OPERATIONAL PLAN FOR INTENSIVE MANAGEMENT OF CARIBOU (*RANGIFER TARANDUS*) IN GAME MANAGEMENT UNITS 9B, 17, 18, 19A & 19B DURING REGULATORY YEARS 2022–2028

Prepared by:

DIVISION OF WILDLIFE CONSERVATION

Version 2.1, February 2023

This operational plan has been prepared by the Alaska Department of Fish and Game (ADF&G) to provide supporting information on the intensive management (IM) plan for caribou in Game Management Units 9B, 17, 18, and 19B during regulatory years (RY) 2022–2028 (RY = 1 July–30 June, e.g., RY12 = 1 July 2012–30 June 2013). The IM plan for caribou in the Mulchatna herd can be found in Title 5, Alaska Administrative Code, Section 92, Part 111(c) (abbreviated as 5 AAC 92.111(c)[1]). This IM plan was enacted in 2011 in response to recommendation of a member of the Nushagak Fish and Game Advisory Committee (Proposal 119 Nushagak Fish and Game Advisory Committee (Proposal 119, March 2011 BOG Meeting,). This plan established a predation control area for the public removal of wolves through a same-day airborne (SDA) program based on the biological and management information for this area (Appendix A). Based on the biological and management information for this area (Appendix A), this operational plan describes the rationale for evidence of limiting factors, and decision frameworks on implementation, suspension, or termination for predation control, habitat enhancement, and prey harvest strategies. Although choices of indices for evaluating treatment response are listed in Appendix A, there is no non-treated area or caribou herd to compare summer calf survival with our treatment area at this time.

In 2022 the IM plan was revised to address key changes including an extension of the program until 2028, an expansion of the predation control area, inclusion of black and brown bears for department removal. For details on the administrative procedures and the factors and strategies in adaptive management of predator-prey-habitat systems to produce and sustain elevated harvests of caribou, deer, or moose in selected areas of Alaska, please refer to the *Intensive Management Protocol* (ADF&G 2011). The IM plan and this operational plan may include information and recommendations from the BOG following public comment at the January 2022 meeting.

BACKGROUND

The Mulchatna Caribou Herd (MCH) is the largest caribou herd in southwest Alaska, and formerly was one of the largest herds in the state. It has historically been one of the most important herds for many users including rural subsistence and other resident hunters, as well as Alaska's guide and transport industry and nonresident hunters. The MCH peaked in 1996 at an estimated 200,000 animals and due to a variety of factors has declined over the last few decades (Figure 1). In March 2011 the BOG designated the Mulchatna Caribou Herd Predation Management Area (MCHPMA) due to the population level decline and concerns for continued high demand for consumptive use. The BOG has made significant changes to the framework. The initial 2011 designation of the MCHPMA corresponded to that range of the MCH within Units 9B, 17B, 17C, 19A, and 19B (39,683 mi^2), The objective from the inception of this plan is to enhance recovery of the MCH and achieve a population and sex/age structure that will sustain harvests within the objectives established for this herd by the BOG. The goal is to reduce wolf numbers across migration corridors, the winter range, and calving areas of MCH with the intent to increase calf survival and

[1] Regulatory numbers for existing IM programs formerly under 5AAC92.125 were divided into groups and given new numbers in October 2012 (see IM Plan template).

recruitment and over-winter survival of adult females. The wolf population reduction plan initially authorized in March 2011 for Units 9B, 17B, and 17C was modified in March 2012 to include Units 19A and 19B. Furthermore, a significant portion of the MCH range is within National Wildlife Refuge and National Park boundaries where predator control activities are prohibited.

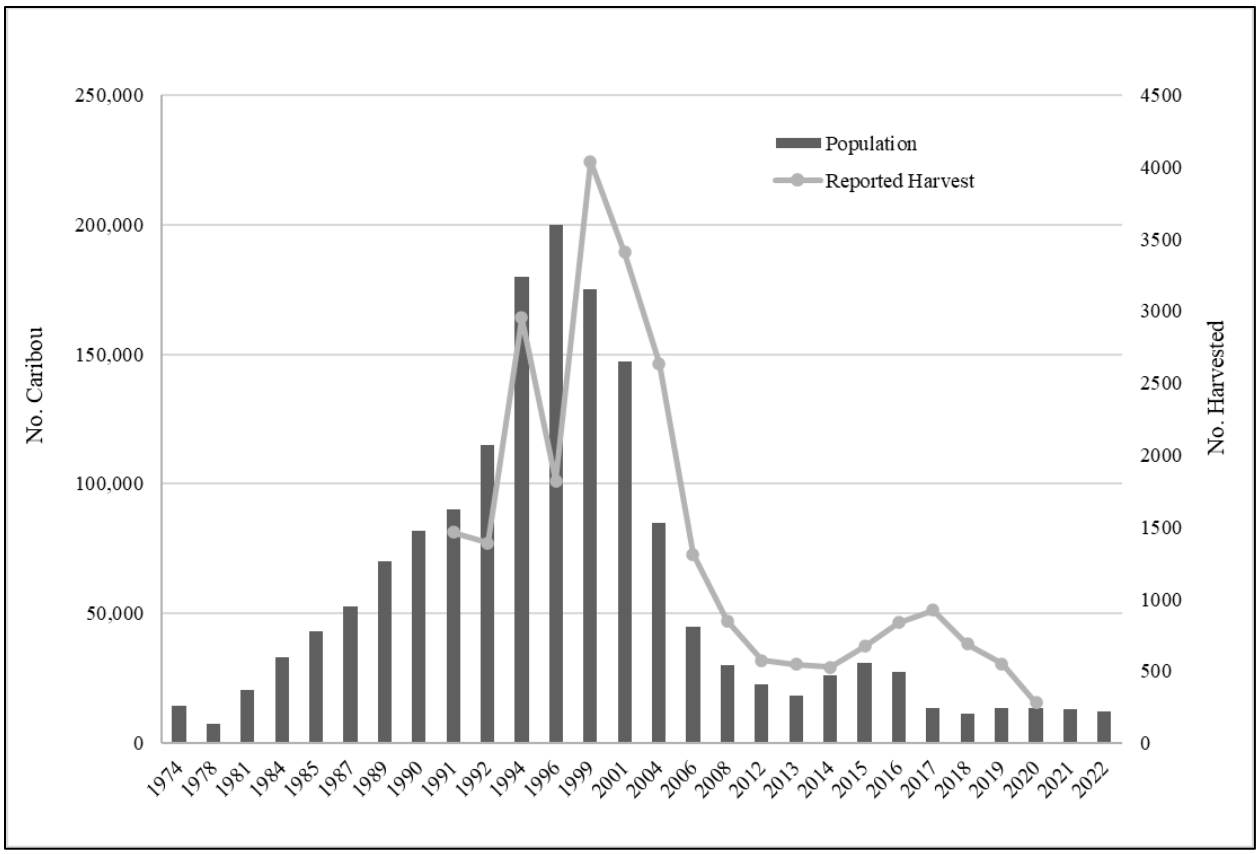

Figure 1. Abundance estimates for the Mulchatna caribou herd population and harvest history during RY74 through RY22.

In 2022, the BOG made significant changes by adding Units 17A and 18, removing the 10,000 mi^2 limitation, but not to exceed the historic range of MCH, allowing for multiple control areas and the addition of black and brown bears to the IM Plan. The following prey and predator population estimates were identified, and objectives specified during the initial adoption of the MCH IM plan as follows:

- 2016 post-calving MCH population estimate: 27,242 caribou
- IM population objective for MCH: 30,000–80,000
- 2016 reported MCH harvest: 348
- IM harvest objective for MCH: 2,400–8,000
- Spring 2017 wolf estimate in expanded wolf removal area: 2.2–3 wolves/1,000 km^2

The abundance estimate of the Mulchatna caribou herd has continued to decrease prompting the closure of a hunt; the management objectives of MCH remain unchanged.

- RY22 MH population estimate: 12,112 caribou
- IM population objective for MCH: 30,000–80,000
- IM harvest objective for MCH: 2,400–8,000
- Amount Reasonably Necessary for Subsistence (ANS) for MCH: 2,100–2,400
- RY22 MCH harvest: Closed season since RY21
- Calf-to-cow ratio objective: sustain >30:100
- RY22 MCH calf-to-cow ratio: 31:100 (average RY20–22 = 30.7)

Wolf Predation Control Objective: reduce wolf numbers in the Predation Control Area to a level that results in increased adult and calf survival and recruitment.

Bear Predation Control Objective: remove black and brown bears from calving grounds to enhance calf survival.

The plan was initially approved for 6 years and scheduled to end in 2017; however, because most of the IM objectives were not met by 2017, the department requested that the board reauthorize this program for an additional 6 years, extending through 2024, which coincides with the region's three-year board cycle. The BOG reconvened in 2022 and reauthorized the program through 2028 authorizing the department to conduct aerial, land-and-shoot, or ground-based lethal removal of wolves, black bears, and brown bears. In addition to the changes made regarding wolf predation control area limitation, the department was authorized to remove black and brown bears from the west Mulchatna calving grounds buffering parturient female caribou in an attempt to increase calf survival. Data suggest that bears are the primary cause of mortality for calves within the first two weeks of life (Demma & Sattler 2022). The Department will continue to issue permits to public pilot/gunner teams to take wolves on the same-day-airborne (SDA) program. These permits allow for land-and-shoot taking of wolves and/or aerial shooting by a backseat gunner.

The initial MCHPCA measured ~2,870 mi^2 during RY11–RY16. The MCHPCA covered Tikchik Mountain east to Sleitat Mountain, southeast to the Koktuli Hills southwest to Lower Klutuk Creek, west to the Muklung Hills and then north returning to Tikchik Mountain (Figure 2), which encompassed the core western calving area of the MCH at the time, because IM objectives were not met the WCA was later expanded in 2017 to 9,844 mi^2. Because of the lack of response from the MCH the BOG made further changes in 2022. The department again expanded the public wolf

predation control area to 15,584 mi^2 to encompass both the wintering grounds in Unit 9B near Levelock and the historic calving areas in Unit 19B; additionally, lands open to control efforts in eastern Unit 18 were added. These lands in Unit 18 are a core migration route for the western segment to calving grounds in Unit 17B during the previous three regulatory years (2020–2022). The Kemuk Wolf Control Area will remain unaltered within the Greater Mulchatna Wolf Control Area (GMCHWCA) to allow Nushagak River villages an opportunity to trap and hunt in the surrounding area prior to allowing SDA permitees to operate beginning on February 1.

