2022. This included 0% in five years, less than 7% in six years, and 22% to 24% in two years (Table 1). The percentage of WAH collared cow caribou crossing the proposed Ambler Road Alternative A route in the fall was 3.0% over the 13 years between 2010 and 2022. This included 0% in five years, less than 10% in seven years, and 17% in one year, as shown in Table 1 (Data from BLM 2024 Appendix E Table 24). The data in Table 1 indicate that if past trends continue with an average of less than 5% of collared caribou crossing the Ambler Road route, a small proportion of the WAH will encounter the proposed Ambler Road in fall and winter in most years.

Multiple factors should be quantified when studying environmental impacts (Betini et al. 2017) including the impacts of roads (Wilson et al. 2015, Teixeira et al. 2020). Responses to roads depend on several factors, not just the presence of a road. For example, vehicle traffic will affect caribou behavior and caribou will avoid roads when hunted from them (Haskell and Ballard 2008, Plante

et al. 2017). This suggests that the question of whether a road affects caribou movements is simplistic. A more appropriate question is: What are the characteristics of the road and surrounding areas, including traffic levels and hunting from or near the road, that affect caribou movements? For example, topography and forage availability might also affect caribou movements. Higher elevation topography could have more wind than lower river bottoms, and wind can reduce insect harassment of caribou (Pollard et al. 1996a). Predators might also affect caribou reaction to roads, as bears will den in culverts. It is also important to consider all the experiences of a caribou herd. Animals in a range with no hunting or harassment year-round might behave differently than animals that are hunted and avoid humans (Haskell and Ballard 2008, Plante et al. 2017).

Studies of caribou during the fall migration have been done at the Red Dog Mine Road near Kotzebue (Wilson et al. 2015, Fullman et al. 2025). The Red Dog Mine Road was constructed in 1987-1988 and ore shipment began in 1989. The WAH reached its largest population numbers in 2003, so during the first 15 years of road and mine operations the WAH increased and there was no apparent impact on the WAH at the herd level.

Some migrating caribou have been delayed or blocked by the Red Dog Mine Road (Dau 2015, 2023, Wilson et al. 2015, Fullman et al. 2025). However, a good proportion of caribou in these studies crossed the road without delay. These studies should be consulted for detailed results. Also, local residents have observed thousands of caribou crossing the Red Dog Mine Road (Howarth 2025). These observations indicate that caribou cross, and are frequently not blocked or delayed crossing, the Red Dog Mine Road.

Caribou regularly cross other roads during migrations in Alaska (Figure 5). The Central Arctic Herd has maintained movements across the Dalton Highway and adjacent Trans-Alaska Pipeline (TAPS) between winter and summer ranges (ADFG 2017a, TAPS 2001). Some WAH caribou cross the Dalton Highway with substantially altered movements (Fullman et al. 2025). The Fortymile Herd has maintained movement and migration patterns across several highways and roads (ADFG 2000), and the Nelchina Herd crosses several highways annually (Wilson et al. 2015, ADFG 2021). In late summer the Porcupine Herd migrates east and south from the coastal plain in the Arctic National Wildlife Refuge (ANWR) and crosses the Dempster Highway in Canada in some years (Johnson and Russell 2014). The Denali Herd occurred along highways and in communities in 1992 (Adams et al. 2005). The references for these caribou herds should be consulted for detailed information. The ranges of these herds in relation to highways are shown in Figure 5. These Alaska herds demonstrate that migrating caribou will cross highways and roads.

The 216 caribou in Wilson et al.'s (2015) study were captured and had radio collars put on them. Data for the year caribou were captured were not included in their analysis. Of the 216 collared caribou, 32 came within 15 kilometers (9.3 miles) of the Red Dog Mine Road and were considered as potentially crossing the road. This included 17 WAH animals in 2009 to 2012 and 15 Teshekpuk Caribou Herd (TCH) caribou in 2004 to 2012. Four of these 32 caribou never crossed the road and 4 deflected movements and went around the east end of the road, indicating that eight of 32 (25%)

caribou were delayed or deflected by the road. These non-crossings and delayed crossings occurred only with WAH caribou in 2011, and not with any TCH caribou or WAH caribou in other years.

Fullman et al. (2025) expanded the Wilson et al. study at the Red Dog Mine Road and four other remote roads in the range of the WAH. They reported that 231 of 366 (63%) collared caribou had at least one encounter with one of the five roads. Of these 231 caribou, the movements of 142 (61%) were changed by delaying or not crossing the road, and 89 (39%) caribou did not change their movements.

Most caribou in most years crossed the Red Dog Mine Road in the Wilson et al. (2015) study. This is consistent with observations of local residents. For example, the oral testimony of a resident of Noorvik noted that the Red Dog Mine Road was started in 1985 and is a 53-mile road. He has seen caribou by the thousands cross the road, and they stop all the haul trucks for two to three hours at the most, to make sure all the caribou cross. He doesn't think building the Ambler Road from the Dalton Highway to Ambler would be a problem (Howarth 2025).

The Red Dog Mine Road can be used by local hunters to access caribou with all-terrain vehicles or snow machines (Wilson et al. 2015, Fullman et al. 2025). Residents of Kivalina are the primary hunters and can access the road through a gravel bar on the Chukchi Sea about 16 miles from the marine port. It is apparently not known if the caribou that were blocked or delayed crossing the Red Dog Mine Road in 2011 may have been approached or shot at by hunters using all-terrain vehicles (ATV) with access from the road (Wilson et al. 2015:3). Fear of humans because of previous experience with hunters could have influenced caribou behavior when crossing the road (Haskell and Ballard 2008, Plante et al. 2017). Hunters will not directly impact caribou in the area of the proposed Ambler Road because the road will be private, and hunters will not be allowed access to the road. Hunters can cross the road on ramps from existing trails, but existing hunting trails (RS2477 routes, BLM 2024) cross only the eastern portion of the proposed Ambler Road alignment at mile posts 5 and 23-26 and most of the WAH range is west of mile post 175.

The studies at the Red Dog Mine Road (Wilson et al. 2015, Fullman et al. 2025) indicate that a mining road could deflect or delay caribou movements, but not completely. The Red Dog Mine Road has been successfully crossed in the fall migration in many years even though hunting is allowed from the road. Wilson et al. (2015) considered several environmental variables in addition to the road, but traffic levels or the presence of hunters when caribou encountered the road were apparently not quantified at the time caribou were blocked or delayed crossing. This suggests that the results from the Red Dog Road are not directly comparable to the proposed Ambler Road because there is hunting from the Red Dog Road but there will not be hunting from the Ambler Road.

Much of the Red Dog Mine Road runs on or below a ridge with higher elevation than the Wulik River to the north and the Noatak River to the south. Higher elevation topography could have more wind than lower river bottoms, and wind can reduce insect harassment of caribou (Pollard et al.

1996a). This could have contributed to slower movements near the road, although Wilson et al. (2015) found the road, and not environmental variables, to be the primary factor influencing caribou crossing.

Wilson et al. (2015) suggested that the movements of approximately 30% of the collared caribou were delayed or blocked crossing the Red Dog Road, extrapolated this rate to the entire WAH, and estimated 70,000 caribou could be delayed crossing a road. Because the WAH migration often has not occurred in the area of the proposed Ambler Road it is unlikely this estimate will apply to the Ambler Road.

Another potentially relevant factor is that the studies at the Red Dog Mine Road (Wilson et al. 2015, Fullman et al. 2025) analyzed caribou that were captured and had collars put on them. Installation of collars on caribou could have instilled fear of humans that contributed to the behavior of those caribou avoiding the road. This might not apply to the studies at Red Dog because data for the year caribou were captured were not included in the analysis of Wilson et al. (2015). Many of the studies of caribou in the last 30 years have relied on radio collars, including GPS telemetry collars, to determine caribou locations and movements (e.g., Wilson et al. 2015, Baltensperger and Joly 2019, Johnson et al. 2020, Fullman et al. 2025). Capturing caribou and other animals and telemetry collars can impact animal fitness causing stress and mortality (Kock et al. 1987a, 1987b, 1987c, Rasiulis et al. 2014, Haskell and Ballard 2007, Cronin 2024, O'Shea et al. 2025). Data such as observations by local residents and Traditional Ecological Knowledge (TEK, Polfus 2010, Polfus et al. 2014, Howarth 2025) should corroborate telemetry data.

It is appropriate to recognize the potential for, but not a definite outcome of, a road to alter caribou movements. With regard to the proposed Ambler Road, it is important that fall caribou migration routes have been variable and only crossed the western portion of the route of the proposed Ambler Road in some years (Figure 24). Impacts of the road cannot be predicted with certainty, but it is not likely the Ambler Road will significantly affect the WAH migration, particularly because it will be limited to mining vehicles and no hunting will be allowed.

As noted above, it is important to recognize that caribou herds other than the WAH regularly cross roads (including public-access roads) during migrations (Figure 5). These include the Central Arctic Herd crossing the Dalton highway and Trans-Alaska Pipeline System (TAPS 2001), several roads in the ranges of the Nelchina Herd and the Forty-Mile Herd, and the Dempster Highway in the Yukon Territory, Canada over which the Porcupine River Herd crosses and are hunted in some years (Johnson and Russell 2014, Deuling 2015, COSEWIC 2016, Scott 2019, DOI 2023). Caribou also regularly cross roads with adjacent elevated pipelines in the North Slope Alaska oil fields during the summer (Cronin et al. 1994, Lawhead et al. 2006, Prichard et al. 2020b, 2022).

The Trans-Alaska Pipeline System has an interesting and little-known data set documenting occurrences of wildlife, including caribou, in the pipeline and service road right-of-way (TAPS 2001:3.2-36-3.2-38). Lenora (2020) provides other little-known data obtained from ground

surveys of caribou occurrence close to the Dalton Highway on Alaska's North Slope. These data provide insights into wildlife use of transportation corridors that are relevant to the Ambler Road Project but apparently were not used in the SEIS process.

Table 1. The percentage of GPS-collared WAH cow caribou crossing the proposed Ambler Road Alternative A alignment in the fall and winter seasons between 2010 and 2022 (BLM 2024).

Season	Year	Herd Size	Number of Collar-	% Collared Caribou Crossing Road Alignment
Winter	2010		29	24.1
	2011	325,000	29	6.9
	2012		33	3.0
	2013	235,000	38	2.6
	2014		36	0.0
	2015		46	0.0
	2016	201,000	65	0.0
	2017		58	0.0
	2018		40	5.0
	2019	244,000	38	2.6
	2020		54	5.6
	2021	188,000	40	22.5
	2022	164,000	31	0.0
	All		537	**4.8**
Fall	2010		29	17.2
	2011	325,000	36	5.6
	2012		34	0.0
	2013	235,000	38	0.0
	2014		45	6.7
	2015		49	2.0
	2016	201,000	72	1.4
	2017		74	1.4
	2018		46	0.0
	2019	244,000	43	2.3
	2020		62	0.0
	2021	188,000	43	9.3
	2022	164,000	32	0.0
	All		603	**3.0**

*A collar-year is one collar active for one season in one year.
Data from BLM 2024, Appendix E Table 24.

The proposed Ambler Road does not overlap the major migration routes that have been used in recent years by the WAH, and mitigation measures will be implemented to reduce impacts (BLM 2024), for example, prohibiting hunting from the road and limiting traffic to only mining industry vehicles. Monitoring the WAH's migration and stopping or reducing traffic when large numbers of caribou approach the road could also be effective in reducing the potential impact of traffic on caribou movements. This has been done at the Red Dog Mine Road (Wilson et al. 2015:3, Howarth 2025). Installation of overpasses or underpasses in appropriate areas (Dickie 2017, Vartan 2019) can also provide mitigation.

Limiting hunting to the south side of the proposed road right-of-way, after the fall migration has crossed the road, could also be effective in reducing impacts on migration. The Gwich'in Tribal Council and Inuvik elders in the Yukon and Northwest Territories in Canada urge hunters to wait until the Porcupine Caribou Herd (PCH) caribou cross the Dempster Highway before hunting so the caribou will not avoid the migration route over the highway (Dueling 2015, Scott 2019).

Hunting is arguably the most important factor in determining caribou response to human activity including roads (Haskell and Ballard 2008, Plante et al. 2017). Predator avoidance is a primary motivation for caribou (and all prey animals) and association of roads with humans (and thus hunters) could influence how they react to roads. The same fear of humans could apply to animals captured for research, monitoring, and installation of telemetry collars which should be considered in impact assessments. Because subsistence hunting and research/monitoring are necessary, caribou avoidance of human activities and roads is to some extent unavoidable.

Displacement and Disturbance

Caribou can be disturbed and displaced from habitats near roads and facilities (Noel et al. 2004, Plante et al. 2018, Johnson t al. 2020, Prichard et a. 2020b,). WAH spring, calving, post calving, and summer ranges have generally not been near the proposed Ambler Road route (Figures 6 through 11 and 20) and will likely not be significantly affected.

Displacement of caribou from roads, development, and human activity has been studied extensively in the North Slope Alaska oilfields and around the Trans-Alaska Pipeline System (TAPS 2001). These studies show that cow caribou may be displaced 1-2 kilometers from roads during the calving season, but they frequently cross roads and occur on and near roads and oil field facilities during the post-calving period, especially when mosquitoes and parasitic oestrid flies are active (Cronin et al. 1998b, Noel et al. 1998, 2004, 2006, Pollard et al. 1996a, 1996b, Haskell et al. 2006, Lawhead et al. 2006, Prichard et al. 2020b, 2022). Caribou herds also frequently cross highways and roads during migrations (TAPS 2001, Deuling 2015, Scott 2019).

Considering past distributions, winter ranges could be affected by the proposed Ambler Road (Figure 22). The number of WAH caribou on winter range in the area of the proposed Ambler Road Alternative A route varies significantly over years and is generally small. Four per cent or less of WAH collared caribou occurred within 3.1 miles (5 km) of the proposed road corridor

between 1987 and 2022. Less than 17% occurred within 30 miles (48 km) of the proposed road corridor in 14 of the years between 1987 and 2022 and less than 28% and 40% in each of two of the 16 years for which there are data (Appendix E Table 22 in BLM 2024).

Caribou might be displaced from the Ambler Road at some times on winter range, but unless deliberately harassed or hunted, this likely would not be a significant impact.

