OPERATIONAL PLAN FOR INTENSIVE MANAGEMENT OF CARIBOU (*RANGIFER TARANDUS*) IN GAME MANAGEMENT UNITS 9B, 17, 18, AND 19B DURING REGULATORY YEARS 2018–2024

Prepared by:

DIVISION OF WILDLIFE CONSERVATION

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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) 2018–2024 (RY = 1 July–30 June, e.g., RY12 = 1 July 2012–30 June 2013). The IM plan for caribou in the Mulchatna herd is found in Title 5, Alaska Administrative Code, Section 92, Part 111 (abbreviated as 5 AAC 92.111[1]). Based on the biological and management information for this area (Appendix A), this operational plan describes 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 control area to compare with our treatment area at this time. This could change year to year depending on where the caribou choose to calve. *Intensive Management Protocol* (ADF&G 2011) describes 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. The IM plan for caribou in the Mulchatna herd has been developed based on the recommendation of a member of the Nushagak Fish and Game Advisory Committee (Proposal 119, March 2011 BOG Meeting). The IM plan and this operational plan may include information and recommendations from the BOG following public comment at the February 2018 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 is one of the most important herds for rural subsistence and was once used heavily by Alaska's guide and transporter industry than nearly all of Alaska's other caribou herds. The herd declined precipitously from an estimated peak abundance of 200,000 caribou in 1996 to 18,000 in summer 2013(Figure 1). During the last few years there is some suggestion that the population is increasing to desired levels (i.e., the 2016 population estimate was 27,242). However, not only are the confidence intervals around the point estimates large, but they overlap, so care must be taken when interpreting the current population trend.

During the period of decline following the population's peak, management of this herd 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 harvest in the spring that could lead to a further decline in population that would inhibit its recovery. As part of this conservative shift in management the nonresident season was closed in 2008. During this period, reported harvest decreased, paralleling the MCH population decline(i.e., 4,770 in RY98 to 121 in RY13). As of RY16, reported harvest has increased along with the apparent MCH population increase to 348.

[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).

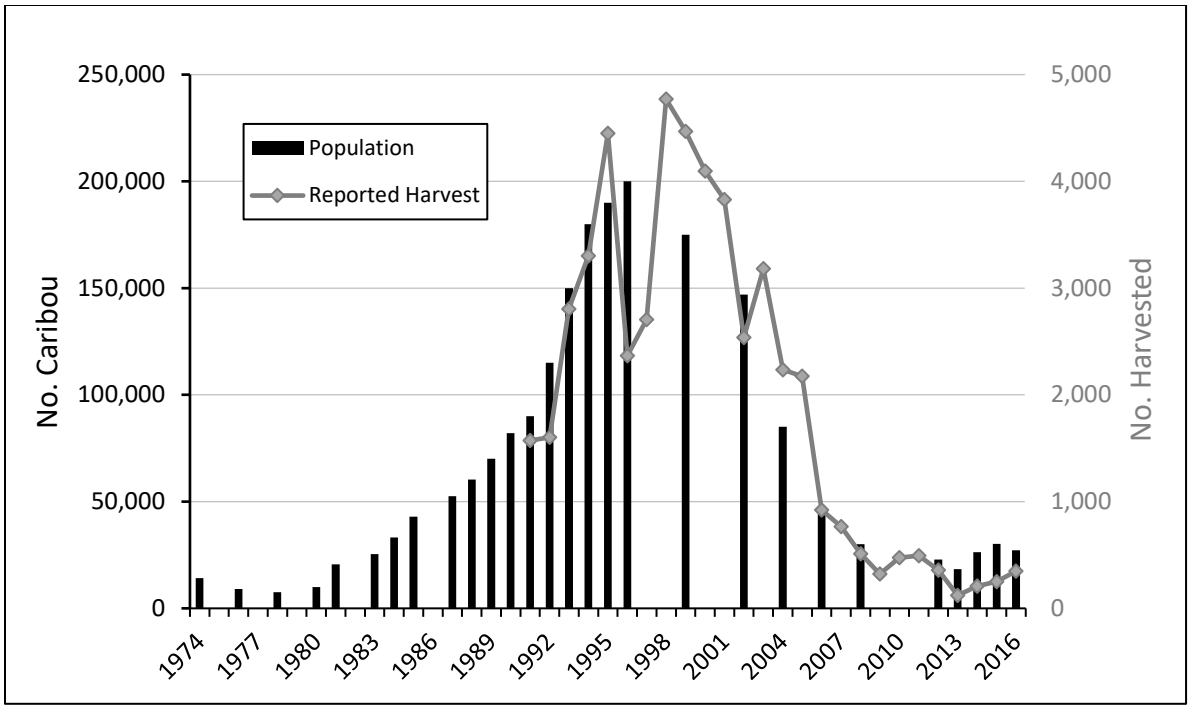

Figure 1. Mulchatna caribou herd population and harvest history, RY74 through RY16.