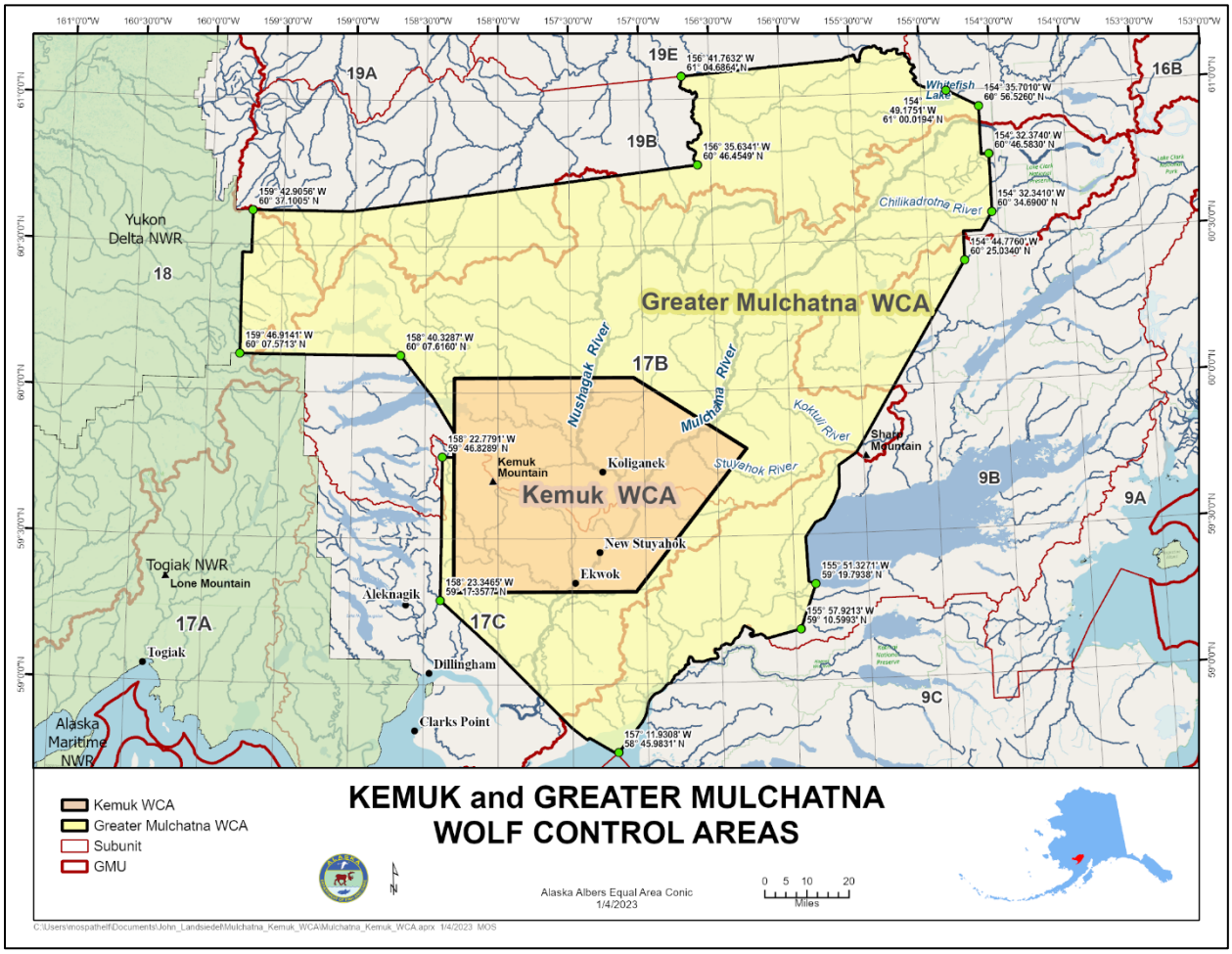

Figure 2. Intensive management area for Mulchatna caribou (*Rangifer tarandus*) with the Greater Mulchatna and Kemuk wolf control areas in Game Management Units 9B, 17B, 17C, 18, 19A, and 19B in southwest Alaska, RY2022.

1.2. Background - Mulchatna caribou herd range and important population metrics

During the last few years, the population abundance survey estimates have not changed significantly and efforts to evaluate population dynamics will continue (i.e., the 2019 population

estimate was 13,448 and 2022 population estimate was 12,112). Due to an increase in radio collared animals within the Mulchatna caribou herd confidence intervals around the abundance estimate have narrowed, increasing the precision, and giving better insight into the current population trend.

At its peak abundance, the annual range of the MCH comprised about 60,000 mi^2 but has contracted with the decline in population that began in the late 1990s. During this period, seasonal space use began to diverge into 2 primary patterns. One segment of the herd began to predictably spend fall and winter in Unit 18, generally between the Kilbuck and Eek Mountain ranges and the Kuskokwim River. The majority of these animals migrated into western Unit 17B and 17C during late winter/early spring to calve, then returned to Unit 18 by mid-summer. The other major segment of the herd spent fall and winter in the Nushagak, Mulchatna, Kvichak, and upper South Fork of the Hoholitna river drainages in eastern Unit 9B, 17B&C, and 19A&B, and typically remained to calve within those units. As these spatial segregation patterns strengthened managers divided radiocollaring and monitoring efforts primarily between the 2 segments for annual survey and inventory (S&I) surveys. Satellite and GPS telemetry data indicate that there is generally strong seasonal spatial segregation between these segments, but seasonal ranges do overlap at times in some areas, such as the upper Tikchik River basin, in western Unit 17B, and individuals do occasionally switch their annual spatial patterns and affiliations between the western and eastern segments. The Unit 18 population is generally referred to as the western segment, and Unit 17 population as the eastern segment; and the primary calving grounds for each of these segments are referred to similarly, as the west and east calving ground, respectively.

The Department maintains a sample of radio-collared caribou to facilitate routine Survey and Inventory assessments (currently, there are >150 collared female caribou across the Mulchatna herd). Survey and Inventory efforts include a post-calving population abundance estimate, fall herd composition survey, a spring parturition survey, and capture, weighing and collaring a cohort of 10-month-old female to assess age-specific survival and survival to reproductive age (true recruitment), and evaluating harvest dynamics (Barten 2015). These efforts highlighted some important fluctuations in adult survival and pregnancy rates over the last 10 years and can be found in a department presentation in the 2022 Board of Game meeting (Demma & Sattler 2022). Broadly female survival averaged around ~80% for adults, however when categorized by east and west, we observed more variable rates in survival in the east and a marked drop in survival of western females in 2017. Herd-wide pregnancy rates over the last 5 years has averaged 75% in females 4+ years old. There are occurrences of 2-year-olds being pregnant from 2016–2018, but it is infrequent (<25%). Annual weights collected from a sample of 10-months old females has put average weight at ~125lbs over the last ten years but has a slightly declining trend since 2012 (Figure 3).

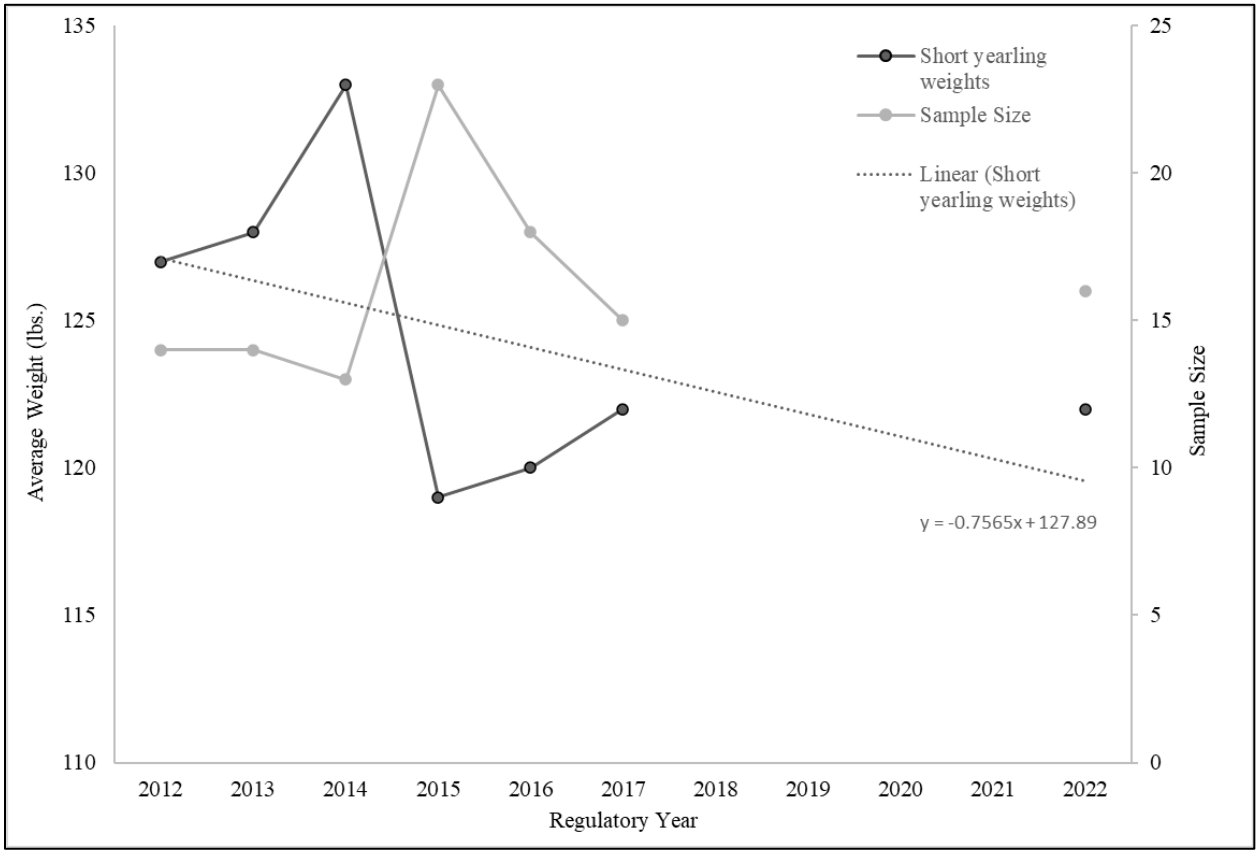

Figure 3. The average mass of MCH short-yearlings (~10-month-old) by calendar year from 2012–2022.

In addition to these Survey and Inventory activities, the Mulchatna has been the focus of research efforts to further understand the herds decline and contemporary challenges slowing population recovery. A caribou calf survival and cause of death study was carried out from 2011–2021. Newborn caribou calf weights were collected during 2011–2021 as part of a research study evaluating neonate cause of death and 1st year calf survival (Demma & Sattler 2022). Calf survival to 4 months range widely over the study area (listed in Section II. C. *Caribou Abundance)* and showed notable differences between the east and the west segment of the herd. Calf mortality rates of 47% to 4 months of age was reported for ungulate populations with intact predator communities (Linnell *et al.* 1995). Estimates of the proximate cause of mortality was conducted for calves 0–14 days old and return that brown bears, black bears, and wolves were the predominate predators of neonates (Figure 4 & 5).