Weather and Icing

Fall and winter icing events likely contributed to the WAH decline in 2003 and other years (Dau 2015, ADFG 2023). Icing occurs when warm, wet conditions are followed by freezing that covers vegetation with ice making it unavailable to caribou (Miller and Barry 2009). These conditions can affect the WAH numbers substantially (BLM 2024:3-132). Warming climate conditions might contribute to the occurrence of icing events and other changes to caribou ranges (FWS 2023).

A decline in lichens and an increase in shrub vegetation in the WAH winter range has also occurred which suggests caribou habitat degradation (Joly et al. 2021). However, good body condition of caribou suggests that habitat degradation is probably not the cause of the recent decline in herd numbers (Dau 2015). Fires can also impact caribou habitat considerably (Leopold and Darling 1953).

The ecological concept of carrying capacity (how many animals a given habitat will support) is complex for a migratory animal with highly variable seasonal ranges. Winter range might be the best measure of carrying capacity because of potentially limited access to forage with snow and icing events. For example, the Nelchina Caribou Herd in southcentral Alaska may exceed the habitat carrying capacity in some years (ADFG 2017b), and Leopold and Darling (1953) describe overgrazing by reindeer in western Alaska during the early 1900s. Good body condition observed for the WAH in 2012-2014 suggests that the herd was not at carrying capacity. However, unpredictable winter conditions, especially icing events, probably affect the herd more than the range vegetation condition alone. Local knowledge (Traditional Ecological Knowledge-TEK) can contribute to understanding the frequency, intensity, geographic scope, and impact on caribou of icing events and other habitat factors (Polfus 2010, FWS 2023).

Predation

The numbers of animals, ranges, and migration routes of caribou herds, including the WAH, change over time. The numbers and distribution of predators, winter weather, icing, and habitat conditions also change over time. The causes of such changes to caribou herds, predators, weather, and habitat are difficult to determine, especially on the geographic scale of a population as large as the WAH. However, predation is a significant source of mortality for the WAH (Table 2, Figures 18, 19, Haskell and Ballard 2007, Dau 2015).

Several species prey on caribou as described in a review of caribou herds in Canada (COSEWIC 2016:40). Wolves (*Canis lupus*) and grizzly bears (*Ursus arctos*) prey on both sexes and all ages

of caribou (Gau et al. 2002). In the Northwest Territories in 2007 and 2010, about 75% of wolves had stomach contents containing substantial amounts of caribou (Davison 2015). Caribou were up to 93% of the diet of grizzly bears on the Bathurst herd summer range (Gau et al. 2002; see also Mowat et al. 2013). Wolverines (*Gulo gulo*) kill caribou with long pursuits (Dumond 2007) and scavenge caribou killed by wolves (Lee 1995; van Dijk et al. 2008). Lynx (*Lynx canadensis*) occasionally prey on caribou. Golden Eagles (*Aquila chrysaetos*) have killed calves on the calving areas west of the Coppermine River (Theberge and Nagy 2001, Nagy and Johnson 2007).

Wolves and grizzly bears kill many caribou calves (Table 2), although caribou calving areas are often in areas with reduced risk of predation (Gustine et al. 2006). Bergerud (2000:677) reports that calf mortality was as high as 80% in different caribou herds and most of this was predation by wolves and bears. In Denali National Park calf mortality was 66%, and 38% of this was by wolves and 26% by bears. The Fortymile Herd in Alaska had calf mortality of 23% from grizzly bears and 27% from wolves. On the Porcupine Caribou Herd calving grounds in northeast Alaska, calf mortality was 25-29%, and 61% of the mortality was attributed to predation by golden eagles, grizzly bears and wolves (Griffith et al. 2002).

It is known that predators can affect caribou and other prey species' population numbers. For example, caribou and moose can be kept at low population density by predation, a phenomenon known as a "predator pit", and then increase in numbers when predator numbers are reduced (Ballard and van Ballenberghe 1998:267, Bergerud 2014:114). It is obvious that predators killing caribou will reduce the numbers of animals in a herd (population). Bergerud (2014, 2000) and Haskell and Ballard (2007) describe research in which the relationship of the numbers of predators and prey were determined and show that predators can cause declines in caribou herd numbers. Whether predation is enough to affect the numbers of animals in a herd over time depends on the relative amounts of predation, and recruitment and immigration/emigration of new animals each year.

To assess the impact of predators on caribou herd numbers, the numbers or population density of predators should be determined or estimated. For example, Bergerud (2014:112-115) found that for caribou across North America, mortality and recruitment were balanced and the population numbers were stable when wolf density was 6.5 wolves/1,000 km^2. Caribou numbers declined when wolf density was greater than 6.5 wolves/1,000 km^2. Bergerud (2014:114) suggested that wolf density should be less than eight wolves/1,000 km^2 to maintain caribou population numbers. Also see Haskell and Ballard (2007) regarding wolf density and caribou herd numbers.

Another example is estimation of the numbers of elk (*Cervus elaphus*) that would be killed per year following a proposed introduction of wolves into Colorado (Cronin 2020). These estimates indicated a potential of 672 to 1108 wolves in Colorado, an annual prey rate of 16.8 elk/wolf/year, and a potential of 11,269 to 18,581 elk/year killed by wolves in Colorado. Such estimates can be used to assess the effect of predation on population numbers.

Predation affects population dynamics, mortality, distribution, and movements in prey species, including caribou (Lima and Dill 1990, Bergerud 2000, 2014, Haskell and Ballard 2007). In some populations of woodland caribou (*R. t. caribou*) in North America, predation was the primary cause of declining numbers (Wittmer et al. 2005). Predators often take young animals and reduce recruitment which can affect population numbers for several years.

Predation in Alaska and the Western Arctic Caribou Herd

Predation can be a significant mortality factor in the WAH and has the potential to impact the herd's numbers, as described above and in Table 2. Known mortality due to predators and other natural causes, and hunting has been quantified for the WAH (Figures 12-19). These data indicate that in all years there has been substantial predation which accounts for the majority of natural mortality (Figures 18-19). Severe winter weather and icing events can also cause significant mortality (BLM 2024:3-132) that was not detected in the data in Figures 18 and 19 for radio-collared caribou.

Wolves and grizzly bears are the primary predators of caribou in Alaska and golden eagles also prey on caribou (ADFG 2004). The Mulchatna caribou herd in Alaska has considerable calf mortality from predation by bears and wolves (ADFG 2025). The majority of mortalities of calves with radio collars in the WAH that occurred in 2012 to 2017 were attributed to predation. Wolves were the most commonly observed predators of adult and juvenile caribou (ADFG 2024). Field observations have shown grizzly bears and wolves killing many caribou in 2012 to 2014 was a large source of WAH caribou mortality (see Figures 12–14). Predators had a larger effect on the WAH in 2012 to 2014 than in the 30 previous years (Dau 2015). The information in Table 2 indicates that predators can have a substantial effect on caribou herds.

Wolves and grizzly bears are abundant in the range of the WAH, and were particularly common in 2012 to 2014. The 2015 Caribou Management Report (Dau 2015) notes that "…opportunistic observations by department staff and many reports from residents of this area, long-term guides, and transporters all indicate that predator numbers are high compared to previous years". However, the actual numbers and densities of predators are not known.

The most recent ADFG Western Arctic Caribou Management Report and Plan (ADFG 2024) discusses causes of mortality to caribou with radio collars between 2012 and 2017. Mortality causes were categorized as "hunter harvest, predation, unknown natural, and unknown". Considering average daily mortality of collared caribou between 2006 and 2016, predation exceeded hunter harvest, unknown natural, and unknown causes as shown in Figures 18 and 19. Predation resulted in 86% of all mortality of collared calving female caribou and 100% of all of post-calving collared male caribou for which a cause of mortality was determined (ADFG 2024). Predation was identified as the largest cause of mortality between 2012 and 2016 and accounted for 49% of mortalities among collared caribou examined in these years. Wolves and grizzly bears were the cause of the majority of mortalities where the predator could be positively identified.

In some years, predators were the largest cause of WAH (collared) caribou mortality and killed more caribou than other natural (non-hunting) or unknown causes as shown in Figures 14, 18, and 19 (Dau 2015, ADFG 2024). Fall and winter icing on the tundra in some years might have also resulted in high levels of mortality and might have started the decline of caribou numbers in 2003. Declines in recruitment could indicate increases in mortality due to poor habitat, though this is not supported by recent data (Dau 2015). Declines in recruitment may also be due to predation (Gustine et al. 2006). Because icing events and predation often impact young animals more than adults these impacts can contribute to population declines. Table 2 presents statements and references described above, indicating that predation is a significant source of caribou mortality. Also see Bergerud (2000, 2014).

Table 2. Statements from selected literature related to predation of caribou.

Reference	Title	Page No.	Quotes from Literature
ADFG 2015b	*Chapter 9: Caribou Management Report, From: 1 July 2012, To: 30 June 2014, Game Management Unit: 13 and 14B, Herd: Nelchina*	9-10, 9-9	"The NCH is likely benefitting from an intensive wolf management program to improve moose abundance that has been going on in Unit 13 since 2001." "Brown bears are considered numerous throughout the NCH summer range and are known to be important predators of caribou (Boertje and Gardner 1998)."
ADFG 2015c	*Chapter 15: Caribou Management Report, From: 1 July 2012, To: 30 June 2014, Game Management Unit: 25A, 25B, 25D, and 26C, Herd: Porcupine*	15-10	"However, wolves, grizzly bears, and golden eagles were determined to be the 3 most common predators, with golden eagles being a significant source of mortality on PCH calves on the calving grounds (Whitten et al. 1992)."
ADFG 2015d	*Chapter 17: Caribou Management Report, From: 1 July 2012, To: 30 June 2014, Game Management Unit: 26A, Herd: Teshekpuk*	17-12	"Preliminary information from the calf mortality study started in 2011 corroborates the highly elevated late winter-spring mortality and suggests predation as the dominant proximal cause, although some calves do die from apparent starvation each spring."
ADFG 2015a	*Chapter 18: Caribou Management Report, From: 1 July 2012, To: 30 June 2014, Game Management Unit: 26B and 26C, Herd: Central Arctic*	18-17	"Winter mortality was probably higher during the 1990s than in previous years because more CAH caribou wintered on the south side of the Brooks Range, where wolves were more abundant, and snowfall is deeper than on the north side."

	Table 2 Continued		
ADFG 2000	*Reducing mortality on the Fortymile caribou herd*	12, 13	"Based on these studies, the Team concluded in October 1995 that slightly reducing wolf (*Canis lupus*) predation was the most manageable way to help hasten or stimulate herd growth." "To summarize, of the 20,000 adult and yearlings and 8,090 newborn calves present in May 1994, we estimate wolves killed 4,100 (15%) caribou within 12 months. In contrast, grizzly bears killed 2,080 (7%), other predators killed 840 (3%), hunters killed 330 (1%), and nonpredation accounted for 1,020 deaths (4%), Table 3)." "Wolves were consistently the major predator of calves in the 1994-2000 cohorts (except the 1998 cohort), and grizzly bears were consistently the second major predator (Table 5)." "Since 1991, wolf predation was the major cause of death among caribou calves 4 – 12 months old and caribou >12 months old."
Dau 2015	*Chapter 14: Caribou Management Report, From: 1 July 2012, To: 30 June 2014, Game Management Unit: 21D, 22A-E, 23, 24A-D, and 26A, Herd: Western Arctic*	14-15, 14-22	"… opportunistic observations by department staff and many reports from residents of this area, long-term guides, and transporters all indicate that predator numbers are high compared to previous years. I have seen substantially more wolf-killed caribou during the last 3 – 5 winters than prior to that time." "If predation by brown bears and wolves is a primary driving force behind the high adult caribou mortality, and if numbers of large predators remained high during 2012 – 2013 as reported by the public, caribou mortality could remain elevated even under favorable winter conditions." "My opportunistic observations during winter suggest that wolf predation on caribou has been higher since about 2008 than in previous years."
Gustine et al. 2006	*Calf survival of woodland caribou in a multi-predator ecosystem*	Abstract	"Gray wolves were the main cause of mortality during the summer. Movement away from calving sites corresponded to higher calf survival and appeared to be in response to increased access to forage during the peak demands of lactation and/or minimizing gray wolf risk in the summer."

	Table 2 continued		
ADFG 2024	*Western Arctic Caribou Management Report and Plan, Game Management Units 21D, 22, 23, 24, and 26A: Report Period 1 July 2012 – 30 June 2017, and Plan Period 1 July 2017 – 30 June 2022*	24	"Predation was determined as the cause in 49% of mortality (*n*=50) and was comprised of 14% wolf predation (*n*=14), 10% bear predation (*n*=10), and 25% unknown predation (*n*=25)."
Lima and Dill 1990	*Behavioral decisions made under the risk of predation: a review and prospectus*	619, 629	"Predation has long been implicated as a major selective force in the evolution of several morphological and behavioral characteristics of animals." "The information reviewed above strongly suggests that many aspects of decision making in animals are sensitive to the risk of predation."
Wittmer et al. 2005	*The role of predation in the decline and extirpation of woodland caribou*	257	"… we found predation to be the primary cause of mortality in 11 of 13 subpopulations with known causes of mortality and predation predominantly occurred during summer. These results are consistent with predictions that caribou subpopulations are declining as a consequence of increased predation. Recovery … will thus require a multispecies perspective…"

Predator Observations by Local Residents and Traditional Knowledge

In addition to technical reports, Traditional Ecological Knowledge (TEK) of local subsistence hunters indicate that predators are a significant source of caribou mortality of WAH caribou as indicated by these selected statements from the Western Arctic Caribou Herd Working Group (WAHWG Roundtable 2021:41-48, see also WAHWG 2022, 2024).

2011

-LOTS of black and brown bears and wolves throughout Kotzebue Sound.
-Wolf packs big now. Wolves coming closer to villages; not as afraid of people.
-Lots of bear cubs; sows with three cubs.
-Barrow – Bad bear behavior last several years; cabin damage. Lots of grizzlies last summer.
-Anaktuvuk Pass – lots of grizzlies and wolves.
-Bettles – hunters saw lots of wolves.

2012

-Lots of wolves and bears; getting caribou the last few weeks (December 2012).
-Lots of wolves. Mentioned that if you see caribou, you will see wolves.
-Wainwright – Lots of bears everywhere this fall, bears were blocking caribou migration until we killed 9 of them in a 10-mile stretch of river.