In response to positive trends in several important metrics for this herd in 2015, the season for residents was lengthened in portions of the Mulchatna range to March 31 to accommodate more harvest opportunity. Factors such as an increasing population trend, increasing bull-to-100 cow ratios (Table 1), and reproductive indices indicating positive population growth (e.g., pregnancy rates of 2 and 3-year-old females; Table 2) all suggested this herd was capable of accommodating more harvest. Managers believed 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.

Table 1. Mulchatna Caribou Herd fall composition and population estimates, calendar years 2008 through 2017.

Calendar Year	Bull: 100 Cows	Calves: 100 Cows	Calves (%)	Cows (%)	Bulls (%)	Small Bulls (% of total bulls)	Medium Bulls (% of total bulls)	Large Bulls (% of total bulls)	Composition Sample Size	Estimate of Herd Size
2008	19	23	16	70	14	47	36	17	3,728	30,000[b]
2009	19	31	21	67	12	40	44	16	4,595	-
2010	17	20	14	74	12	30	44	26	4,592	-
2011	22	19	14	71	15	32	41	27	5,282	-
2012	23	30	20	65	15	38	38	24	4,853	22,809[c]
2013	27	19	13	68	19	39	36	25	3,222	18,308[c]
2014	35	30	18	61	21	44	31	25	4,793	26,275[c]
2015	35	29	18	61	21	35	43	22	5,414	30,736[c]
2016	39	22	14	63	24	43	29	28	5,195	27,242[c]
2017	32	23	15	64	21	44	28	28	5,160	-

Table 2. Parturition of radiocollared Mulchatna cows observed during May surveys, RY08–RY17.

Age Class	2 yrs. old			3 yrs. old			4 yrs. old			≥5 yrs. old			Total	≥ 3 yrs. old
Year	No. Radios[a]	No. Preg	% Preg	No. Radios[a]	No. Preg	% Preg	No. Radios[a]	No. Preg	% Preg	No. Radios [a]	No. Preg	% Preg	Annual Sample Size	% Pregnant
2008	10	1	10	10	4	40	9	7	78	14	11	79	43	67 %
2009	10	0	0	6	5	83	10	9	90	10	10	100	36	92 %
2010	5	1	20	13	9	69	9	5	56	19	16	84	46	73 %
2011	13	0	0	3	2	67	11	10	91	29	22	76	56	79 %
2012	12	0	0	15	10	67	2	1	50	32	27	84	61	76 %
2013	11	3	27	14	12	86	15	10	67	28	23	82	68	79 %
2014	5	3	60	8	8	100	11	11	100	31	26	84	55	90 %
2015	10	3	30	3	3	100	5	3	60	23	13	57	41	61 %
2016	7	1	14	9	8	89	3	1	33	17	14	82	36	83 %
2017	16	3	19	8	5	63	12	10	83	20	14	70	56	73%

[a] Number of radio-collared female caribou in age class observed during survey.

The primary biological assessment activities conducted annually on this herd include a post-calving population estimation, fall composition surveys, spring parturition surveys, capturing and weighing a sample of 11-month-old females each April, weighing neonate caribou calves during calf mortality studies, assessing survival of various age classes through radio telemetry studies, and harvest assessment (Barten 2015).

Because the MCH is important for providing high levels of human consumptive use, the BOG designated the Mulchatna Caribou Herd Predation Management Area (MCHPMA), corresponding with the range of the MCH in Units 9B, 17B, 17C, 19A and 19B (39,683 mi^2). The objective of the plan is to enhance recovery of the MCH and achieve a population and sex/age structure that will sustain human harvests within the objectives established for this herd by the BOG. The goal of the plan is to reduce wolf numbers in the MCHPMA that encompasses or is adjacent to important calving areas and will be defined annually by the department based on demographic data and locations of calving grounds. The wolf population reduction plan initially authorized in March 2011 for Units 9B and 17B&C was modified in March 2012 to include Units 19A&B. It was limited to 10,000 mi^2, which is approximately 25% of the MCHPMA. The following prey and predator population estimates were identified, and objectives specified during the beginning stages of this program.

- 2008 MCH population estimate: 30,000 caribou
- IM population objective for MCH: 30,000–80,000
- RY11 reported MCH harvest:492
- IM harvest objective for MCH: 2,400–8,000
- Fall 2010 pre-control wolf estimate: no data available
- Wolf control objective: reduce wolf numbers in the control area that encompasses the calving grounds of the MCH to enhance the recovery of the MCH

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 to 2024 which coincides with the region's three-year board cycle. This plan authorizes the department to issue permits to public pilot/gunner teams to take wolves on the same-day-airborne (SDA). 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 MCHPA 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 southern calving area of the MCH.