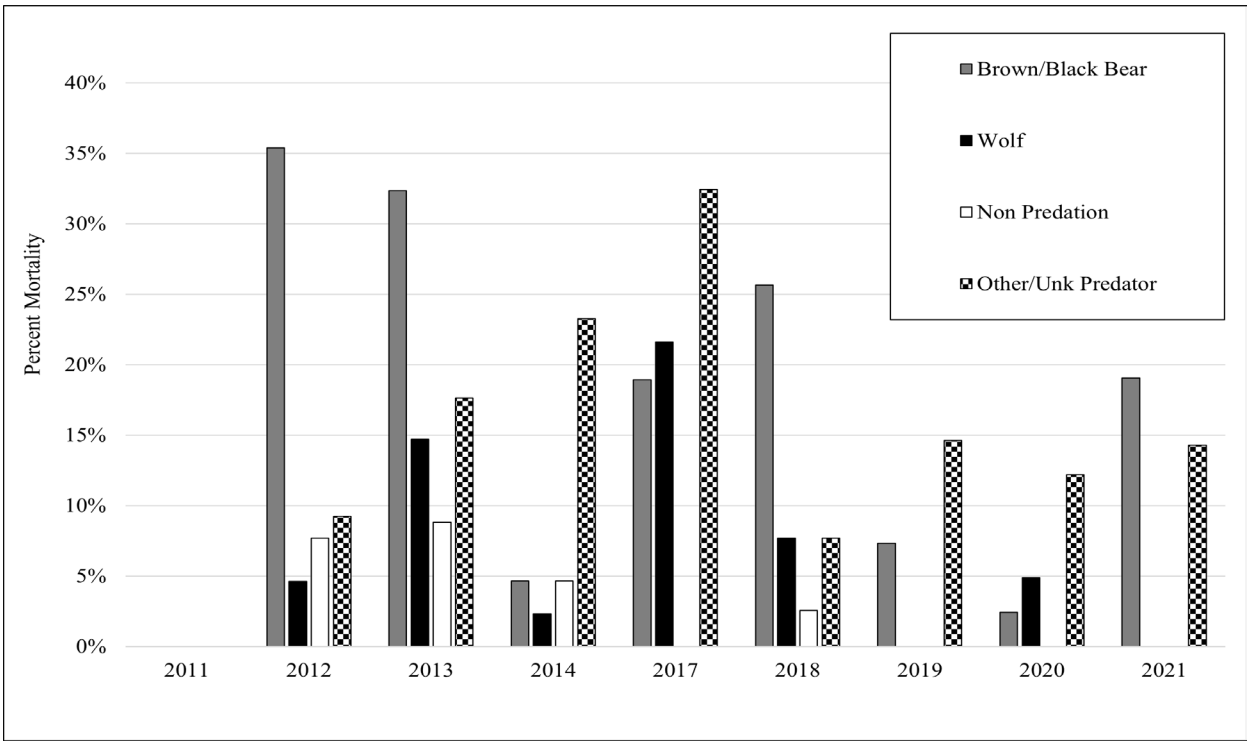

Figure 4. Proximate causes of mortality in of radio collared neonatal (<2 weeks old) MCH caribou calves in 2012–2014, and 2017-2021 in the east calving area.

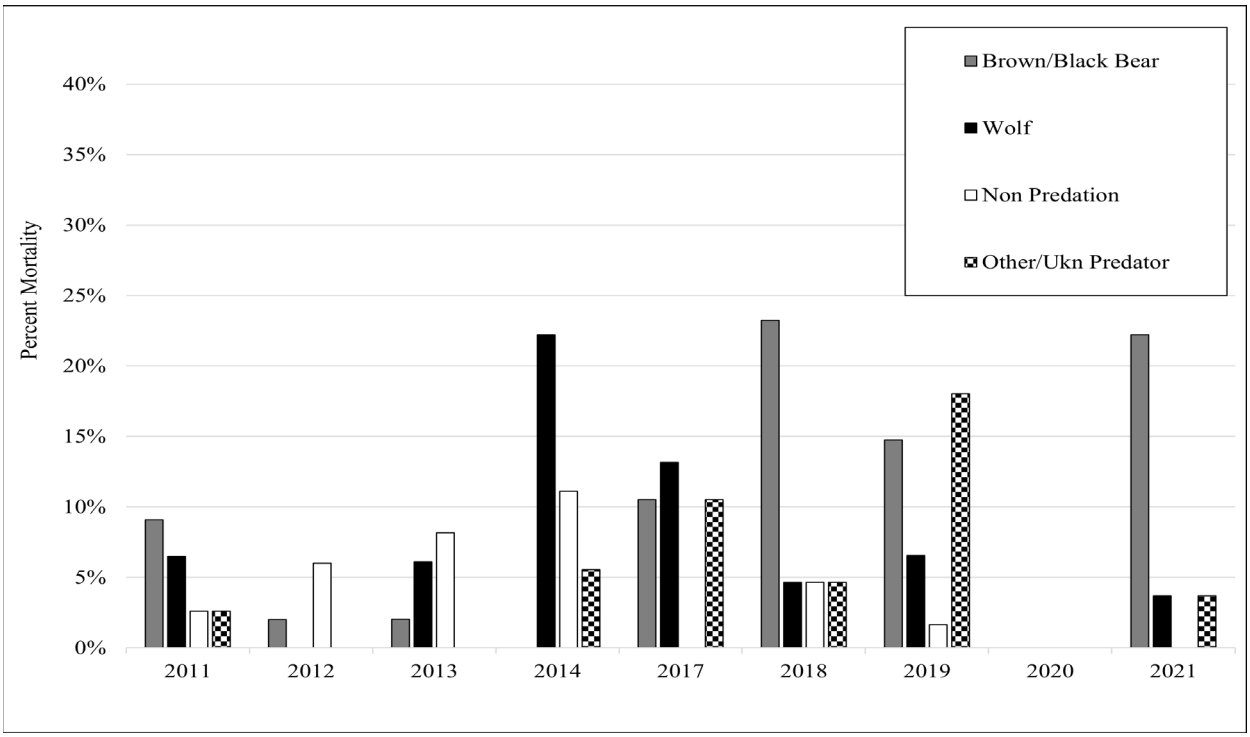

Figure 5. Proximate causes of mortality in radio collared neonatal (<2 weeks old) MCH caribou calves in 2011–2014, and 2017–2021 for the west calving area.

To better understand the health of the Mulchatna female breeding population, a focused research study evaluated female fall body condition (% body fat and protein) and disease prevalence in the east and western segment of the herd from 2020-2022 (Demma & Sattler 2022). Females fall body fat ranged from 4%–16% with a population wide average of 8.13% ±2.96 SD. Estimated ungulate body fats ranging from 6%–9% have been labeled as populations experiencing moderate nutritional limitation, a category in which depressed pregnancy rates, slow juvenile growth and increased winter mortality are observed (Cook et al. 2004, Gunn & Nixon 2008, Cook et al. 2021a, Cook et al. 2021b). More importantly, lactating females were described as thin and had significantly less body fat but not protein (6.66% ±1.44, 17.50kg ±1.70) than non-lactating (10.09% ±3.53, 18.20kg ± 2.09) cows just prior to entering winter. This finding raises concerns over the quality and quantity of forage resources for the Mulchatna herd, and in particular the summer range where females need to replenish nutritional store. We detected a substantial seroprevalence for *Brucellosis suis*, a reproductive disease that can cause abortions, weak calves, reduced adult survival, swollen joints, and retained placentas. This disease was detected in both the east and west segment of the herd but was higher in western Mulchatna females (45%). Finally, investigations into the probable cause of death revealed out-of-season harvest and wounding loss accounted for 50% of adult female mortalities (n=5), followed by unknown non-predation related causes (30%)(n=3), and predators (20%)(n=2). Combined these data point to nutritional challenges, disease, and human-related causes of death, as important and likely interacting with predation to limit the Mulchatna caribou herd recovery.

1.3 Harvest Dynamics

During the population decline in caribou abundance (RY96-RY19), harvest management changed with season dates during the high abundance cycle extending to April 15, then shortened to March 15 in 2006 as this herd was declining to fewer than 50,000 animals. The earlier season closure date was initiated to curtail female harvest in the spring that could lead to a further population decline that would inhibit its recovery. Notably, reported female harvest comprised of >50% in 2005 and maintained as a high percentage of total harvest through 2012; this may have exacerbated the decline. (Figure 6). As part of this conservative shift in management the nonresident season was closed in 2008 which decreased reported harvest, paralleling the MCH population decline (i.e., 4,770 in RY98 to 113 in RY13).

In 2015 in response to slightly increasing trend in population abundance, bull-to-100 cow ratios (Figure 7), and reproductive indices indicating positive population growth (e.g., pregnancy rates; Figure 8) suggested the MCH could sustain more harvest, as such the season for residents was lengthened in portions of the MCH range to March 31.

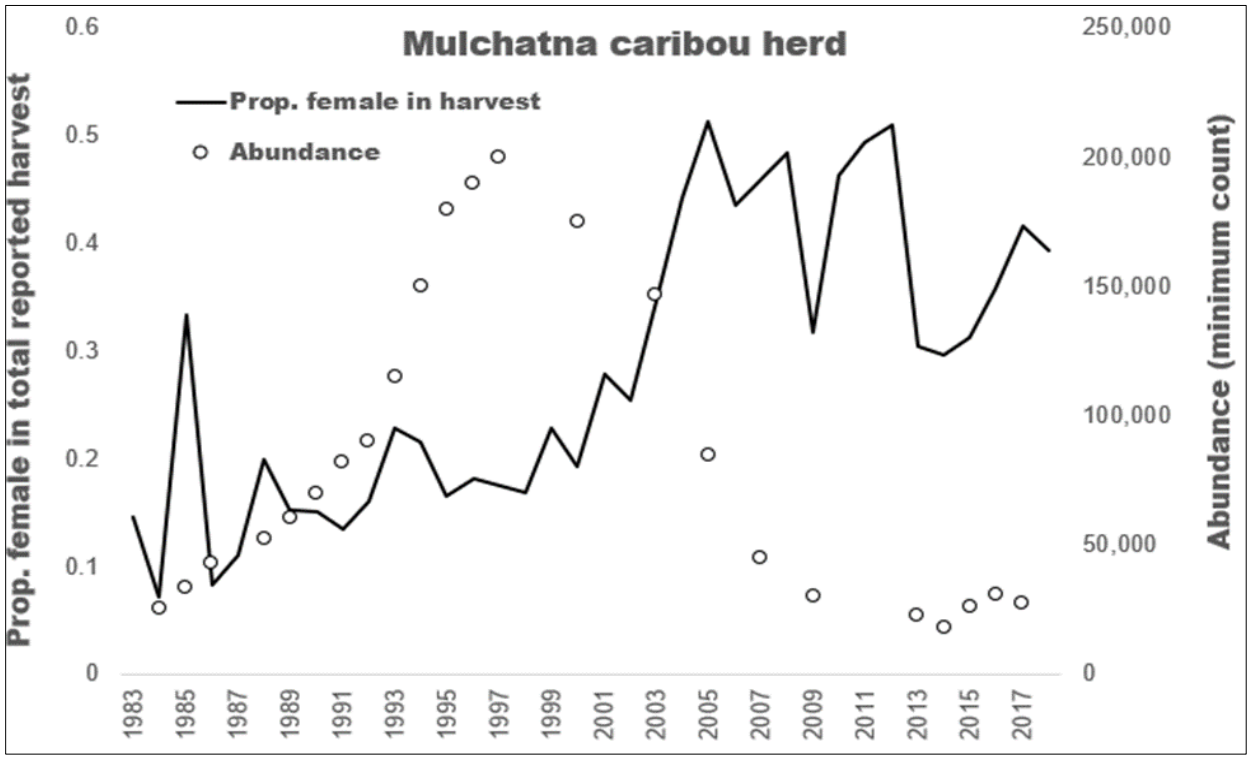

Figure 6. Proportion of Mulchatna caribou cow harvest relative to herd abundance, RY1983–2018.