2013

-Sisoalik – More bears along coast, very different than in the past. At Sisoalik, never saw tracks before, but now have to carry a gun while berry picking.
-Noorvik – Lots of brown and black bears, even near towns. Twenty years ago there were no bears; now numerous. Need to liberalize regulations to get more bears.
-Shungnak – Lots of bears (brown and black).
-Kivalina / Deering – Elders say there are a lot more bears.
-Wolves – Lots of wolves; more than in the past. A lot of wolves around villages. Eat the best part of the caribou. At Shungnak, found two moose side by side completely eaten.
-Koyukuk – Bears (grizzlies) increasing every year. They are killing black bears. Lot's of grizzly tracks.
-Allakaket – Lots of grizzlies, increasing. Hardly any moose.
-Wainwright – A lot of people catching more wolves and wolverines, but few bears.
-Brooks Range Aviation (North Slope) – Lots of wolf and bear sightings by clients.

2014

-Lots of brown bears and wolves.
-More brown bears than black bears.
-Bears breaking into cabins along the coast (Sisualik). This used to be rare, but this year 12 of 13 cabins were broken into by bears.
-Noatak – Lots of bears and wolves. Bears in the village.
-Kobuk, Ambler, Shungnak – Wolves in villages. Also lots of bears in Upper Kobuk. People want to hunt black bear more than brown bear.
-Kivalina – Few bears, no marine mammals. Lots of wolves.
-Selawik – Bear and wolf tracks on every bar.
-Deering – Three wolf packs with pups near village; population expanding fast. About 40 bears near Deering.
-Kotzebue – Four wolves near Kotzebue all year.
-Traveling Kotzebue to Wulik River – saw 19 bears; lots of sows with three cubs. No moose. Heard wolves howling every night and tracks on every bar.
-Bear tracks a few weeks ago on lower Noatak River; maybe a polar bear.
-Seeing lots of grizzlies.
-Wolves weren't all that common 50 years ago, but came to the area with the caribou and now wolves are staying there year-round. Wolves are impacting moose, muskox and reindeer.
-Bears and wolves are increasing in numbers.

2015

-Noorvik – We have a lot of predators, a lot of wolves.
-Kobuk, Ambler, Shungnak – Wolves in villages. Also lots of bears in Upper Kobuk. People want to hunt black bear more than brown bear.
-Kivalina – Few bears, no marine mammals. Lots of wolves.
-Selawik – Bear and wolf tracks on every bar.
-Deering – Three wolf packs with pups near village; population expanding fast. About 40 bears near Deering.
-Kotzebue – Four wolves near Kotzebue all year.
-Wolves are hard on the caribou. When snow is high, they get a bunch.

-People in Southern Penn (GMU 22) villages say they are seeing more wolves.

2016

-Lots of big bear around [Game Management Unit] 24B. Need to do something about this. People don't eat big bears anymore, so they don't kill them so there is lots of big bears now.
-Lots of wolves, low black bear.
-There was an increase in wolves & bears.

2017

-There are more bears and wolves.
-We had more bears coming through last year and maybe a couple wolves around our area.
-The bear sign are healthy also as are the wolves.

2018

-There are more grizzly bears in Koyukuk River. They kill moose and caribou.
-Lots of wolves.
-Bears are seen in the area from April–October and have scared just about everything around the area they are at.
-The same with the wolves and wolverines. Scared caribou away from the area they are at.
-Wolves—too many in our region.
-They are still being seen in our areas with bear numbers increasing. We have plenty of bears & wolves.

2019

-In Allakaket – had state predator control for wolves; grizzly bear population increasing – not too many black bears.
-Same in Nulato – lots of grizzlies, but not as many black bears; grizzly bears will eat black bears and get them in their dens; know they're super healthy when see a sow with 3 cubs; know not as healthy when only see a sow with one cub. Right now, see most grizzlies with 3 cubs.

Hunting

Roads increase hunter access and caribou will avoid roads when hunted from them (Plante et al. 2017). The WAH is hunted by local subsistence hunters and non-local sport hunters. Hunting mortality is about 5% to 40% of caribou mortality (Figure 13) and is considerably less than mortality from natural causes including predators (65% to 90%, Figures 12 and 13). The hunting harvest has been relatively stable since 1998 and likely did not initiate the WAH decline from 2003 to 2023. Approximately 13,000 to 14,000 caribou (2% to 5%) of the WAH is harvested per year (Figures 16 and 17). Harvest data do not include caribou that might have been wounded or killed and not recovered. Field observations suggest that there might be substantial numbers of unrecovered wounded caribou.

Local Subsistence Hunting

Local hunters in the WAH range harvested an average of 13,000 caribou per year (about 95% of the total harvest) since the late 1990s (Figures 17, 18). Subsistence hunters harvest caribou in the WAH range year-round when they are available, but most are harvested in late October to early May on snowmachines, and on boats and all-terrain vehicles during the summer and early fall. Seasonal movements of caribou determine WAH harvests among communities. Aircraft are not often used by local caribou hunters.

Cow caribou are an important part of the subsistence harvest. Bulls are in the rut from around October 7 to12 until late October and their meat has a strong odor and flavor that is considered inedible by many people. From the rut to the end of December, subsistence hunters will often harvest cows more than bulls (Dau 2015:14-30). Reducing the harvest of cows is an important factor that can help stop the recent population decline (WAHWG 2022).

Despite the WAH decline since 2003, local hunters harvest about the same number of caribou as in the past in some communities (e.g., Noatak and Ambler), although with increased cost and effort. In some areas, more cows are harvested than were previously. Some communities (e.g., Unalakleet and Noatak), have not harvested enough caribou to meet their needs in some years.

Non-Local Sport Hunting

Non-local sport hunters harvest about 650 WAH caribou per year, which is about 5% of the total WAH caribou hunter harvest (Figure 17). Most nonlocal hunter harvest bulls. A high percentage (85–90%) of caribou harvested by nonlocal hunters are taken between August 25 and October 7. Non-local hunters generally take few cows (about 40–80 cows per year). There has been no clear change in numbers of nonlocal WAH caribou hunters during the fall hunting season since 1998.

Non-local hunting has created conflicts between subsistence hunters, non-local hunters, guides, and air taxi services, for more than 40 years. Most non-local hunters use airplanes to access hunting areas. A concern is that non-local hunters displace caribou from traditional subsistence hunting areas (Dau 2015:14-38) because both non-local and subsistence hunters might compete for animals in relatively narrow, but variable, migration areas.

Conclusions

The available information suggests the Ambler Road is unlikely to have significant impacts on the WAH caribou because:

> The proposed Ambler Road is not in the majority of the WAH traditional migration routes, especially in recent years. The primary migration routes have been west and north of the proposed Ambler Road. The number of collared WAH caribou moving across the proposed Ambler Road route during fall migrations and winter has been small in past years.

The primary factors that negatively impact the Western Arctic Caribou Herd are predation by bears and wolves and winter weather and icing events. Impacts of the Ambler Road on caribou will likely be minor compared to these other factors.

Caribou regularly cross highways and mining roads during migrations elsewhere in Alaska and Canada.

The Ambler Road will be closed to the public with only mining vehicle traffic, and no hunting will be permitted on or from the road.

The proposed Ambler Road will not be in most of the WAH traditional winter range. A small proportion ($\leq$ 4%) of the WAH has occurred within 3.1 miles of the proposed Ambler Road in winter.

The proposed Ambler Road will occur in portions of the WAH range (Figure 21). Potential impacts of the Ambler Road project on caribou include habitat loss, disturbance, and delaying caribou in their fall migration. Assessment of potential impacts relies on existing data for caribou numbers, distribution, and movements. Impact predictions therefore necessarily rely on the past trends continuing. The WAH has had the same general movement patterns for more than 50 years (Dau 2015:14-17) so it is reasonable, but not certain, that these patterns with their inherent variation will continue.

The amount of WAH winter habitat that might be directly lost due to the Ambler Road is small. The proposed Ambler Road overlaps a relatively small amount of the WAH winter range and disturbance is likely to be small. There is the potential for the road to delay or block some migrating caribou as was seen at the Red Dog Mine Road. However, this will not likely be significant because the proposed Ambler Road has not been in the primary migration routes or in a large portion of the WAH winter range. In addition, the proposed Ambler Road will have a policy of no public access and no hunting from the road.

Because blocking or delaying migration is a concern for the proposed Ambler Road, it is important to recognize that other caribou herds regularly cross roads during migrations. Examples of this include the Central Arctic Herd, the Forty-Mile Herd, the Nelchina Herd, and the Porcupine Herd (TAPS 2001, Johnson and Russell 2014, Russell and Gunn 2019, ADFG 2000, 2021). This suggests that caribou regularly cross roads depending on other factors, primarily human disturbance and hunting.

The overall impact of the proposed Ambler Road on the WAH caribou herd numbers will likely be small compared to other factors, including predators, winter weather, and hunting. Winter weather (snow and icing events) can cause substantial mortality of WAH caribou. Predators, specifically grizzly bears and wolves, are potentially the largest source of WAH caribou mortality. Subsistence and sport hunting cause less caribou mortality than winter weather and predators.

Given the extensive movements of caribou and the millions of acres of available habitat in western Alaska, potential habitat loss of forage vegetation would be relatively minor (BLM 2024).

The proposed Ambler Road will have a policy of no public access and no hunting from the road. Other mitigation measures could be implemented to reduce impacts including restricting traffic when migrating caribou approach the road and installing overpasses or underpasses in appropriate areas. These measures can minimize impacts of the road on caribou.

Predator control can be considered by the State of Alaska and Federal government to achieve management objectives for the WAH. Regulating caribou and predator hunting in accordance with the WAH numbers and distribution could be continued by the State of Alaska and Federal governments.

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Figures

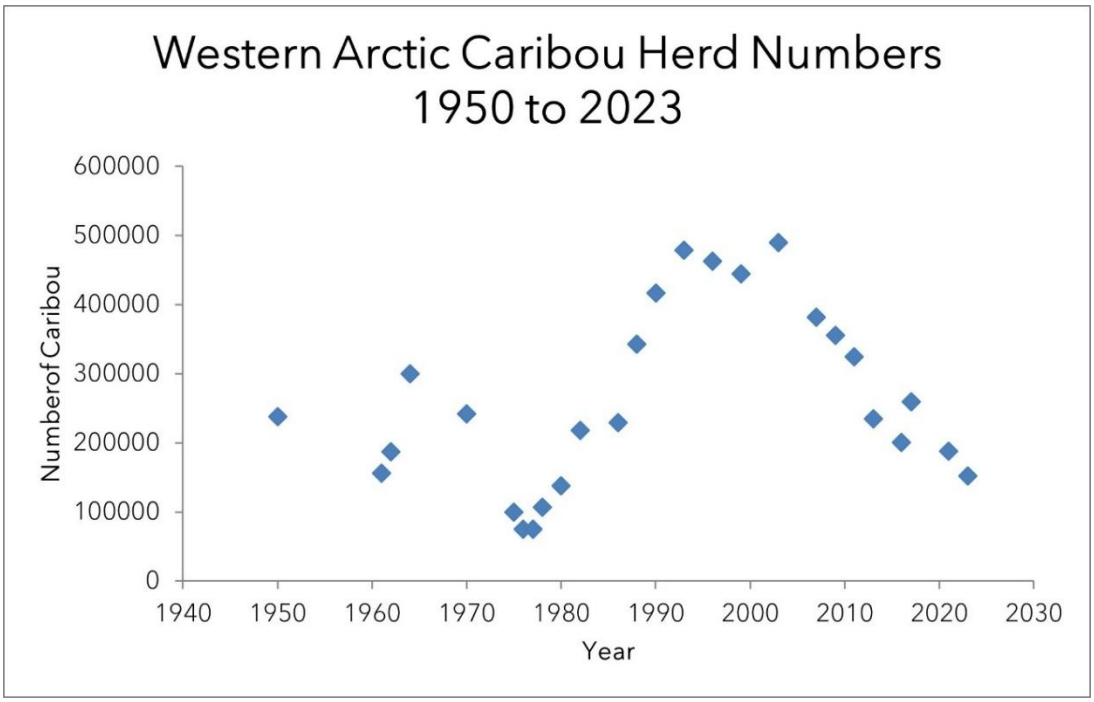

Figure 1. Western Arctic Caribou Herd population numbers between 1950 and 2023.

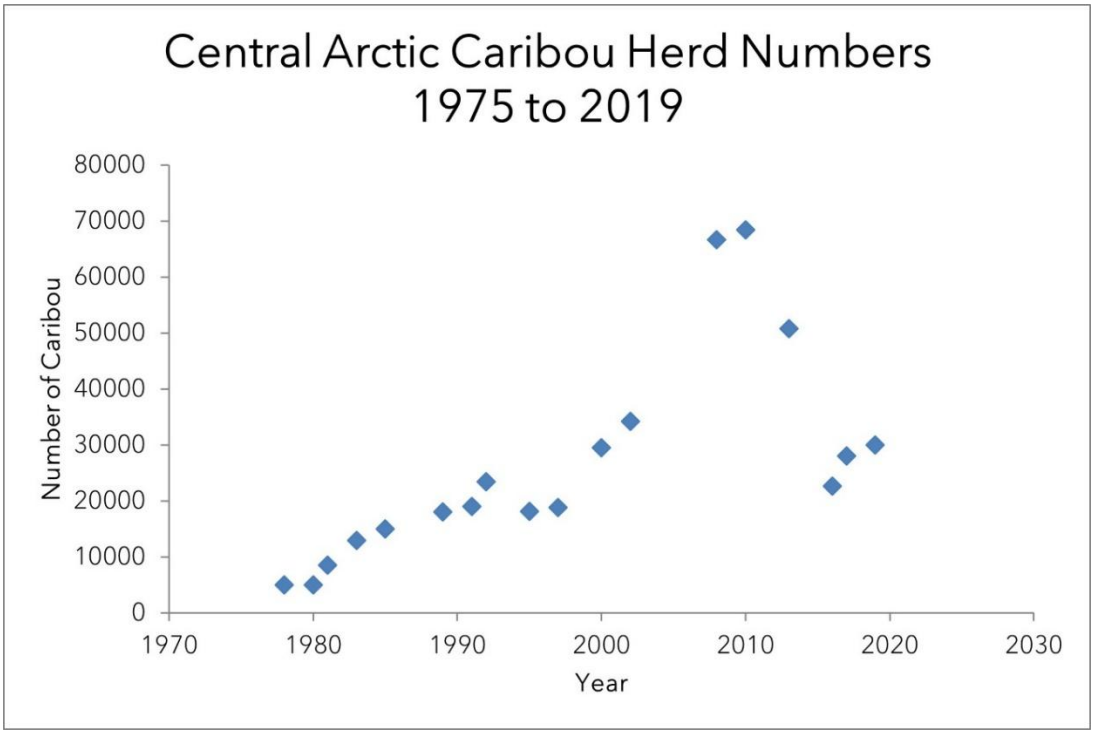

Figure 2. Central Arctic Caribou Herd population numbers between 1975 and 2019.

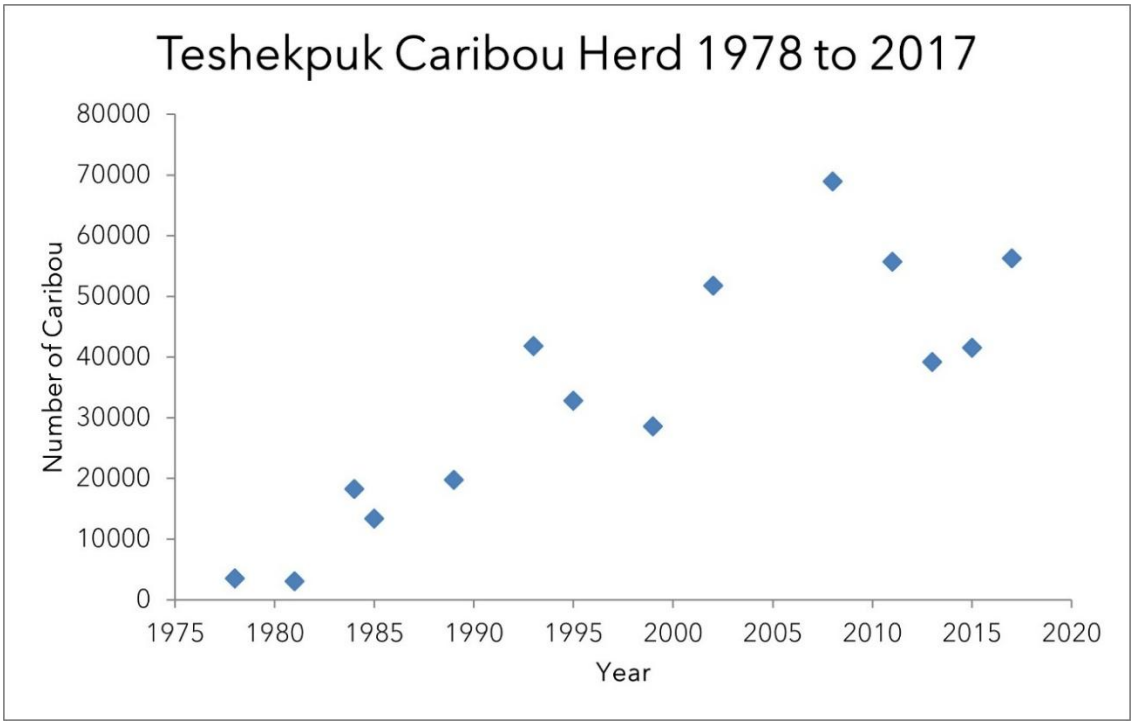

Figure 3. Teshekpuk Caribou Herd population numbers between 1978 and 2017.

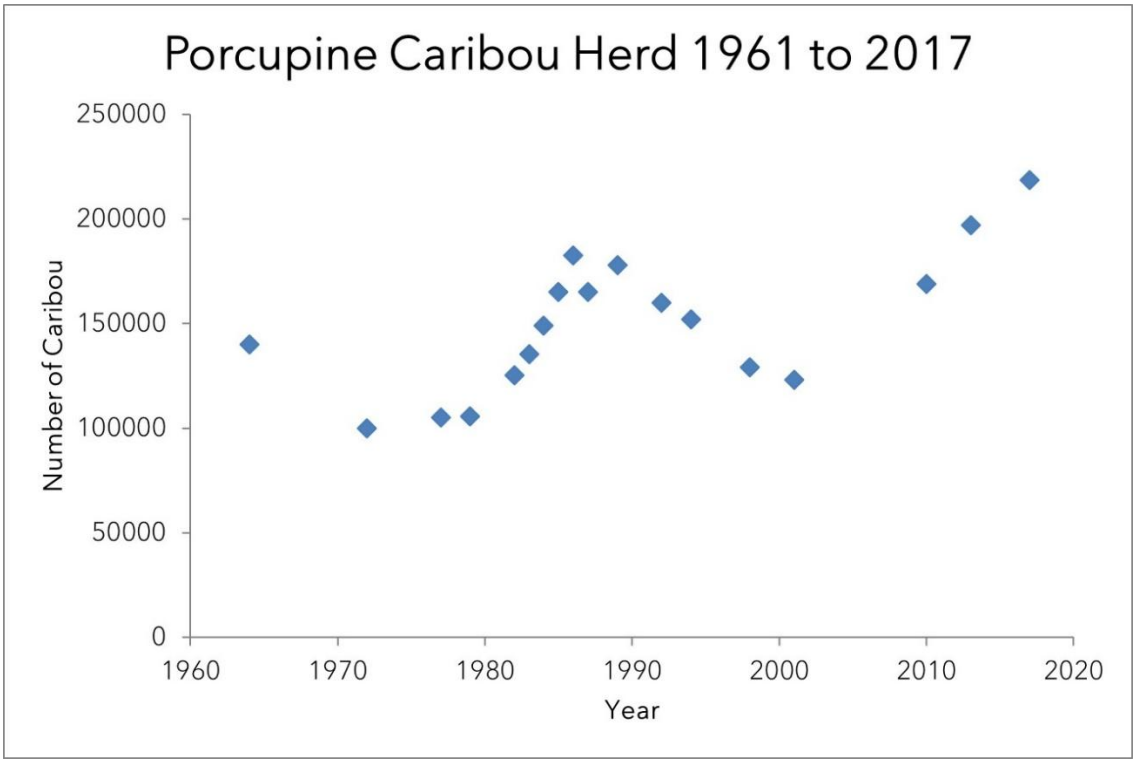

Figure 4. Porcupine Caribou Herd population numbers between 1961 and 2017.

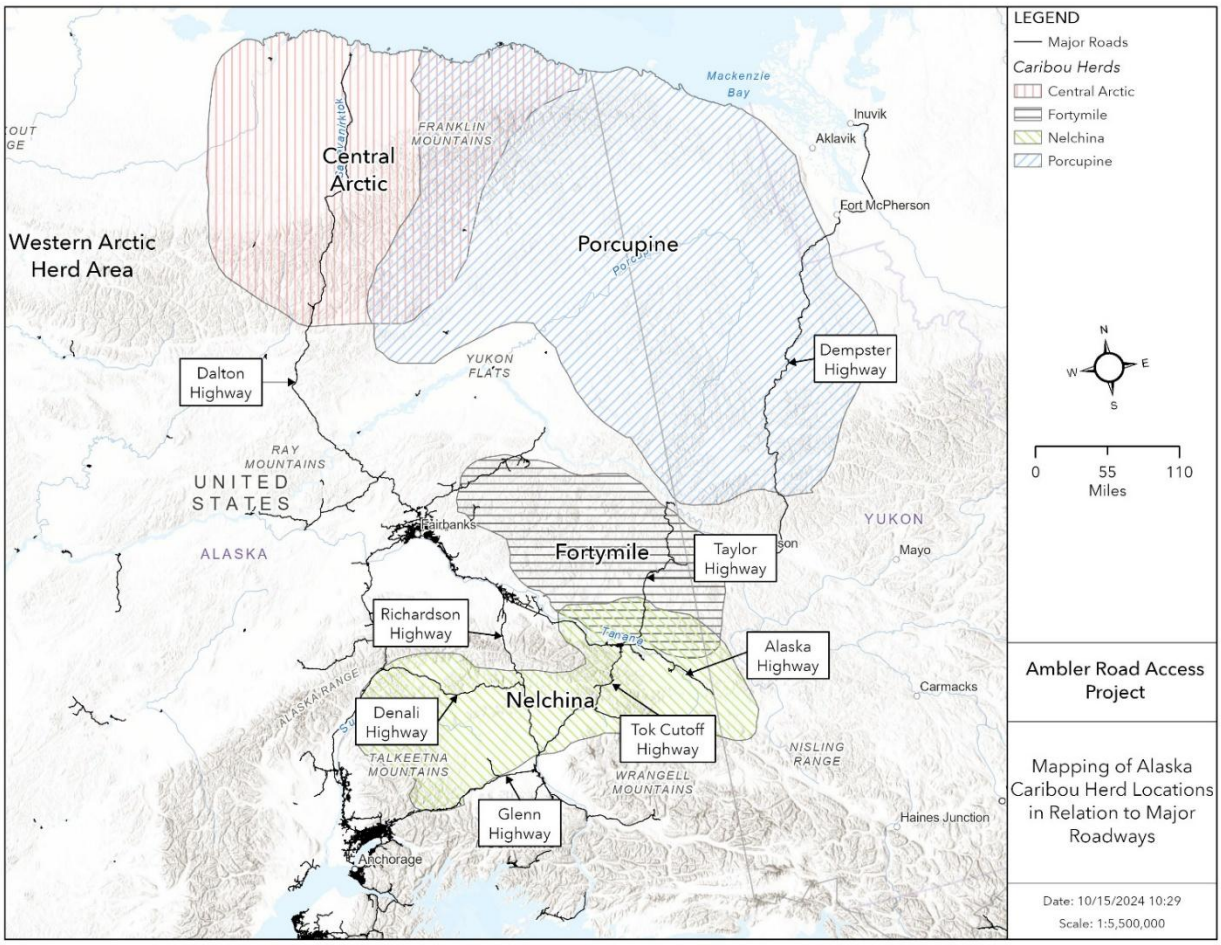

Figure 5. Ranges of the Central Arctic, Porcupine, Fortymile, and Nelchina caribou herds in relation to major highways in Alaska and the Yukon Territory, Canada.

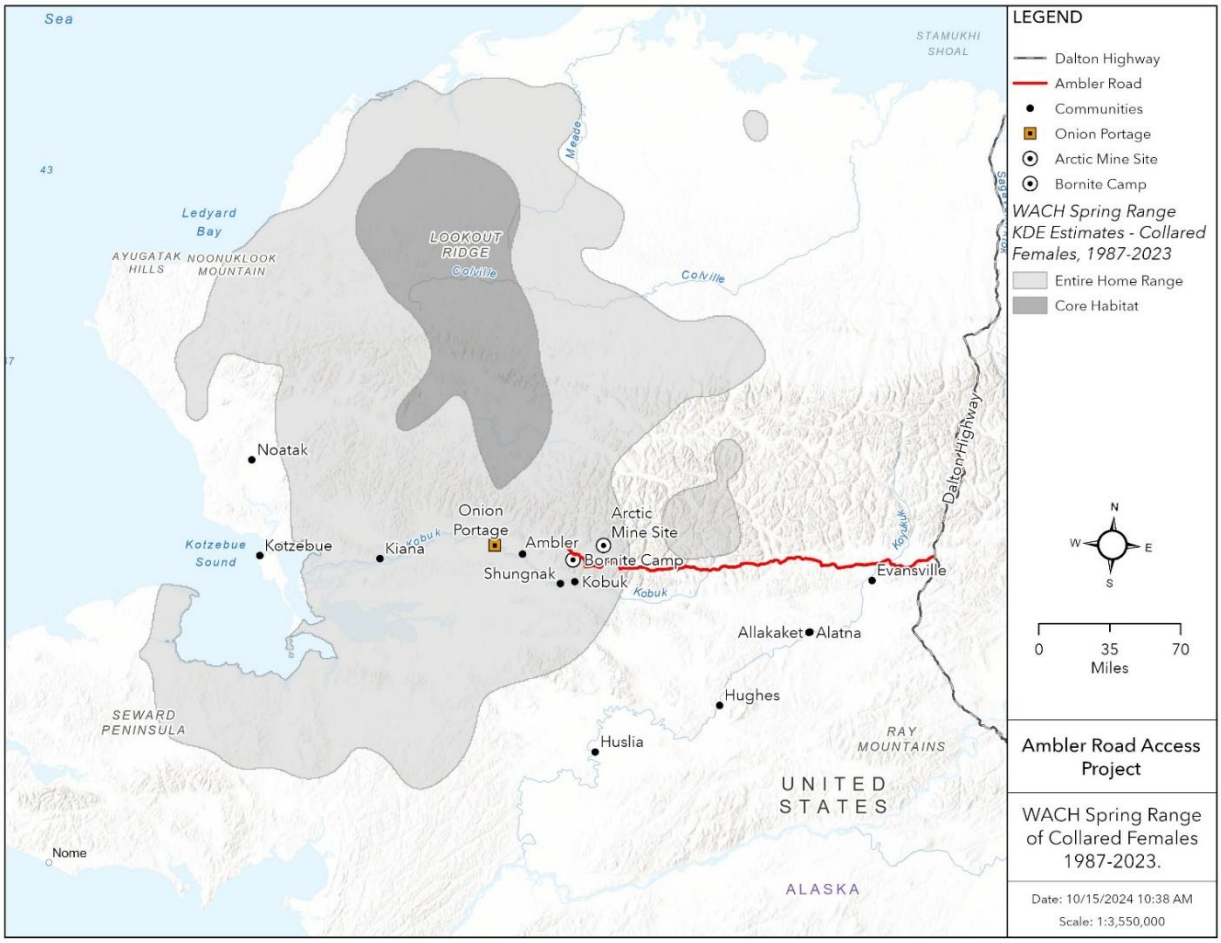

Figure 6. Western Arctic Caribou Herd spring range estimated from collared cow caribou between 1987 and 2023. The map shows the spring range in relation to the proposed Ambler Road Alternative A. Darker shading indicates higher use by collared caribou.