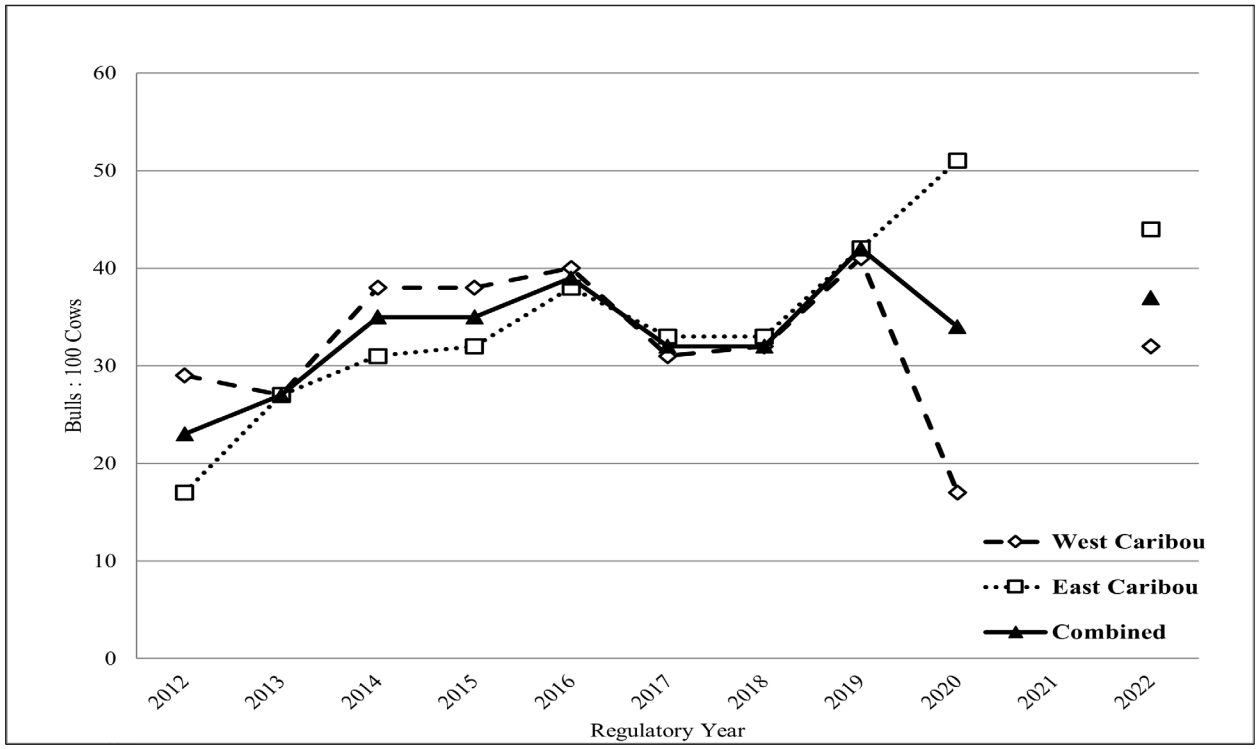

Figure 7. Bull to cow ratios of East and West Mulchatna caribou from October composition surveys between RY12–RY22.

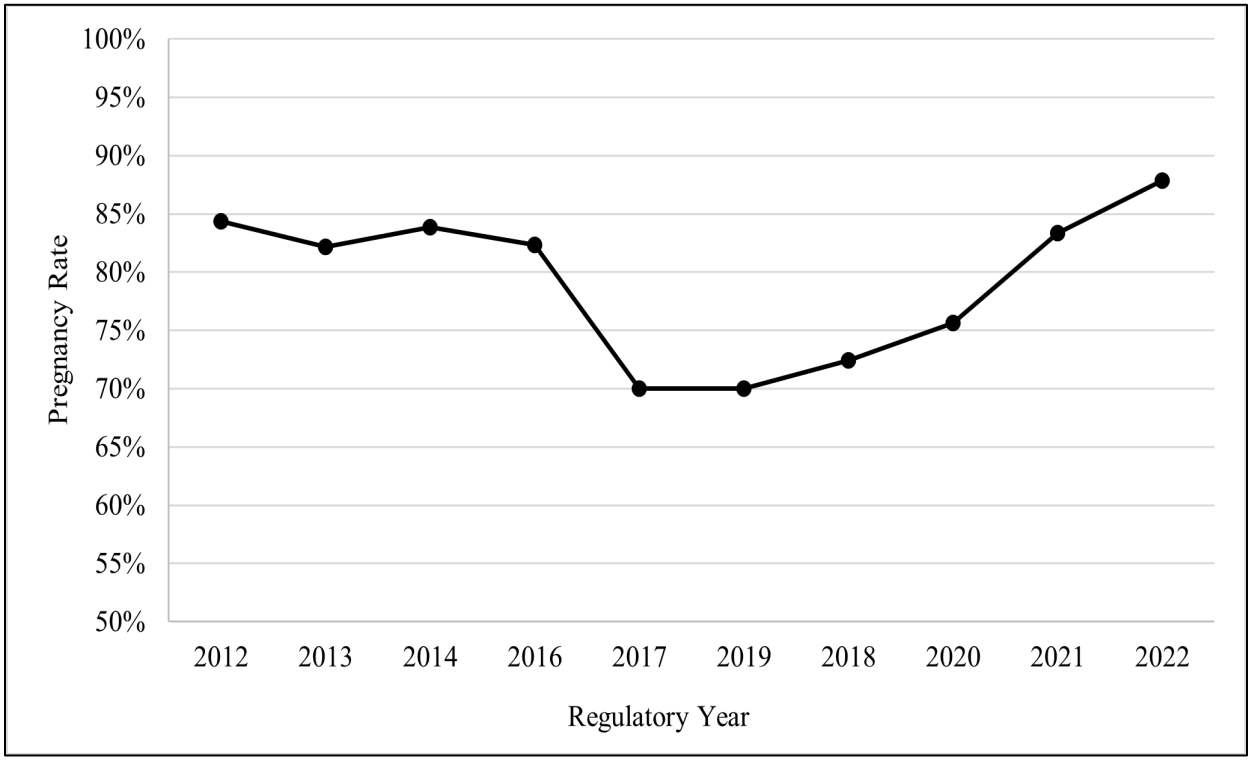

Figure 8. Parturition rates of radio collared Mulchatna cows ≥5 years old observed during May surveys RY12–RY22.

that the most important determinant for the low harvest was not caribou abundance, but rather an inability to access caribou due to poor winter traveling conditions. Reported harvest declined to 226 in RY20 and subsequently RC503 was closed due to uncertainties of what may be contributing to the continued population decline. After a limited hunt in 2020, there is currently no open season for caribou across the historic range of the Mulchatna caribou herd. However, since RY19 when the harvest season was closed, we detected a notable amount of out-of-season harvest and efforts to evaluate the number of unreported based on coordinated surveys documenting caribou mortalities on the landscape initiated in 2021.

Concurrent with the IM plan being adopted in RY11, the department-initiated research to evaluate survival and characterize mortality of MCH neonates radiocollared primarily in the two main MCH calving grounds. The initial intent was for the west calving ground to serve as an experimental treatment area as it was within the Kemuk Wolf Control Area at the time, and the east calving ground to serve as the non-treatment control. But the east calving ground encompassed an area within the Unit 19A Predation Control Area, therefore both calving grounds essentially received experimental treatments during the early study period (RY10–RY13). During RY16–RY20, the west calving ground had shifted to the upper Tikchik River basin in Unit 17B, which and was mostly outside of the western boundary of the newly created GMCHWCA), while the east calving ground had shifted to the upper Mulchatna and South Fork Hoholitna Rivers in Units 17B and 19B, and was primarily encompassed within the GMCHWCA, therefore a robust comparison between control and experimental treatment areas was not possible. Wolves and brown/black bears

were determined to be the main predators on neonate (<2 weeks old) MCH caribou for most years, although, golden eagles were an important predator in the east calving ground in RY13, when the calving area shifted to the foothills of the Alaska Range at the head of the Mulchatna and Chilikadrotna rivers.

The subsequent expansion from 9,844 mi^2 to 15,584 mi^2 provides greater potential for increasing neonatal survival by including aerial removal of wolf packs that likely prey on the calves in both calving grounds. This addition to the wolf predation control area also encompasses much of the post-calving range used by the eastern group; thus, removing wolves from this area should not only enhance survival in the first few days-to-weeks of life for MCH calves, but help them survive through the summer into the fall. Additionally, expansion into unit 9B should relieve predation by wolves on wintering MCH of all age classes. of all age classes.

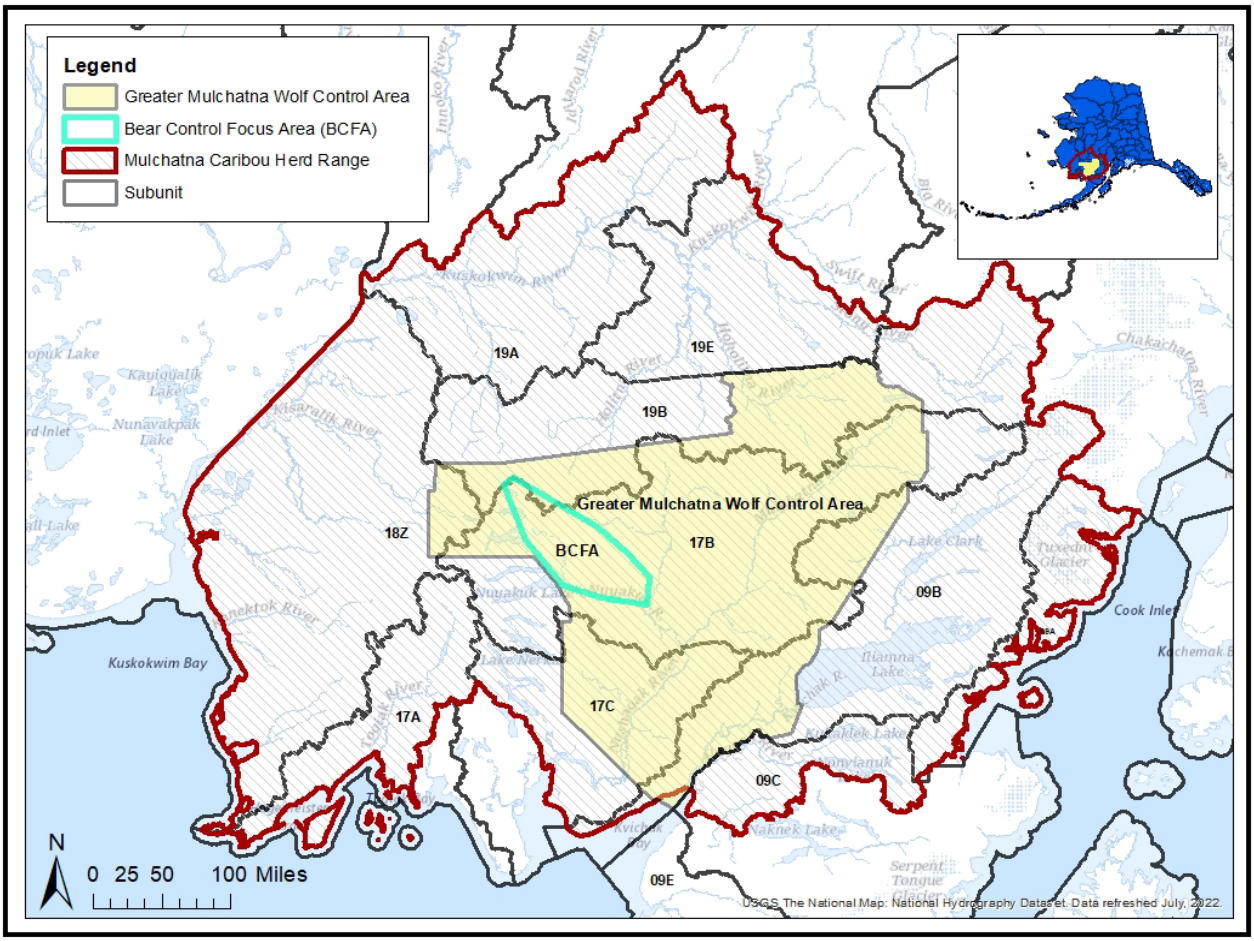

Figure 9. Area designated as the Bear Predation Control Area for the department removal of black bears, brown bears, and wolves in Spring of 2023.