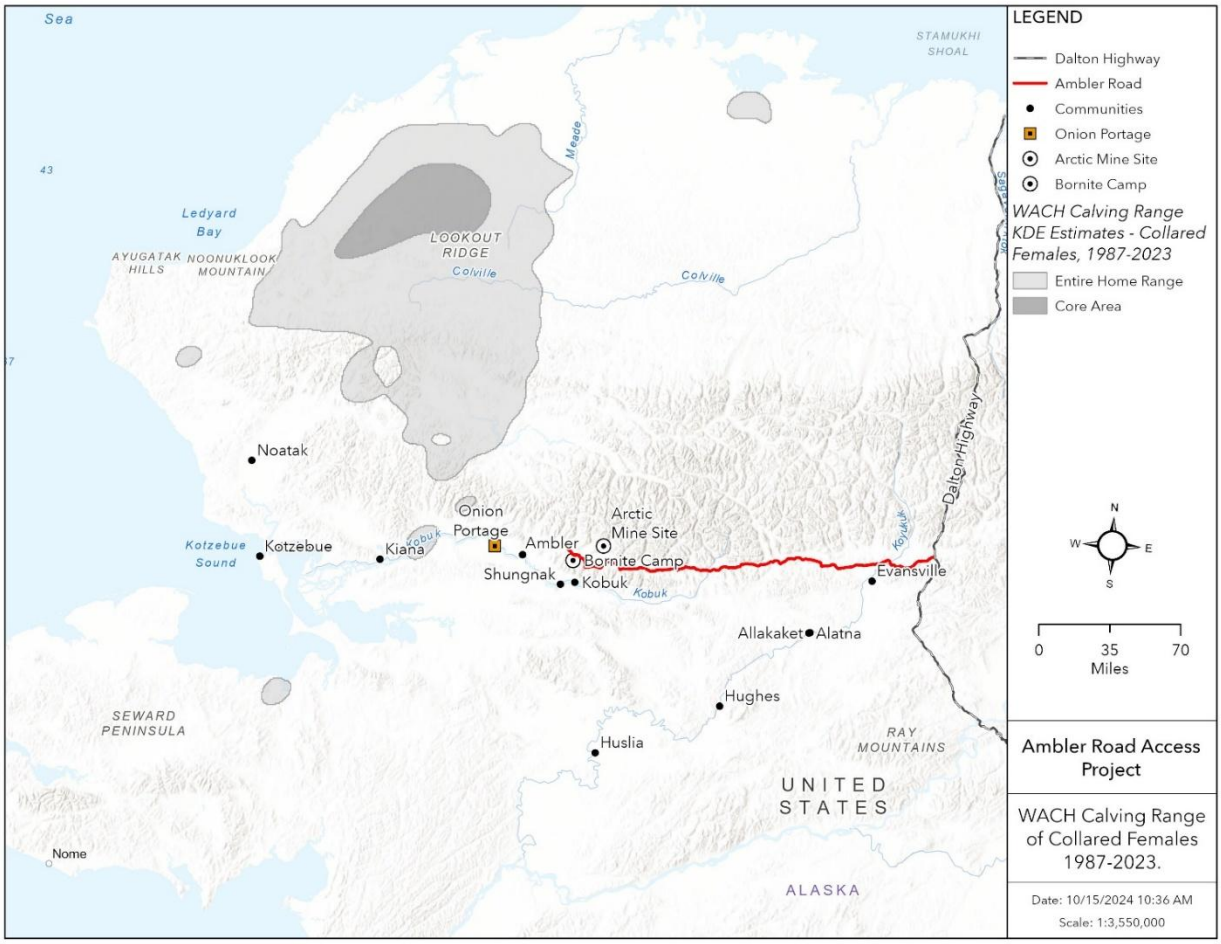

Figure 7. Western Arctic Caribou Herd calving range estimated from collared cow caribou between 1987 and 2023. The map shows the calving range in relation to the proposed Ambler Road Alternative A. Darker shading indicates higher use by collared caribou.

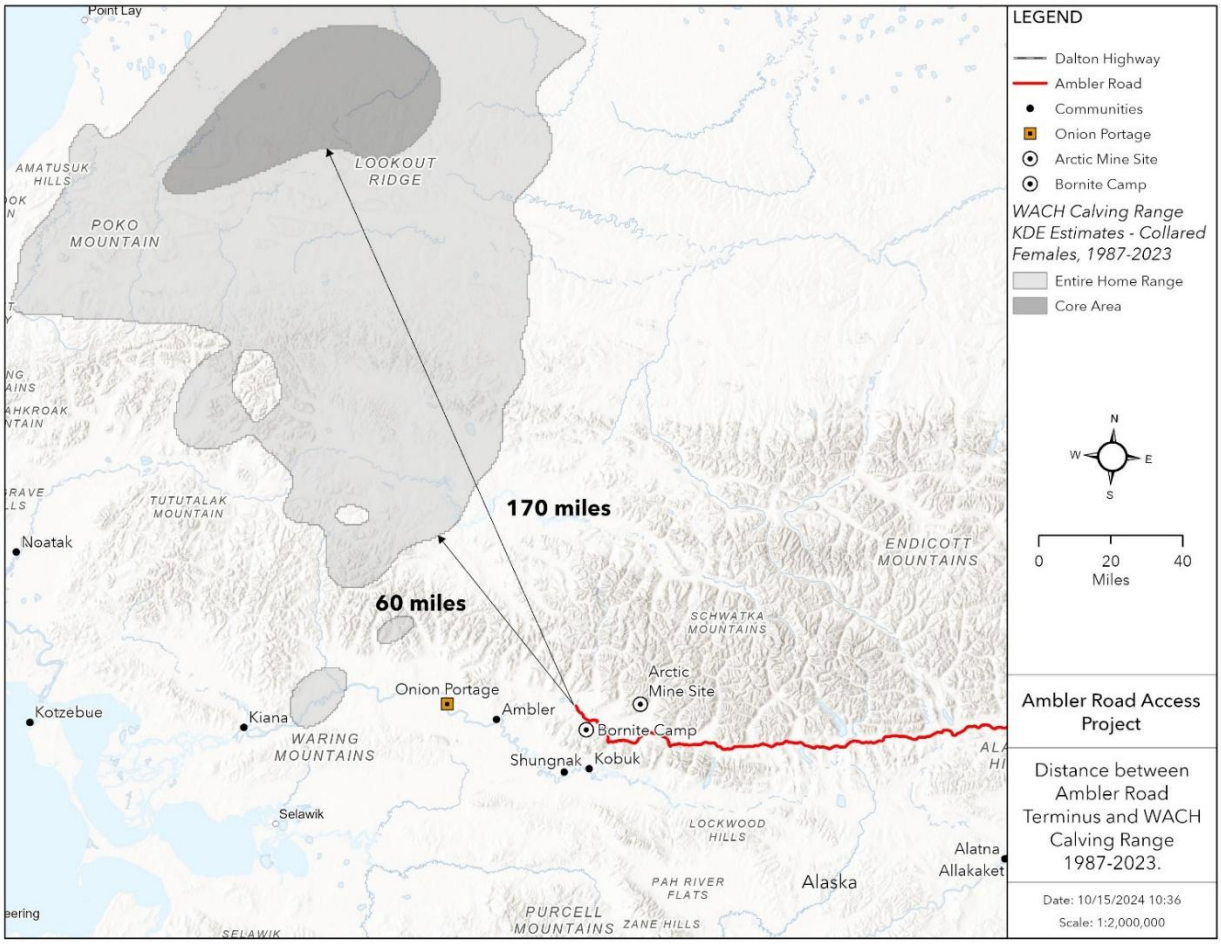

Figure 8. Distances between estimated Western Arctic Caribou Herd calving range and the proposed Ambler Road Alternative A. The map shows the distances between the calving range and the terminus of the proposed Ambler Road Alternative A. The terminus of Ambler Road is 60 miles away from the home range area, and 170 miles away from the core habitat for calving. Darker shading indicates higher use by caribou.

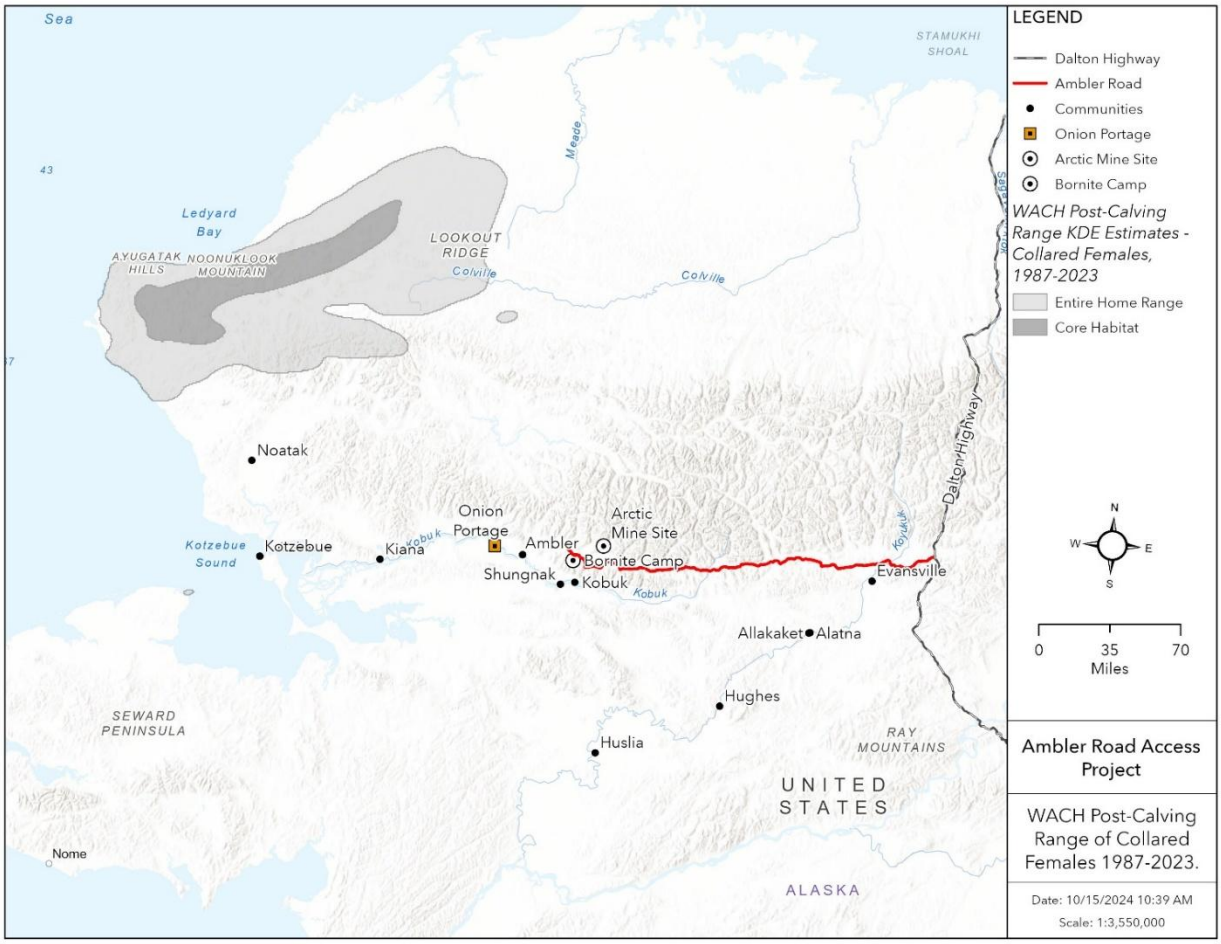

Figure 9. Western Arctic Caribou Herd post-calving range estimated from collared cow caribou between 1987 and 2023. The map shows the post-calving range in relation to the proposed Ambler Road Alternative A. Darker shading indicates higher use by collared caribou.

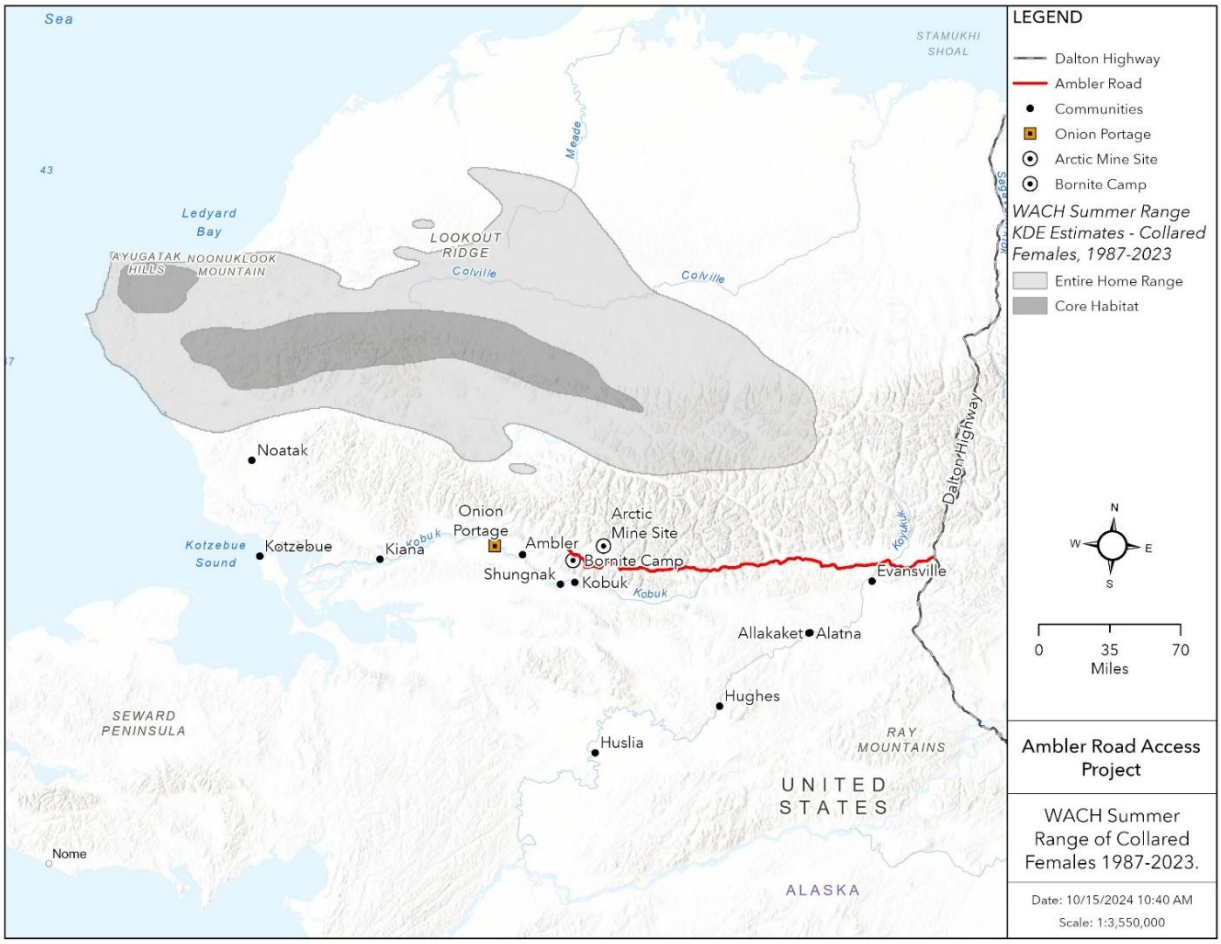

Figure 10. Western Arctic Caribou Herd summer range estimated from collared cow caribou between 1987 and 2023. The map shows the summer range in relation to the proposed Ambler Road Alternative A. Darker shading indicates higher use by collared caribou.

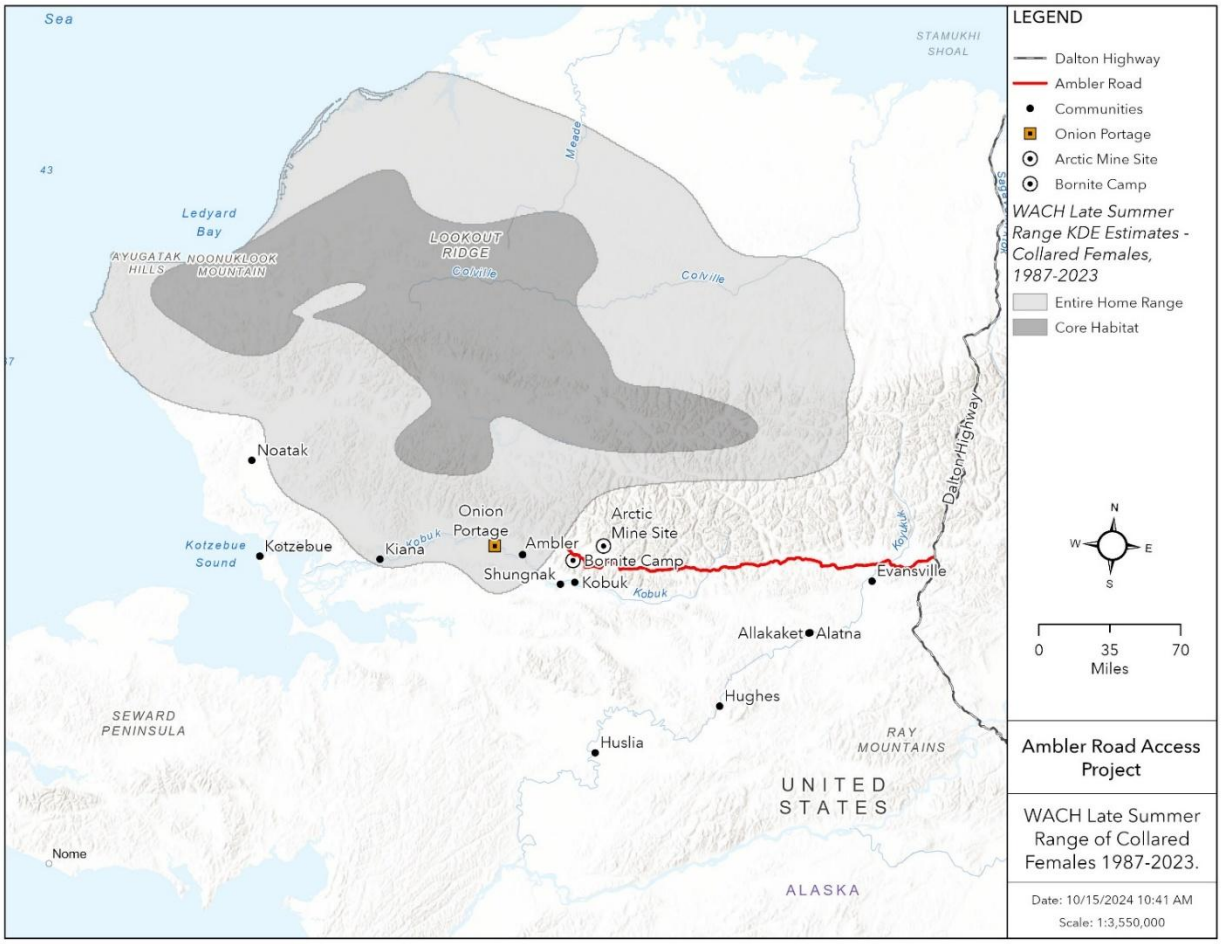

Figure 11. Western Arctic Caribou Herd late summer range estimated from collared cow caribou between 1987 and 2023. The map shows the late summer range in relation to the proposed Ambler Road Alternative A. Darker shading indicates higher use by collared caribou.

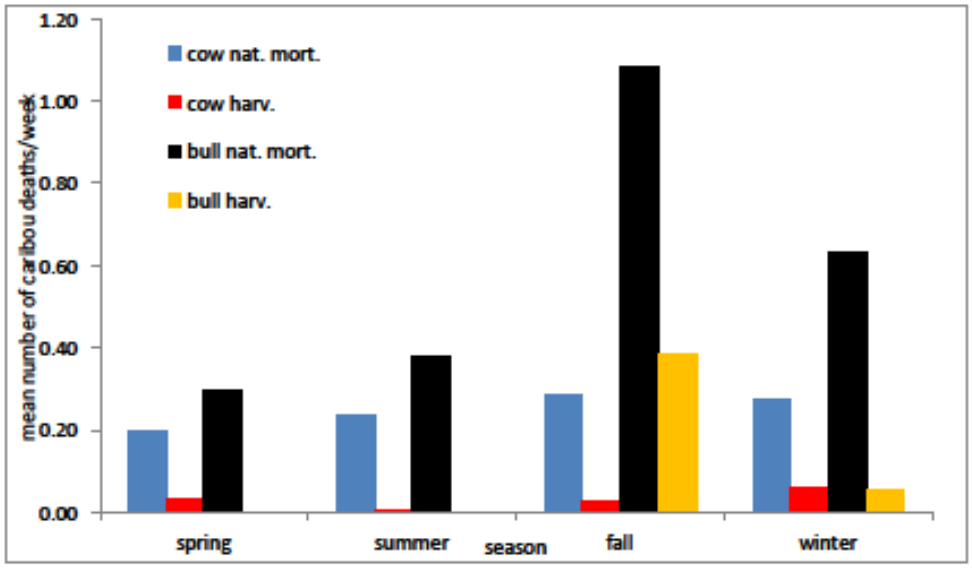

Figure 12 (Figure 31 from Dau 2015). "Seasonal mortality of radio collared caribou by sex, CY92 through CY14 (all years combined); sample sizes for each sex standardized to 100 individuals/yr to compensate for annual differences in the total number of collared individuals and variable samples sizes between bulls and cows." "harv." Indicates hunting mortality and "nat." indicates natural mortality.

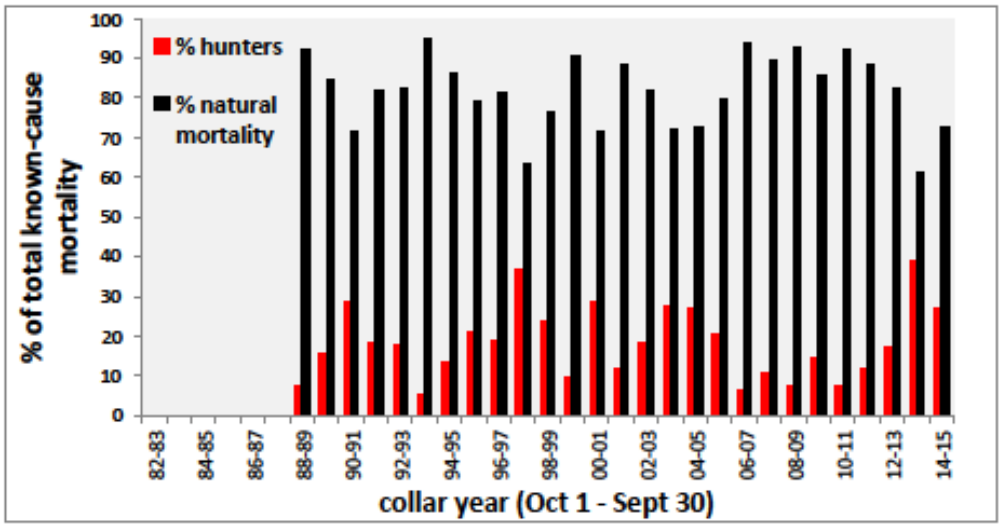

Figure 13 (Figure 32 from Dau 2015). "Percentage of total known-cause caribou mortality attributed to hunters (red bars) vs. natural factors (black bars), Western Arctic caribou herd, CY83-CY15. Data based on radio collared bulls and cows, and excludes all unknown-cause mortalities. Years with <10 known-cause mortalities are excluded."

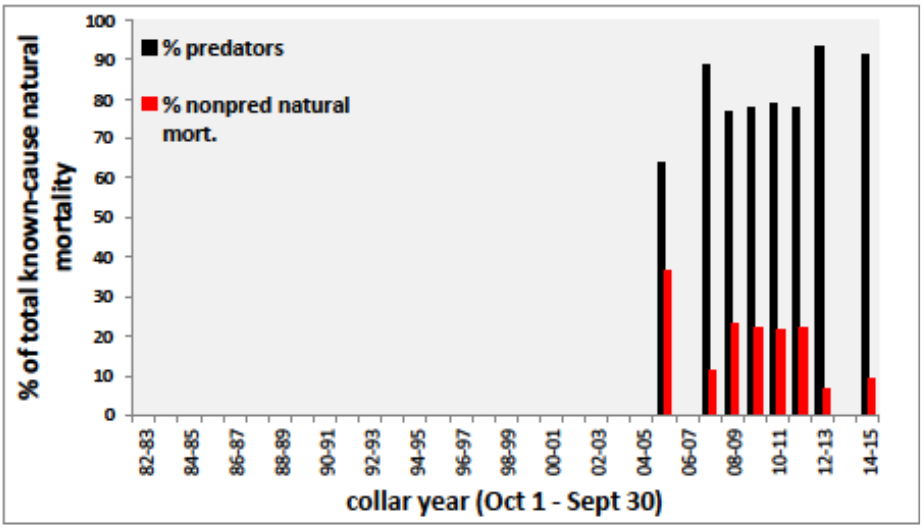

Figure 14 (Figure 33 from Dau 2015). "Percentage of total known-cause natural mortality attributed to predators (black bars) vs. other natural causes (red bars), Western Arctic caribou herd, CY83-CY15. Data based on radio collared bulls and cows, and excludes all unknown-cause mortalities as well as natural mortalities for which cause of death was uncertain. Years with <10 known-cause mortalities are excluded."

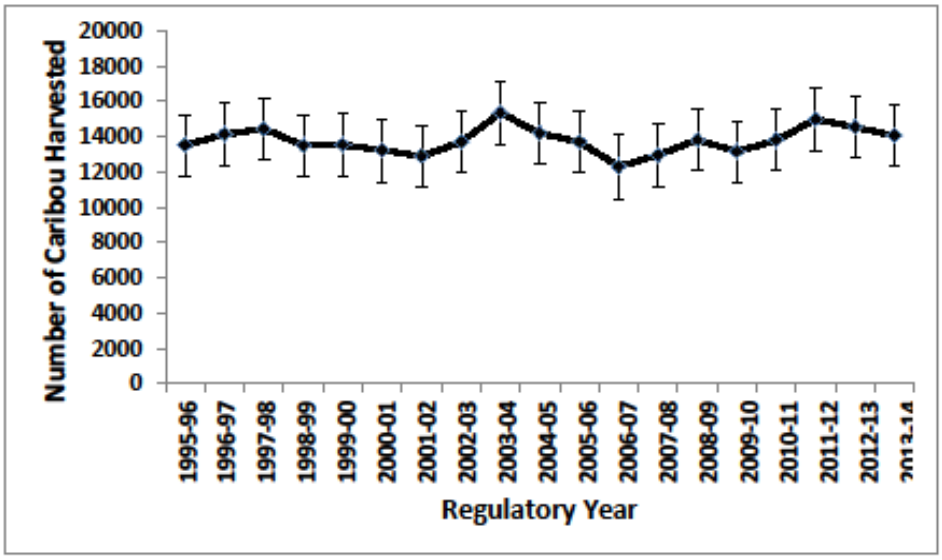

Figure 15 (Figure 34 from Dau 2015). "Estimated annual caribou harvest and 95% confidence intervals (vertical lines) by hunters living within the range of the Western Arctic caribou herd, RY95-RY13."

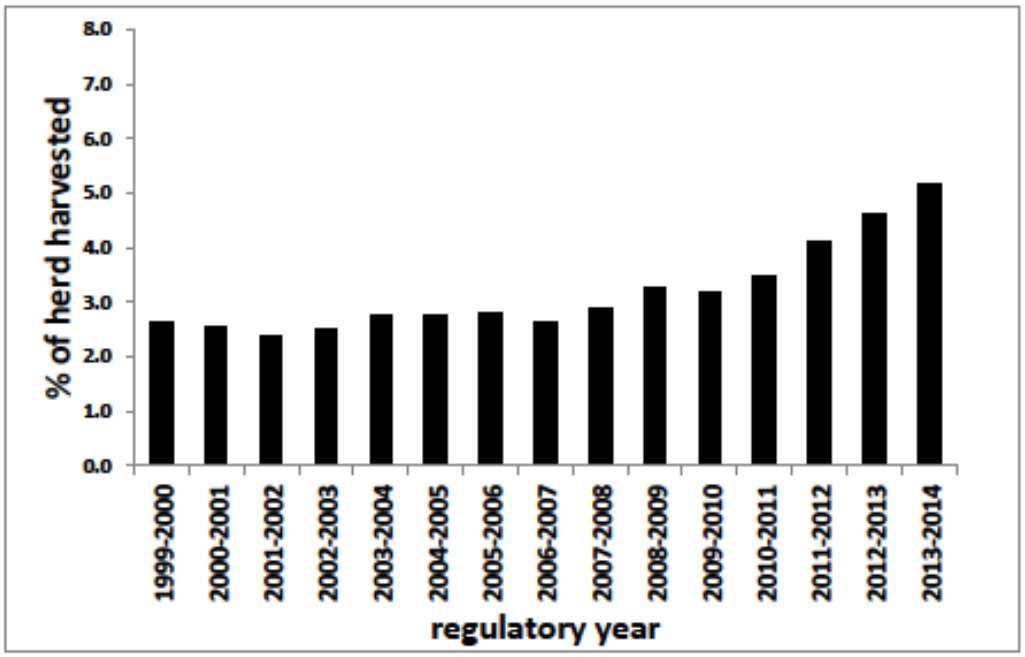

Figure 16 (Figure 35 from Dau 2015). "Percentage of the WAH harvested annually, RY99-RY13."