In spring 2017, the department deployed radio collars on 17 wolves, comprising 5 separate packs in Units 17B and 17C. This effort was initiated to assess wolf abundance and density within and adjacent to the MCHPCA. Initiation of the control program prior to fully instrumenting and

enumerating all packs in the control area resulted in high removal rates of collared wolves and thus precluded a robust wolf population estimate. Wolf densities across the wolf control area (KWPCA & GMWPCA) extrapolated from 5 instrumented packs were estimated to be 2.2–3.0 wolves per 1,000 km^2 but should be viewed cautiously as an underestimate. However, this is very similar to the previous density estimate conducted in RY11 using a minimum count method (McNay 1993; Gardner and Pamperin 2014; Rinaldi 2013) that is also likely an underestimate of density.

ADAPTIVE MANAGEMENT FRAMEWORK

The goal of adaptive management is to design programs that maximize what can be learned from field experiments for potential application elsewhere (National Research Council 1997:122). Managers wishing to use the best available information for management decisions and recommendations often need to generate new information for specific situations (National Research Council 1997:174). Any section of the following framework may be modified as new information comes to light in the study area or the scientific literature (Riley *et al.* 2003). Determining predator abundance prior to removal efforts is an important metric to derive a better understanding if predators are the primary driver of population level declines and which additional factors may be influencing the system and whether they are practical to manage.

I. TREATMENTS

A. *Predation Control:*

Units 9B, 17A, 17B, 17C, 18, 19A, and 19B define the population of wolves associated with this effort. The MCPMA was initially established to increase the MCH within Units 9B, 17B, 17C, 19E, and 19B. This program includes portions of each of these units within the wolf removal area excepting Unit 19E which already is part of the Unit 19E Predation Control Area to increase moose abundance.

In spring 2012 the department conducted a minimum count wolf survey across a 7,612 $mile^2$ wolf assessment area. This was centered over the Kemuk wolf control area of 2,870 $miles^2$, providing the expanded area within which to assess wolf abundance. Four aircraft were used for this survey, and when tracks were encountered, the wolves were tracked and if located, the animals counted. This survey yielded a density estimate of 2.0 wolves/1,000 km^2 which is highly likely to be an underestimate (from poor survey conditions) when compared with areas having lower prey biomass (e.g., Adams *et al*. 2008). To the extent wolf harvest is relatively low in adjacent areas, a high proportion of take in late winter may be transient immature animals (Adams *et al.* 2008) rather than resident wolves. Successful wolf control on caribou often has 3 years of relatively high wolf kill followed by subsequent years of lower take that regulate wolves from increasing as prey biomass increases (footnote b of Table 17 in Adams *et al.* 2008:19). The continued periodic high take of wolves in the MCH program (Figure 5) and relatively low fall calf:cow ratio (Table 1) compared with the fall calf ratios on successful wolf control programs for caribou (>40 calves:100 cows, Gasaway *et al.* 1983: 26) suggest that wolf take spread across the large MCH control

area has been ineffective at improving calf summer survival. Lack of numeric response in the MCH over the same period suggests no improvement in overwinter survival of calves into the breeding population or in adult survival occurred while hunting continued.

Department research on MCH calf mortality (2011–2021) indicates that wolf and bear predation on calves is one of the major factors on MCH calf survival during their first two weeks of life. Although a majority of the calf mortality takes place on the calving grounds, post-calving mortality occurs throughout the summer. The expanded treatment area that includes this summer range should enhance calf survival and recruitment.

A wolf predation management area has been in place since 2011 in portions of Unit 17B and 17C (Kemuk WPCA), with private pilots and gunners permitted to conduct same-day-airborne (SDA) and aerial shooting of wolves. This program was centered on 1 of the 2 main calving grounds of the MCH, near the village of Koliganek and known as the western (Kemuk) calving ground. The department limited the aerial wolf removal period to February 1–April 30 because of concerns by local residents who wanted an opportunity to harvest this valuable furbearer under the established hunting and trapping seasons and bag limits prior to any aerial hunting associated with IM occurring. The success of this program toward removing wolves has been limited with harvest by aerial hunters occurring only during years 1 and 6 (Table 1) with adequate snow and weather conditions.

Table 1. Wolf removal from wolf assessment area and wolf removal area, RY11 through RY21.

Period[a]	Reg Year	Non-SDA Harvest Removal from Area wolf assessment area (7,612 mi²)		Department Control Removal from predation control area (2,870 mi²)	SDA Public Control Removal from predation control area	Total Removal from wolf assessment area[b]	Minimum Spring Abundance (variation) in wolf assessment area
		Trap	Hunt				
Year 1	2011	14	52	0	11	77	14
Year 2	2012	17	0	0	0	17	-
Year 3	2013	0	10	0	0	10	-
Year 4	2014	0	0	0	0	0	-
Year 5	2015	19	2	0	0	21	-
Year 6	2016	26	28	0	3	57	-
Year 7	2017[c]	30	10	0	30	70	-
Year 8	2018	12	0	0	11	23	-
Year 9	2019	3	45	0	28	76	-
Year 10	2020	20	4	0	28	52	-
Year 11	2021	5	14	0	0	19	-

[a] Each respective year of data is from the ADF&G WinfoNet database: Fur Sealings, Fur Sealing Lookup.
[b] Additional removal may be Defense of Life and Property (DLP), vehicle kill, etc.
[c] In 2017 the Wolf Control Area was expanded to include 9,844 square miles.

Snow and appropriate flying conditions are major limitations that impact effective wolf tracking and removal by permitted pilots. Most pilots who signed up for the program are from distant communities and success is dependent on a window of several good weather days to make it worth the associated travel costs. In some years there were windows of good conditions prior to this date use, but was limited to hunters and trappers, additionally during good conditions after Feb. 1 department staff have temporarily suspended the aerial removal program on several occasions to allow staff to safely survey moose. The expansion of the wolf control area will allow for a much larger area for participants to locate wolves, and while the aerial control period in the original Kemuk WPCA will remain Feb. 1–April 30, the season in the much larger Greater Mulchatna WPCA will run from December 1–April 30 (with some variation providing flying and ground conditions are suitable). With this larger area for wolf control, we may be able to close portions of the area during our surveys, while leaving larger areas open to wolf hunting. Despite low success with the aerial predation control program, hunting and trapping, under ordinary seasons, have been effective for harvesting wolves within the wolf control area (Table 3).

Calf survival is the vital rate with the highest potential to increase the caribou population abundance, though it is also the most inherently variable. Typically, neonatal mortality is believed to be more additive than compensatory due to the increased susceptibility of this less mobile age-class to predators (Johnson *et al.* 2019). Therefore, this program aims to increase calf survival by reducing predation. Wolves and bears are the predominate predators of caribou calves, although eagles, wolverine, and other predators are active in the MCH. Wolf reduction to meet prey objectives when centered on caribou calving grounds has been shown to be effective in other areas (Gasaway *et. al.* 1983; Boertje *et. al.* 1996; Hayes *et. al.* 2003; Riley 2011: CITE Crowley) assuming adequate forage and other conditions necessary for caribou life-history needs are met. Although the IM program for the MCH has not resulted in an increase in caribou abundance thus far, we hope that with the expansion of the program to include more removal area, increased participation of aerial pilot/gunners permitted under this program, and a couple of years of good snow conditions could increase the number of wolves removed in the Mulchatna range.

Though we lack estimates of black or brown bear densities in Unit 17 and 18, black and brown bears are frequently observed on the calving grounds (N. Demma, Wildlife Biologist, ADF&G, Palmer, personal communication). Thus, reducing the number of bears on and immediately surrounding the calving grounds immediately prior to calving may have a substantial impact on neonate survival. Both bear and wolf populations, have been shown to repopulate within 3-5 years post reduction efforts (ADFG 2020). Long-term effects on the Unit 17 bear population from the removal effort are assumed to be unlikely due to the relatively focused and limited treatment area (1,150 mi^2) (Figure 7). The Bear Predation Control Focus area is approximately 3% of the Greater Mulchatna Range in which both brown and black bears are present and probable immigration from surrounding untreated areas are reasonably expected to augment the remaining bears within the Bear Predation Control Area. Bear survival and fecundity can reasonably be expected to have

increased with recent record high salmon returns in Bristol Bay over the last five years (Elison *et al.* 2022).

In response to the BOG addition of brown and black bears to the MCH IM plan the department determined the bear removal effort to be implemented by department staff via aerial removal. The bear predation control focus area (1,150 mi^2) defines where bear predation control may be conducted. Bear predation control objectives are to reduce the number of bears on the calving grounds with the intent of increasing survival of calves through the first few weeks of life. Bear salvaging requirements include removal of salvageable parts: head, hide and claws, and meat. The meat of some brown bears and all black bears are to be distributed to a few local communities that have responded to department inquiries. The bear predation control focus area encompasses the most recent western calving grounds where department activities are likely to be successful due to the large, open tundra basin allowing for more efficient aerial work. Western MCH have used the Tikchik Basin the last three years (i.e., 2020–2022), but due to uncertainties of where calving may occur, bear removal will focus on locations of marked parturient cows. Calf collaring efforts will resume in the western MCH to assess known fate and detect predation events in a timely manner, as well as a comparison to historic survival estimates. Since 2014, the western MCH have lower calf:cow ratios and productivity relative to the east segment of the MCH. Removal of bears on the calving grounds can reasonably be expected to increase neonate survival, although the magnitude and its effects on herd growth are impossible to predict. Peak calving has occurred on or around May 17th over the last 10 years and bear removal efforts are two weeks before and after this date. Department staff will work closely with area outfitters to prevent conflict with department efforts and guiding activities during the removal period.

B. *Habitat Enhancement:*

There are no widely practiced methods to enhance habitat for caribou. An incursion of shrub species into formerly tundra habitat was noted by local residents (Van Lanen et al. 2018) and is increasingly being reported coinciding with changing climatic conditions and increased fire disturbance (Macander *et al.* 2022). Fire, a commonly used tool to regenerate the quality and quantity of moose habitat, can have severe negative effects on lichen, a vital component of caribou diets in winter. Indices related to the nutritional condition of the MCH (weights of short-yearling females, and pregnancy rates of two- and three-year-old females should be viewed cautiously as the most recent body weights have started a negative trend indicating habitat could be limiting calf production and condition. Current efforts to better understand individual health through measurements of fat stores in adult females is a more direct measure of individual health and potential fitness. Recent research suggests that the Mulchatna summer range may be of concern though whether the limitation is quality or quantity is not yet determined. Caribou summer ranges are especially important to females to restore body reserves and support the next years pregnancy (Barboza *et al.* 2018).