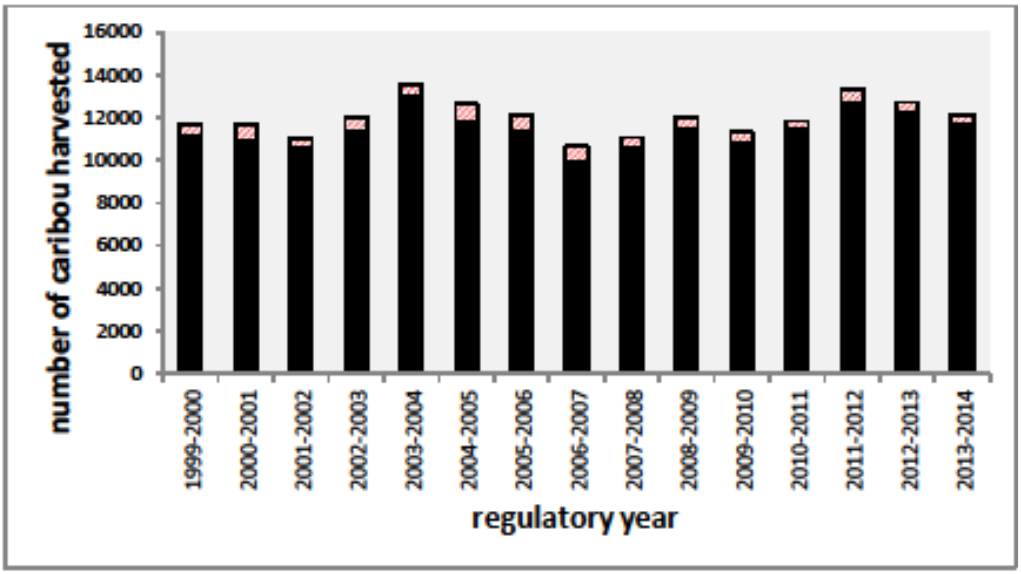

Figure 17 (Figure 39 from Dau 2015). "Total harvest by local (black bars) and nonlocal (red patterned bars) hunters, Western Arctic caribou herd, RY99-RY13."

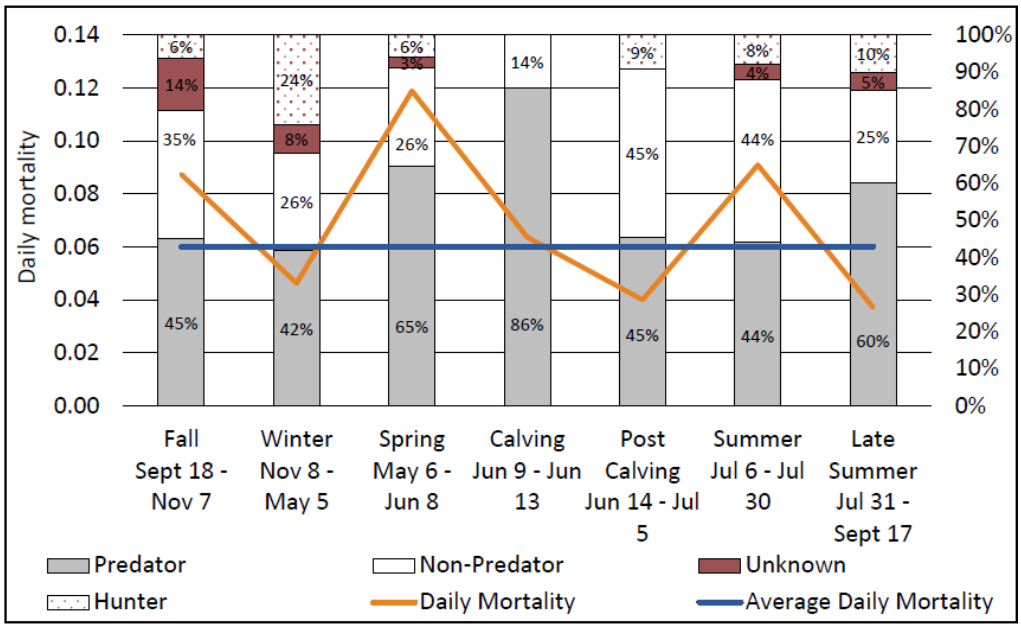

Figure 18 (Figure 10 from ADFG 2024). "Average seasonal collared Western Arctic caribou herd cow mortality and cause, collar years 2006 – 2016, Alaska."

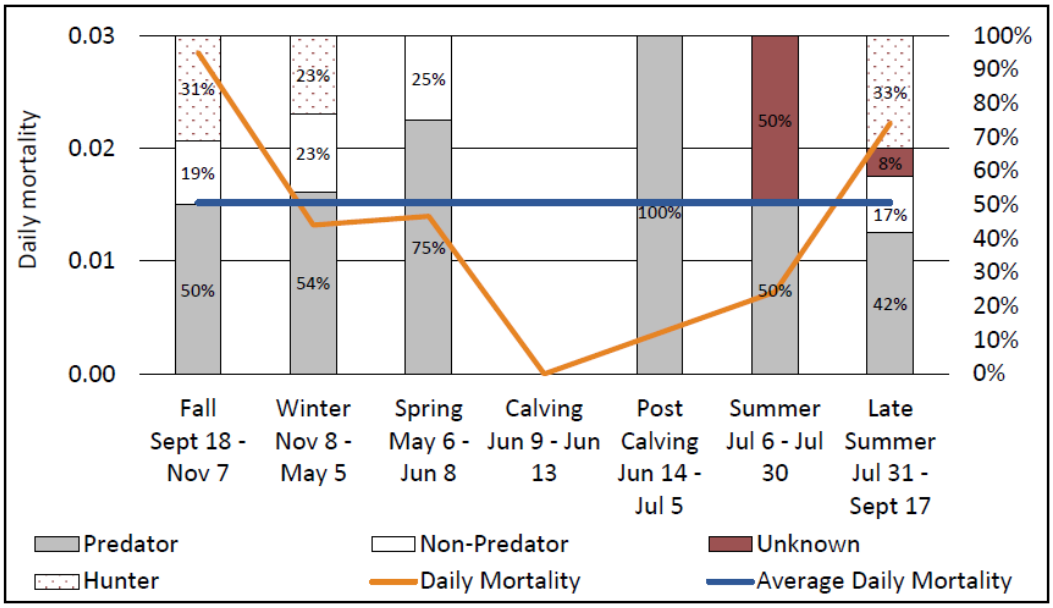

Figure 19 (Figure 11 from ADFG 2024). "Average seasonal collared Western Arctic caribou herd bull mortality and cause, collar years 2006 – 2016, Alaska. No collared bull mortality was detected during the calving season in regulatory years 2012 – 2016."

Western Alaska mining (AIDEA) infrastructure in relation to seasonal ranges of the Western Arctic Caribou Herd 2012-2017. From WAHWG (2019).

Proposed location of the Ambler Access Road **Location of the Red Dog Mine Road**

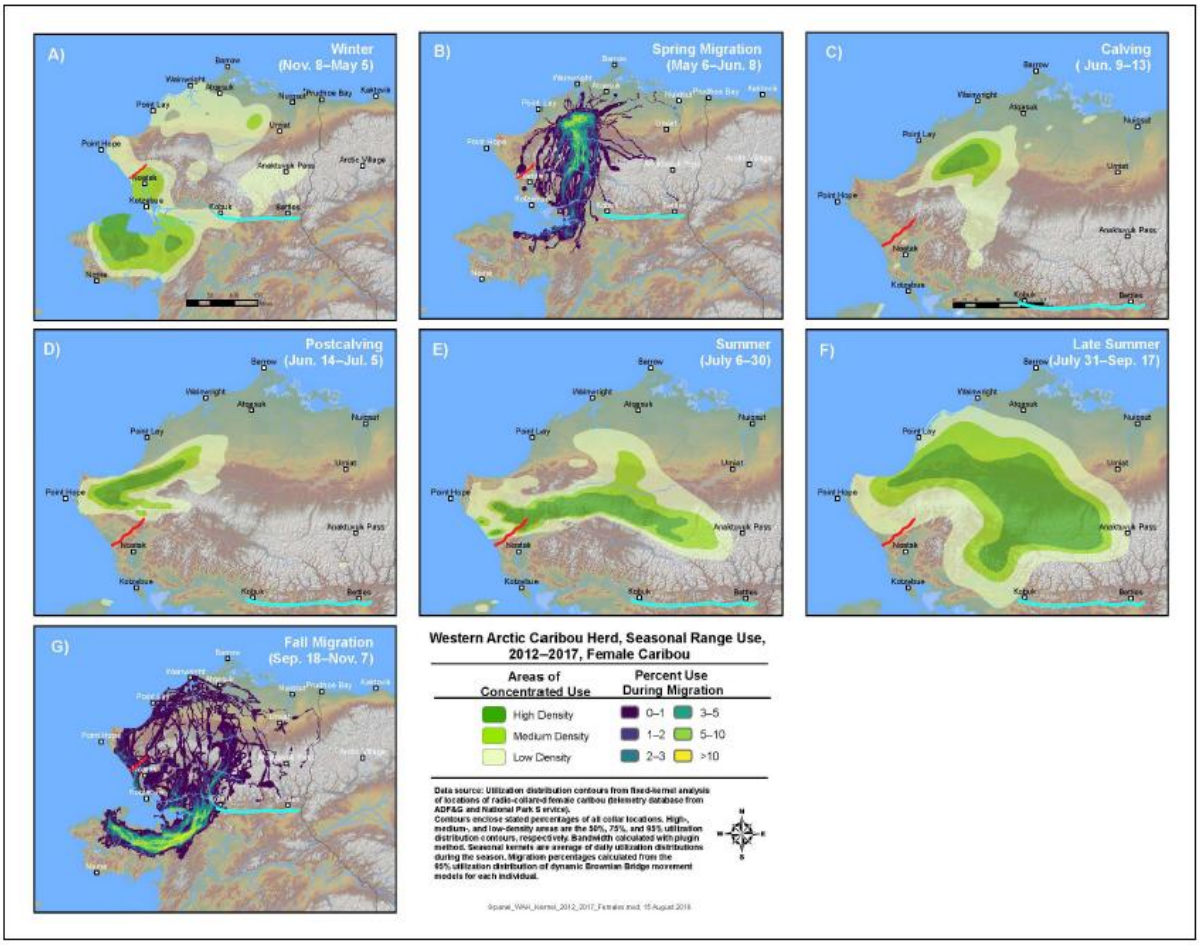

FIGURE 10: Seasonal ranges of the Western Arctic Caribou Herd for recent 5-year period, 2012-2017.

Figure 20. Seasonal Ranges of the Western Arctic Herd 2012 to 2017. Figure 10 in WAHWG (2019).

Western Alaska mining (AIDEA) infrastructure in relation to the annual range use of the Western Arctic Caribou Herd. From National Park Service (2024).

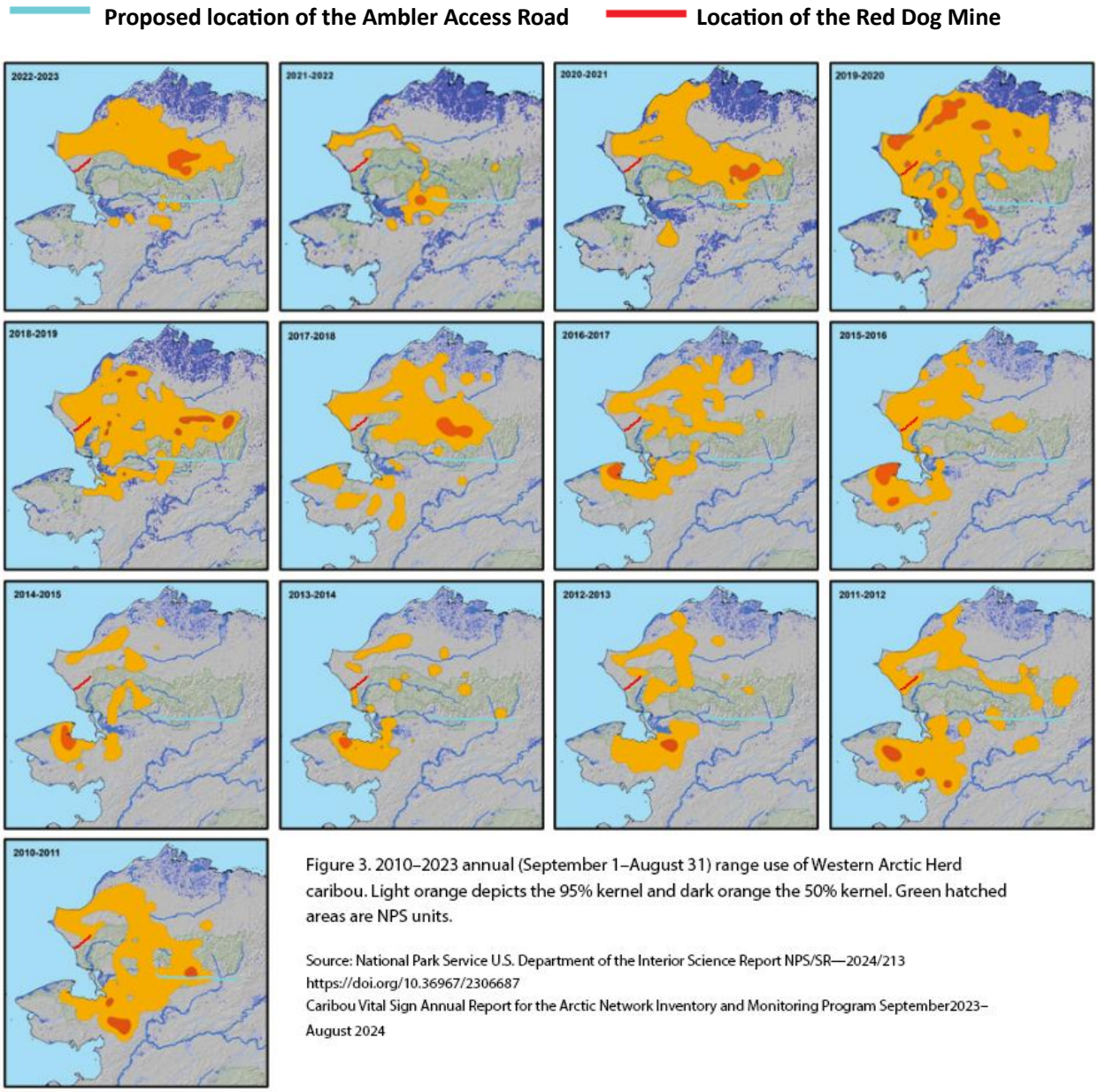

Figure 3. 2010–2023 annual (September 1–August 31) range use of Western Arctic Herd caribou. Light orange depicts the 95% kernel and dark orange the 50% kernel. Green hatched areas are NPS units.