C. *Caribou Harvest:*

The nonresident season has been closed since 2008. Due to the continued decline in 2019 all hunting was closed in 2020 for MCH. Prior to closure of hunting, the bag limit for the MCH under registration permit RC503 was 2 caribou of either sex prior to a change to the bag limit in the last year of the hunt that allowed only 1 bull caribou during Aug. 1–Jan. 31. The prior bag limit of 2 caribou was due to a steady increase in the bull-to-cow ratio that met objectives and a reported harvest that was far below the estimated harvestable surplus. The simplification of regulations helped subsistence hunters take advantage of the harvest opportunity when it presented itself. Currently, there is no open season for MCH, but substantial demand exists for caribou among the numerous and widely distributed villages within the range of the herd in addition to nonlocal residents (Table 2). Due to this demand for caribou meat from subsistence hunters, out of season harvest has been documented since the hunt has been closed and these firearm related mortalities that often target adult cows during winter hunts could be a compounding factor to slowing herd recovery.

Table 2. Mulchatna caribou annual hunter residency and success, regulatory years 2012–2020.

	Successful				Unsuccessful				
Reg Year	Local resident[a]	Nonlocal resident	Non resident	Total (%)	Local resident[a]	Nonlocal Resident	Non resident	Total	Total hunters[b]
2012	279	48	3	59	155	67	7	41	572
2013	88	24	1	20	328	96	3	80	545
2014	137	48	6	36	238	95	2	64	526
2015	198	39	3	36	352	79	1	64	672
2016	292	49	2	59	347	145	1	41	836
2017	367	70	0	48	352	135	0	52	924
2018	185	45	0	33	328	131	0	67	689
2019	84	206	0	53	153	107	0	47	550
2020[c]	38	188	0	82	16	36	0	18	278

[a] Includes residents of communities within the range of the MCH (GMUs 9B, 17AB&C, 18, and 19 A&B).
[b] Collected from harvest report cards. Includes hunters of unknown residency who would not be tallied under the column headings, as well as hunters who reported killing more than one caribou.
[c] RC503 moratorium

Generally, most caribou harvest by local hunters has taken place in the winter as soon as snow conditions permit travel by snowmachine (Table 3). Longer daylight, milder temperatures, and better snow conditions provide the best opportunity for hunters to access caribou. In those years without good snow, local hunters do harvest caribou in conjunction with moose hunting, but the overall harvest is usually pretty low in those situations. During recent warm falls, hunters in Unit 18 have successfully harvested caribou via boats into October, allowing for a higher than usual fall harvest. Nonlocal hunters tend to target the timing of their hunts for the fall when bull caribou are still carrying antlers.

Table 3. Mulchatna caribou annual harvest chronology percent by month[a], regulatory years 2012 through 2020.

Reg. Year	Harvest Periods										
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total[b]
2012	-	3	7	1	2	12	6	16	52	-	330
2013	-	16	28	8	18	12	2	8	8	-	113
2014	-	19	32	10	3	18	2	11	5	-	191
2015	-	17	23	5	10	16	7	17	4	0.4	240
2016	-	9	11	5	2	8	7	20	38	-	343
2017	-	4	12	2	3	6	3	12	58	-	437
2018	-	10	20	2	1	15	23	16	13		230
2019	-	12	13	4	-	3	11	-	0.3	-	290[c]
2020[d]	-	10	15	-	-	-	-	-	-	-	226[c]

[a] Starting fall 2015, Unit 17 and 9B closing date moved to March 31.
[b] Collected from harvest report cards and includes unknown harvest date.
[c] does not equal 100% due to no reported harvest date.
[d] RC503 moratorium.

II. ANTICIPATED RESPONSES TO TREATMENTS

A. *Predator Abundance:*

In March 2017, the department initiated a study including deployment of GPS collars on wolf packs in the IM area. The objectives of the study were to map wolf pack territories, determine seasonal pack sizes, and evaluate change in wolf density relative to the wolf removal program. During the initial capture field work, wolf tracks were common and found throughout much of the MCH WCA. Seventeen wolves were collared, comprising 5 packs and multiple lone wolves. Mean minimum observed pack size was 6 wolves during spring and 9 wolves during fall in 2017. A preliminary density calculation based on 7 months of GPS data and minimum observed seasonal pack sizes resulting in spring and fall 2017 wolf densities of 2.2. and 3.0 wolves per 1,000 km^2, respectively, in the Mulchatna and lower Nushagak River drainages. The estimated fall density of 3.0 wolves calculates to a minimum of 76 wolves comprising the packs that inhabit the MCH WCA. This estimate should be viewed cautiously, as we did not have all the known packs within the WCA collared, and the estimate does not include lone wolves that are known to occur in the WCA.

In RY2017, favorable snow conditions similar to the first year of the program, and an expanded WCA boundary, facilitated the highest reported wolf harvest since the first year of the wolf control program. A total of 70 wolves were reported harvested in the WCA including 9 of 12 (75%) remaining radiocollared wolves. The density of harvested wolves alone equals 3.1 wolves per 1,000km^2 and compared to the minimum estimate of pack-dwelling wolves previously mentioned, indicates a significant population reduction obtained during RY2017. If wolf removal at a high rate is successful and prey objectives

are met, it is anticipated that wolf numbers would recover to pre-control levels in 3–5 years after control efforts cease (National Research Council 1997:52–53). Under the current SDA program, it is unlikely that the removal of wolves would result in a dramatic decline on a broad scale given the limited success of this program to date and extensive refugia surrounding the IM area. This is especially true for the lands within Lake Clark National Park and Preserve that encompass a portion of the northern calving area, and to some degree areas adjacent to the Mulchatna wolf removal area that are remote and receive very little hunting or trapping pressure.

Brown bear abundance within Units 17B and 17C have yet to be measured, but there are multiple estimates from surrounding areas in Southwest Alaska. Density estimates from west of the removal area in the southern Kuskokwim mountains found a minimum of 47/1,000 mi^2 (Van Daele 2001) while Walsh *et al.* 2010 estimated 103/1,000 mi^2 within Togiak National Wildlife Refuge, which is southwest of the removal area in 17A. These two studies represent the closest brown bear abundance estimates to the treatment area, although it is prudent to recognize the differing habitat types across the entire sub-units 17B and 17C and those studies were both conducted in units 17A and 18. Densities across the southwest Alaska region are variable and strongly correlated to salmon abundance and access. Estimates as high as 250/1,000 mi^2 exist in unit 9C (Quang 2005) and as low as 20/1,000 mi^2 in unit 19A and 19D (ADFG 2020). It can reasonably be expected that bear densities within Unit 17B falls within the range of estimates found in portions of Unit 17. Estimates from Van Daele *et al.* (2001) and Walsh *et al.* (2010) extrapolated to Units 17B and 17C results in an estimated 735–1,612 bears. Further, extrapolating prior estimates to the removal area (1,150 mi^2) results in 54–118 brown bears. If these same estimates are used across Units 17B&C the expanded extrapolation equates to >1,600 brown bears.

While the objective is to remove all bears within the Bear Predation Control Area it is unlikely that all bears will be removed, or that all bears using the Tikchik Basin will be present during removal efforts.

Correspondence with multiple pilots and biologists who have worked extensively within the MCH calving grounds have estimated it is likely to encounter 5–15 brown bears on the western calving grounds that could be removed. Annual harvest from the public within the Bear Predation Control Area over the last decade have averaged 18 brown bears (Figure 10) with the majority taking place during fall combination hunts by non-residents.

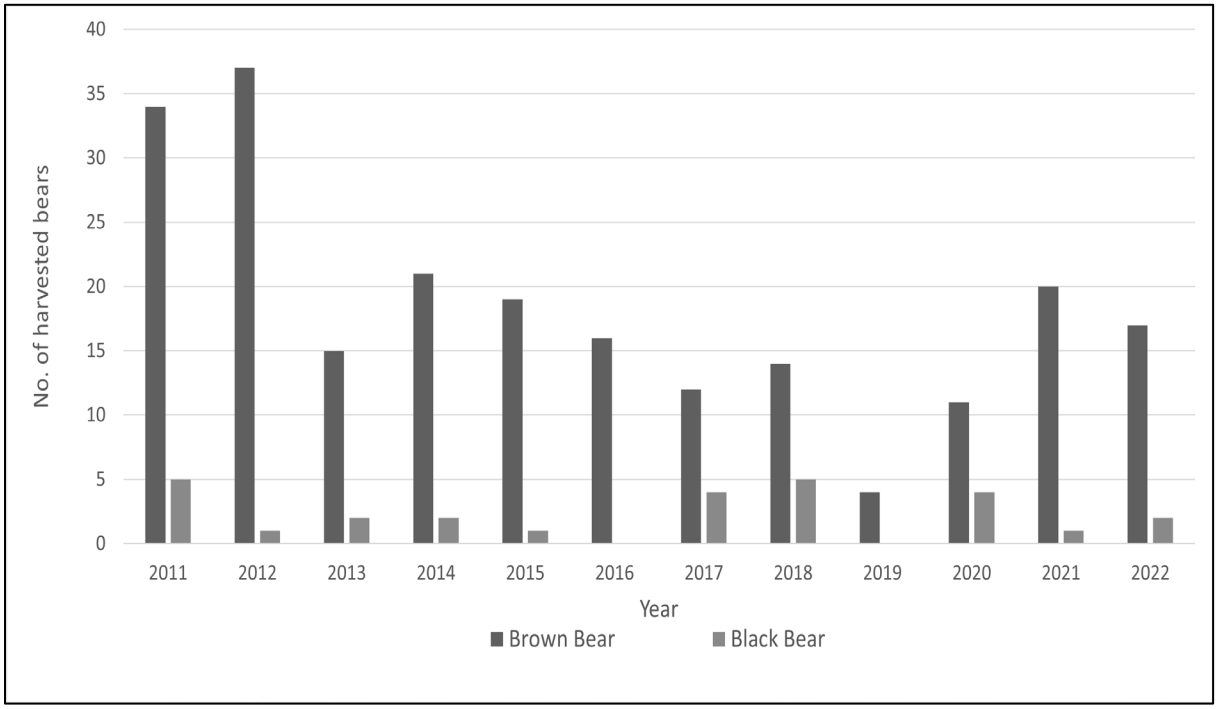

Figure 10. Reported bear harvest through hunting in the Bear Predation Control Area (1,150 mi^2) in the western portion of Unit 17B, 2011–2022.

There have been two years in the last decade exceeding harvest of more than 50% females after harvest declined from the 40-year peak in 2011 (Fig. 11). Bear harvest has fallen below the harvest objective of 50 bears annually two times in the last decade (Fig. 10). Non-residents account for approximately 70% of brown bear harvest and there may be more interest if barriers to nonresident participation were reduced such as costs and complex hunt logistics in this area. Lack of resident interest and participation is likely the cause of decreased harvest rates, not due to a population level decline.

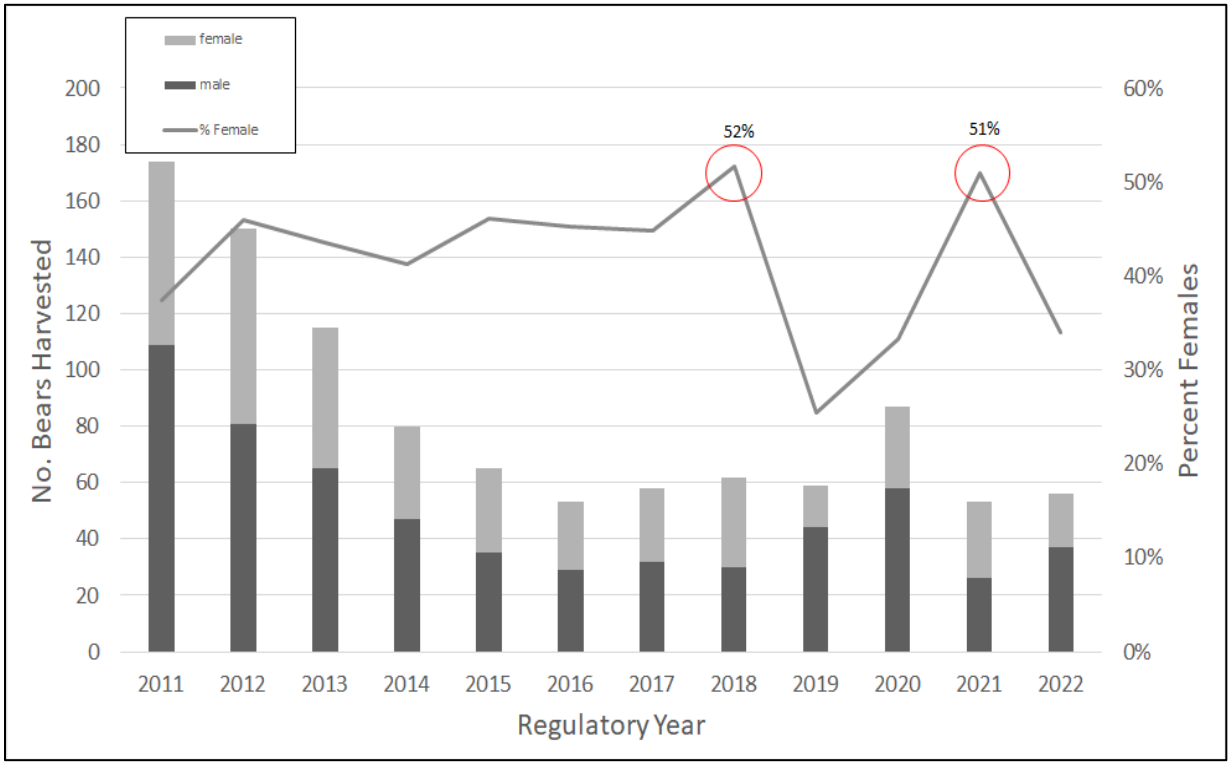

Figure 11. Unit 17 brown bear harvest from 2011–2022, by sex. Percent female was greater than 50% of the harvest in 2018 and 2021.

B. *Predation Rate:*

We do not know wolf or bear predation rates on different caribou age-classes. The caribou calf collaring efforts monitored survival from 0-~4months of age and estimated proximate cause of mortality during the first two weeks of life from 2011–14 and 2017–2021. From these data, predation rates varied annually and spatially between the two primary calving grounds (Demma 2021). From known adult mortality, 20% was caused by bears, although sample size was extremely limited (n=10). Continued monitoring of annual adult survival will be an additional utility of marked adult females, but proximate cause of death is unlikely to be assessed. Annual fall composition surveys provide recruitment information on ~4-month-old calves. Although this program does not allow us to directly assess predation rates, we can assess calf survival via the fall composition survey.

C. *Caribou Abundance:*

The RY22 MCH population abundance estimate resulted in an estimated 12,112 caribou. This estimate can be further broken down into an estimated 6,242 individuals in the east MCH and 5,870 in the west MCH.

D. *Caribou Calf Recruitment:*

Calf survival estimates are an important component in determining probable trends in population trajectory. MCH Calf Survival study ended in 2021 with survival to June

ranging from 33% - 74% in the east calving grounds, and the west ranged from 43% - 91%. This survival estimate is from the early stages of life where bear predation is most prominent.

Survival to 4 months in the east calving grounds ranged from 25% (n=32) to 78% (n=37) and in the west 38% (n=42) to 91% (n=46).

With a successful wolf removal program by public permittees across much of the MCH range and, if necessary, the addition of department lead wolf and bear removal efforts in the western calving area just prior to calving, it is expected that calf survival and recruitment to the 4-month age class should increase if predation from other species and other sources of mortality do not have a large impact on calf survival. Assessing calf survival and cause-specific mortality during the removal program aides the department in understanding factors driving recruitment rates and provides a comparative basis to years when bears were not being removed.

We expect removal of the primary predators of MCH calves will increase survival of additional calves that otherwise would not have survived. If survival of these individuals reaches reproductive age, they ultimately could contribute additional animals to the herd, thus potentially increasing the MCH population abundance. These increases should be noticed in fall calf:100 cow ratios as calves reach 6 months. Through radiotracking collared neonates, a direct estimate of calf survival through early to mid-summer will be defined. The fall composition surveys will provide us with a broader assessment of survival and recruitment at the population level later in the year.

E. *Prey Productivity or Nutritional Condition:*

We will continue to collect data biannually on weights of 10-month-old females to provide an indirect measure of nutrition. Parturition surveys and assessing the pregnancy rates of two and three-year-old females will provide further insight into the nutritional state of animals in this herd.

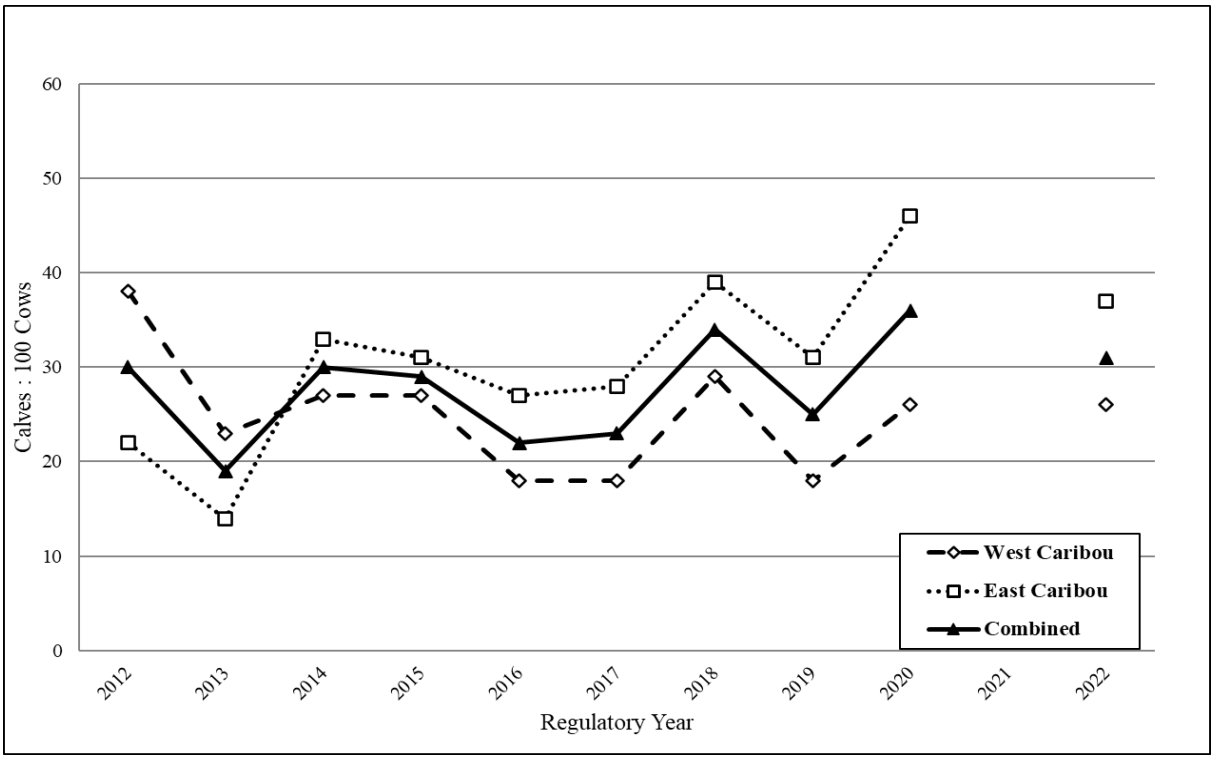

Figure 12. MCH fall composition survey data (calf-to-cow ratios), RY12 through RY22.

F. *Harvest:*

Consideration of harvestable surplus, spatial use and herd segment variability, availability to local users and timing of travel conditions will all be considered before adopting any new hunt structure. Initially, conservative seasons will be implemented upon hunt re-introduction likely through a Tier structure as required by regulation.

Current harvest objectives are 3–8% of the population abundance objectives. The population objective of 30,000 individuals at the objective of 5% growth rate will take decades to reach. Conservative seasons with 1-3% of the bull population may be permitted for harvest initially through Tier hunt structure. If the composition numbers from RY22 are applied to the overall abundance estimate there could be up to 2,705 bulls currently within MCH. A harvest range of 1–3% of the adult male population may sustain a harvest of 27–82 individuals.

G. *Use of Nontreatment Comparisons:*

We do not have a nontreatment comparison. Comparing the calf survival between the eastern and western calving area is not appropriate given both grounds will receive predator removal but at different times and intensities. Furthermore, the high prevalence of brucellosis found within the western segment of the herd is evidence that there are likely different constraints on calf survival between these two areas.

There are also no suitable adjacent populations for comparison. The nearby Nushagak Peninsula Herd (NPH) declined simultaneously with the MCH in the late 1990s but is a non-migratory transplanted population.

III. Evaluation Criteria and Study Design to Document Treatment Response

Adaptive management with the intent to increase harvestable surplus of prey requires evaluating the biological response and achievable harvest after treatments are implemented. Evaluation will be reported to BOG on 1 February each year.

A. *Predator Abundance and Potential for Return to Pre-treatment Abundance:*

Based on data collected in spring of 2017 via the use of radiocollared wolves, the baseline density of wolves within the wolf removal area was estimated at 2.2–3 wolves/1,000 km^2 and will continue to be used to measure the success of the program through harvest data and removal efforts by SDA pilots. Additionally, wolf population objectives within this plan for Unit 17 are to maintain a wolf population that can sustain an annual harvest of at least 25 wolves. Minimum harvest of 25 wolves at a 30% removal rate equates to a starting population of 83 wolves. Due to refugia surrounding the GMCHPCA it is reasonably expected that these density estimates are at the very low end due to the prey biomass that exists within Unit 17 and the expanding moose population from neighboring Unit 18. There is high likelihood of dispersal of transient wolves from neighboring Units 17A and 18 adding to both 17B&C's wolf population.

No current data exists to estimate bear densities within Unit 17. The prior extrapolation of estimates conducted in Units 17A and 18 applied to the bear predation control area result in 54–118 brown bears that may exists in the area. Given that bear removal will be focused on a relatively small area we believe the bear populations will return to pre-treatment levels quickly.

B. *Habitat and Forage Condition:*

Although not part of this program, ongoing department research into the spatial and temporal quantity and quality of caribou forage across the ranges of five southwestern caribou herds will help evaluate confounding effects of nutrition on performance of the herd. It also will provide a baseline to evaluate changes in caribou forage relative to any population increases resulting from this active IM program.

C. *Prey Abundance, Age-sex Composition, and Nutritional Condition:*

The department should attempt to assess the MCH population abundance every year. A successful survey depends on funding, weather patterns, and availability of pilots.