Source: National Park Service U.S. Department of the Interior Science Report NPS/SR—2024/213
https://doi.org/10.36967/2306687
Caribou Vital Sign Annual Report for the Arctic Network Inventory and Monitoring Program September2023–August 2024

Figure 21. Annual range use of WAH caribou 2010 to 2023 by year. Figure 3 in National Park Service (2024). Light orange depicts the GIS 95% kernel and dark orange the 50% kernel. The green shading is National Park Units, not caribou distribution.

Western Alaska mining (AIDEA) infrastructure in relation to winter range use of the Western Arctic Caribou Herd. From National Park Service (2024).

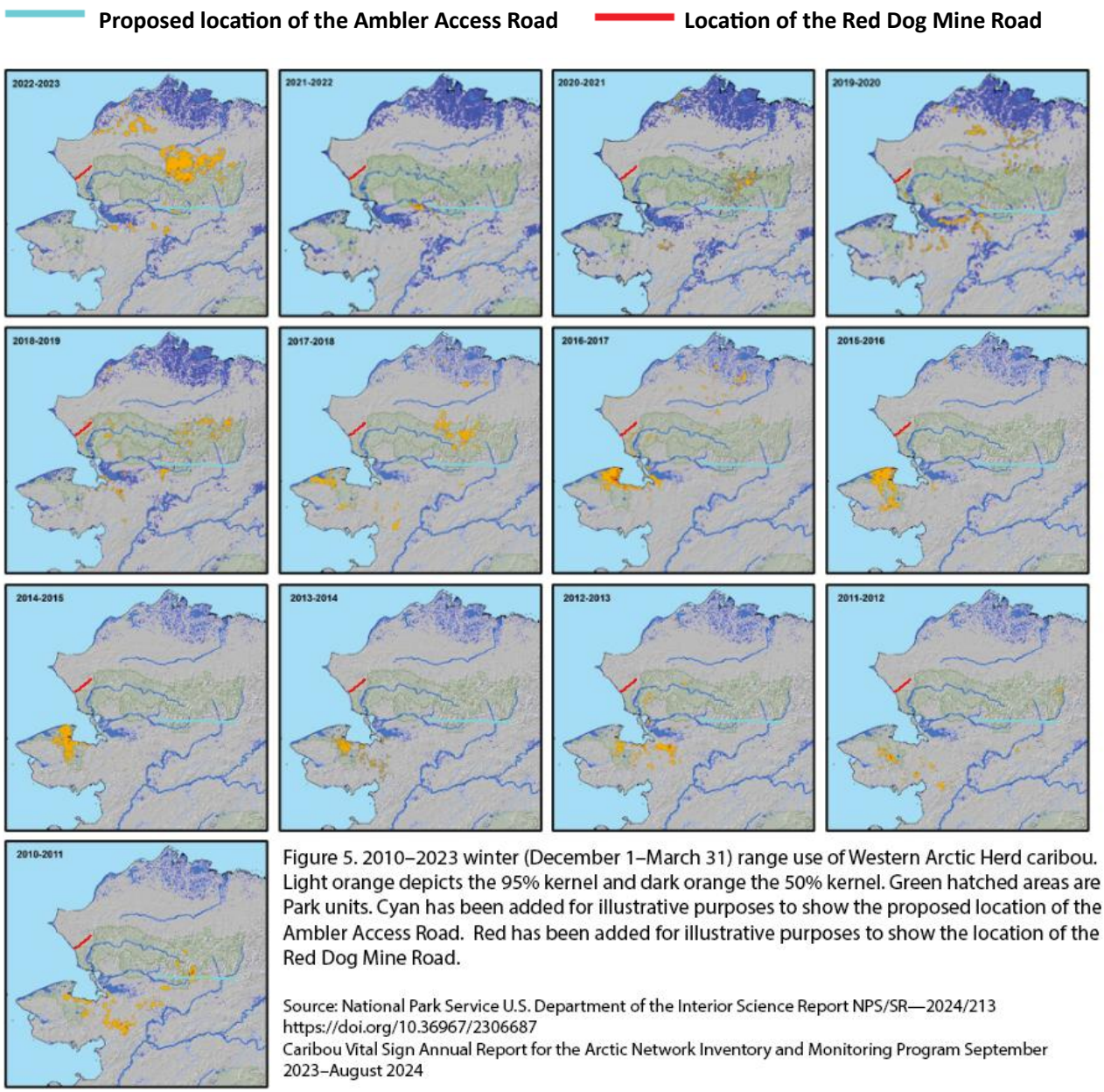

Figure 5. 2010–2023 winter (December 1–March 31) range use of Western Arctic Herd caribou. Light orange depicts the 95% kernel and dark orange the 50% kernel. Green hatched areas are Park units. Cyan has been added for illustrative purposes to show the proposed location of the Ambler Access Road. Red has been added for illustrative purposes to show the location of the Red Dog Mine Road.

Source: National Park Service U.S. Department of the Interior Science Report NPS/SR—2024/213
https://doi.org/10.36967/2306687
Caribou Vital Sign Annual Report for the Arctic Network Inventory and Monitoring Program September 2023–August 2024

Figure 22. Winter range use of WAH caribou 2010 to 2023 by year. Figure 5 in National Park Service (2024). Light orange depicts the GIS 95% kernel and dark orange the 50% kernel. The green shading is National Park Units, not caribou distribution.

Western Alaska mining (AIDEA) infrastructure in relation to the calving range use of the Western Arctic Caribou Herd. From National Park Service (2024).

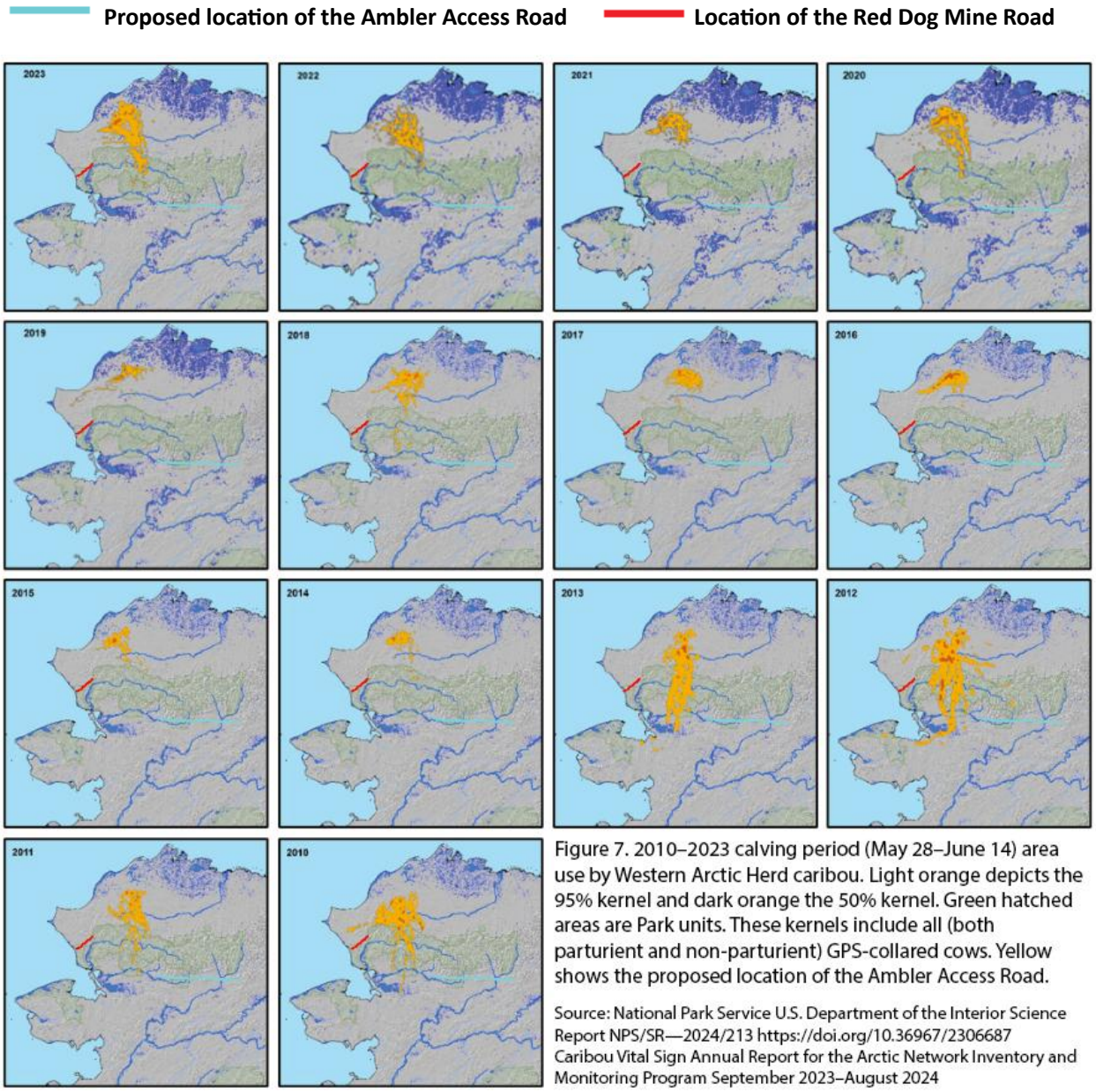

Figure 7. 2010–2023 calving period (May 28–June 14) area use by Western Arctic Herd caribou. Light orange depicts the 95% kernel and dark orange the 50% kernel. Green hatched areas are Park units. These kernels include all (both parturient and non-parturient) GPS-collared cows. Yellow shows the proposed location of the Ambler Access Road.

Source: National Park Service U.S. Department of the Interior Science Report NPS/SR—2024/213 https://doi.org/10.36967/2306687 Caribou Vital Sign Annual Report for the Arctic Network Inventory and Monitoring Program September 2023–August 2024

Figure 23. Calving ranges of WAH caribou by year. Figure 7 in National Park Service (2024). Light orange depicts the GIS 95% kernel and dark orange the 50% kernel. The green shading is National Park Units, not caribou distribution.

Western Alaska mining (AIDEA) infrastructure in relation to migratory routes of the Western Arctic Caribou Herd 2002-2017. From WAHWG (2019).

Proposed location of the Ambler Access Road **Location of the Red Dog Mine Road**

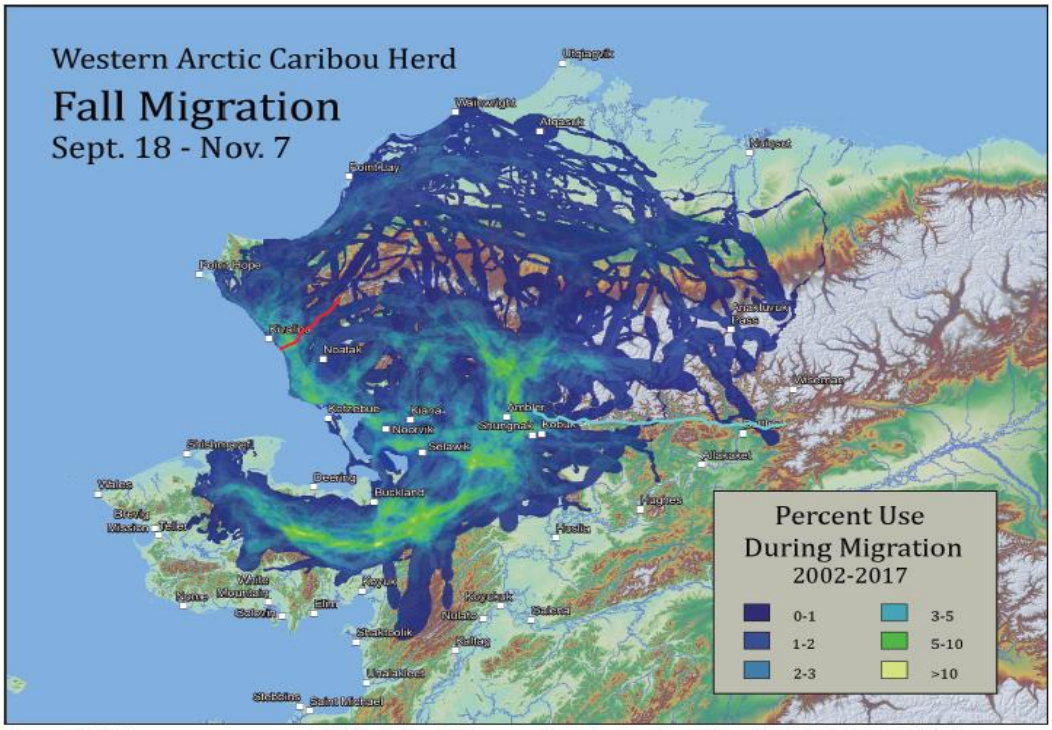

FIGURE 8. Migratory routes (fall) of the Western Arctic Caribou Herd, 2002-2017. High (yellow), medium (green), and low (blue) use corridors as determined using Brownian Bridge movement models. Data are from radio-collared female caribou in telemetry database of ADF&G and National Park Service. The southward fall migration covers the period September 18-November 7.

Figure 24. Migratory routes of the Western Arctic Caribou Herd 2002 to 2017. Figure 8 in WAHWG (2019).