Caribou herd composition surveys will be conducted annually. Composition ratio data could be the result of several factors besides changes in abundance of a given demographic. For example, an increase in a calf-to-cow ratio could be the result of an increase in calves, a decrease in cows, or some combination thereof. However, this

weakness is greatly reduced with periodic estimates of population size, as well as estimates of calf and cow survival of radiocollared animals.

The department will monitor nutritional condition by measuring biannually weights of females 10 months of age (spring) as well as estimate age-specific pregnancy rates through standard parturition surveys of radiocollared adult females.

D. *Prey Harvest:*

The MCH harvest objective under the IM plan is 2,400–8,000 animals. This objective has not been met since 2003 and reported harvest has remained <500 since 2008. The department began monitoring unreported/out-of-season harvest in the winter of RY20 when opportunistic surveys found 23 out-of-season caribou died due to firearm-related injuries. Subsistence household surveys indicate the actual harvest is substantially higher than what is reported through harvest reports (Van Lanen 2018). Once harvest reports changed from a general season harvest ticket to a registration permit in 2013 reporting became more reliable. Outreach efforts through community visits or social media should continue to try and improve harvest reporting. The department will work with the Board of Game when appropriate to determine new harvest strategies. Furthermore, any combination of management strategies still relies on timely and accurate reporting so that over harvest does not occur.

IV. Decision Framework to Implement or Suspend a Treatment

A. *Predation Control:*

The decision-making framework to suspend or terminate wolf predation control will be based on achieving both predator and prey population and harvest objectives as follows:

- When the mid-point of intensive management objectives for the MCH population are reliably achieved;
- If, after three years, any measure consistent with significant levels of nutritional stress in the caribou population are identified; or
- When the caribou population and harvest objectives within the MCH Predation Management Area have been met.
- When the caribou population is below intensive management population or harvest objectives; and nutrition is determined to be the limiting factor affecting population growth.

The decision-making framework to suspend or terminate bear predation control will be based on achieving a response towards predator and prey population objectives based on the following:

- The targeted removal of bears by the department on MCH calving grounds does not increase caribou calf survival.

Predation control activities will be suspended or modified:

- When the caribou population can be reasonably maintained at the midpoint of the IM population objectives, and caribou harvest can be reasonably maintained within the IM caribou harvest objectives;
- If, after three years, there is no indication of an increase in the total number of caribou in the assessment area;
- If, after three years, fall calf-to-cow ratios show no appreciable increase to 40 calves per 100 cows or;
- If after three years, the harvest of wolves is not sufficient to make progress towards the population objectives for wolves; or
- When caribou nutritional indices, such as pregnancy rates, calf and adult body mass, or other condition indices, exhibit a declining trend.
- Fall caribou calf ratios remain below 20 calves per 100 cows for three consecutive years within the wolf control area;

2. Prey Harvest Catch Per Unit Effort (CPUE).

   CPUE will not be used to trigger management actions because many factors influence the number of days it takes for hunters to harvest a caribou. These include weather, water level, snow conditions, cost of fuel, distribution of caribou on the landscape, and reporting habits of the permittees.

B. *Habitat Enhancement:*

No habitat enhancement projects are planned as a component of this operational plan.

C. *Prey Harvest Strategy:*

1. Prey Harvest.

   The harvest rate management objective for the MCH of 2,400–8,000 is 3–10% of the upper end of the population objective (80,000). A single registration permit has been used since 2013 for hunting of Mulchatna caribou. Hunters have been allowed 2 caribou of either sex, until 2019 where the bag limit was reduced to 1 bull. Seasons varied across the range of the Mulchatna herd with all areas historically beginning on August 1, but some ending March 15, while others end March 31. In 2020 the hunt occurred from August 1–September 30. Mulchatna abundance and recruitment prompted the closure of the hunt. The current harvest strategy would likely be

additive mortality and other more flexibly strategies may be more appropriate in the future, but actions would be taken through the Board of Game to change seasons and bag limits.

The unreported harvest on Mulchatna caribou represents an unknown proportion of the total harvest. Insights gained from comparing reported harvest to those acquired through household surveys indicate the actual harvest far exceeds what is reported. Additional insights from wildlife law enforcement suggest hunters forgoing permits and even hunting licenses was not uncommon. However, coming up with a reliable estimate that can be used in modeling the true harvest is difficult. Efforts have increased to document annual unreported harvest numbers.

2. Prey Nutritional Index.

   The weights of 10-month-old females will be collected biannually to provide information on the nutritional status of caribou. Additionally, two and three-year-old female caribou are evaluated for parturition status (linked closely with animal condition) and serves as a surrogate for the quality of the habitat.

V. PUBLIC INVOLVEMENT

A. *Continued Outreach by Department:*

Outreach by the department will include communication with local Advisory Committees (AC's), Regional Advisory Councils (RACs) and the public through updates and reports including the annual and interim BOG reports. Local interest has decreased over the years and non-local participation is sporadic.

B. *Continued Engagement to Confirm Criteria Chosen for Evaluating Success:*

We will continue to engage with local Fish and Game AC's, the BOG, Federal stakeholders, department staff, and other interested parties as we apply criteria for determining the success of this program. The main objective of this operational plan is to increase the MCH population and enhance harvest opportunity.

C. *Participation in Prey and Predator Harvest or Predator Control:*

The public has participated in the aerial wolf control since 2011, and it is expected that interest in this program will continue. Wolf harvests to date appear to be inadequate to be effective. Local hunters and trappers will be encouraged to continue harvesting wolves through liberal seasons and bag limits associated with hunting and trapping. Long term trends of decreased trapper participation have affected trapping rates in Unit 17, much like the trend across the rest of Alaska. If the public are unable to effectively remove wolves at a recommended rate, direct removal by department staff may be warranted. The wolf control area expansion was anticipated to draw a larger pool of skilled applicants but that was not the case in 2022 with only 14 active pilots.

D. *Monitoring and Mitigation of Hunting Conflict:*

Although hunter conflict was minimal given the low population level of the Mulchatna herd and the subsequent closure to hunting. The advisory committee and board processes will be used to monitor and mitigate user conflict. Communication between committees and other users such as air taxis and non-local hunters will be encouraged. Harvest reporting by all hunters will provide the Department with critical information on resource demand and harvest success. Unless the caribou population grows to a level where hunting is re-instated, it is unlikely conflicts will be a concern in the future. There are concerns with continued out of season harvest and large-scale law enforcement efforts have been mounted across the MCH range.

VI. OTHER CONSIDERATIONS

This IM program and the predation control components have been renewed twice since original authorization in 2011. The current wolf removal effort to permit private pilots and gunners have unique challenges to removing large percentages of the wolf population. This has been largely due to inadequate snow conditions that are necessary to allow permitees to track and find wolves, and then be able to land and retrieve them. Additionally, during short windows of good weather, the department has needed to close the area briefly to SDA permittees for safety reasons while we have conducted moose surveys or wolf captures. Additionally, the control area associated with the Mulchatna herd is vast and remote, making it a large endeavor to participate in this program.

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APPENDIX A. Summary of supporting information.

Geographic Area and Land Status	
Management area(s)	Prey abundance assessment (50,000 mi^2), prey harvest assessment (50,000 mi^2), predation management area (39,683 mi^2), and wolf control area (15,584mi^2)–see Figure 2. Both the abundance assessment and harvest assessment are estimated at the scale of the range of the Mulchatna caribou herd.
Land status	The wolf predation control area consists largely of state land with some federal BLM lands, and some private lands along the Nushagak and Mulchatna Rivers. The eastern boundary is near Lake Clark National Park and Preserve. The Bear Predation Control Area (1,150 mi^2) is comprised entirely of state lands, with roughly 50% (575 mi^2) occurring within Wood-Tikchik State Park.
Biological and Management Situation	
Prey population	IM objectives: 30,000–80,000 Estimated in June 2022: 12,112 ($\pm$ 712)
Prey harvest (human use)	IM harvest objective: 2,400–8,000; Last reported harvest in RY2020: 58 caribou. Continued take is documented outside of closed season. Amount necessary for subsistence (MCH): 2,100–2,400
Feasibility of access for harvest	Range of MCH has been readily accessible in the past for caribou harvest by boat and aircraft in fall, and snowmachine and aircraft during winter. However, these access methods which were very successful during high abundance when most landing sites on lakes and rivers as well as ridge tops were within striking distance of caribou, are not nearly so at the present low abundance. This is especially true for non-local aerial hunters who cannot depend on finding caribou near good landing zones as they could in the past. Local hunters are almost entirely dependent on using boats and

	snowmachines for access, although snowmachines provide for most harvest. Recent low snow winters have led to poor travel conditions, and access to caribou has been limited, resulting in lower-than-expected harvests. Land ownership in much of the Mulchatna range is either federal or state lands, with few restrictions for access. The exception would be the Upper Mulchatna Controlled Use Area that is closed to the use of motorized vehicles (except boats and airplanes) for hunting big game during August 1–November 1.
Nutritional condition	Weights of short-yearlings, pregnancy rates of 2 and 3-year-old females, and individual body condition scores may warrant further research into nutritional condition. (Table 2 and Figure 3).
Habitat status and enhancement potential	Recent body condition scores and ingesta free body fat measurements suggest that habitat quality may be in decline. There are currently no proven methods for enhancing caribou habitat.
Predator(s) abundance	In 2017 a density estimate (2.2–3 wolves/1,000 km^2) was estimated for the original and expanded wolf control areas (GMWCA and KWCA) (Figure 2). Currently there are no estimates for brown or black bears within Unit 17. This area is considered to be the western edge of black bear habitat.
Predator(s) harvest	During RY11–20 the wolf assessment area in Units 17 and 9B was 7,612 mi^2 and encompassed the Kemuk WCA. The total wolf harvest during this period was 403 within the WCA. However, only 114 of these wolves were taken by SDA permittees. The average wolf harvest during this period was 40 wolves, with a range of 0–77. The remainder were taken by hunters and trappers outside of this program, and under the standard seasons and bag limits for hunting and trapping of wolves.
Evidence of predation effects	2021 caribou calf mortality study-birth to 4 months of age: • 38%% mortality in eastern calving ground • 30% mortality in southern calving ground Six percent of mortality attributed to wolves, 63% to brown bear, and 19% to unknown predator.
Feasibility of predation control	The Mulchatna Caribou Herd Predation Management Area is very remote and logistically difficult for aerial hunters to access. Short weather windows hinder pilots who often are based in distant communities and

	cannot justify a flight to this area without a few days of good weather to hunt and be able to safely return home. Even for the few local pilots who want to participate, the success of this program is dependent on winter weather conditions, with the necessity of enough snow to allow for permitted pilots to track wolves in order to harvest them and to land nearby and retrieve them. These conditions have been rare over the first six years of this program resulting in very little success. It is possible the combination of normal hunting and trapping efforts and the expanded wolf removal area will provide for a higher likelihood of success. Additionally, 1 or 2 good winters might allow for enough harvest of wolves near the northern calving ground and post-calving range to provide for increased calf survival and recruitment. Bear Predation Control Area removal is expected to reasonably increase calf survival through the first few months of life. Due to costs sustained to the department and social intolerance of aerial bear removal long term continuation of this program is unlikely. Bear populations are expected to recover within 3–5 years post removal effort.
Other mortality	Icing events that lock up forage could play a larger role with recent trends toward warmer winters. Continued harvest occurs outside of a closed season and goes unreported. Brucellosis impacts both reproductive output and individual survival.