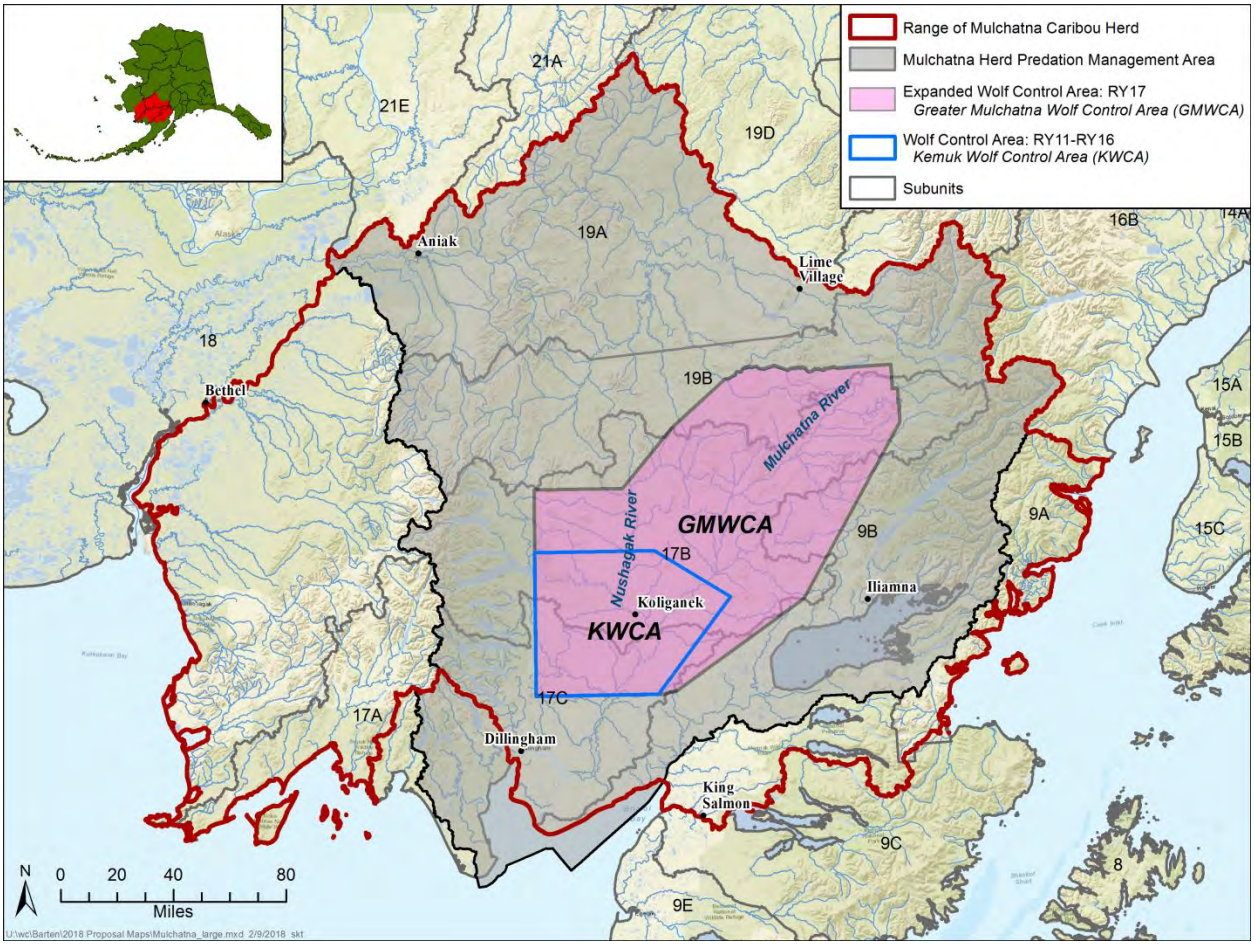

Figure 2. Intensive management area for caribou (*Rangifer tarandus*) in Game Management Units 17B, 17C, 19B, and 9B in southwest Alaska.

In concert with the IM plan being adopted in RY11, the department conducted 4 years (RY10–RY13) of caribou calf mortality studies in the MCH southern calving grounds, and 3 years (RY12–RY14) in the northern calving ground. The southern calving ground served as an

experimental area as it was within the wolf control area, while the northern calving ground served as the control. This was followed by a single year of calf mortality studies in RY16 that also covered both the northern and southern calving grounds. However, during this latter study period, the southern calving ground moved outside the wolf control area, so a comparison between control and experimental was not possible. Wolves, brown bears, and golden eagles were determined to be the main predators on neonate caribou for MCH neonates (D. Demma, unpublished data, ADF&G, Palmer; Figures 3 & 4), although coyotes, wolverines, and black bears also impacted neonate survival.

- Wolf control objective: reduce wolf numbers in the control area that encompasses the calving grounds of the MCH to enhance the recovery of the MCH

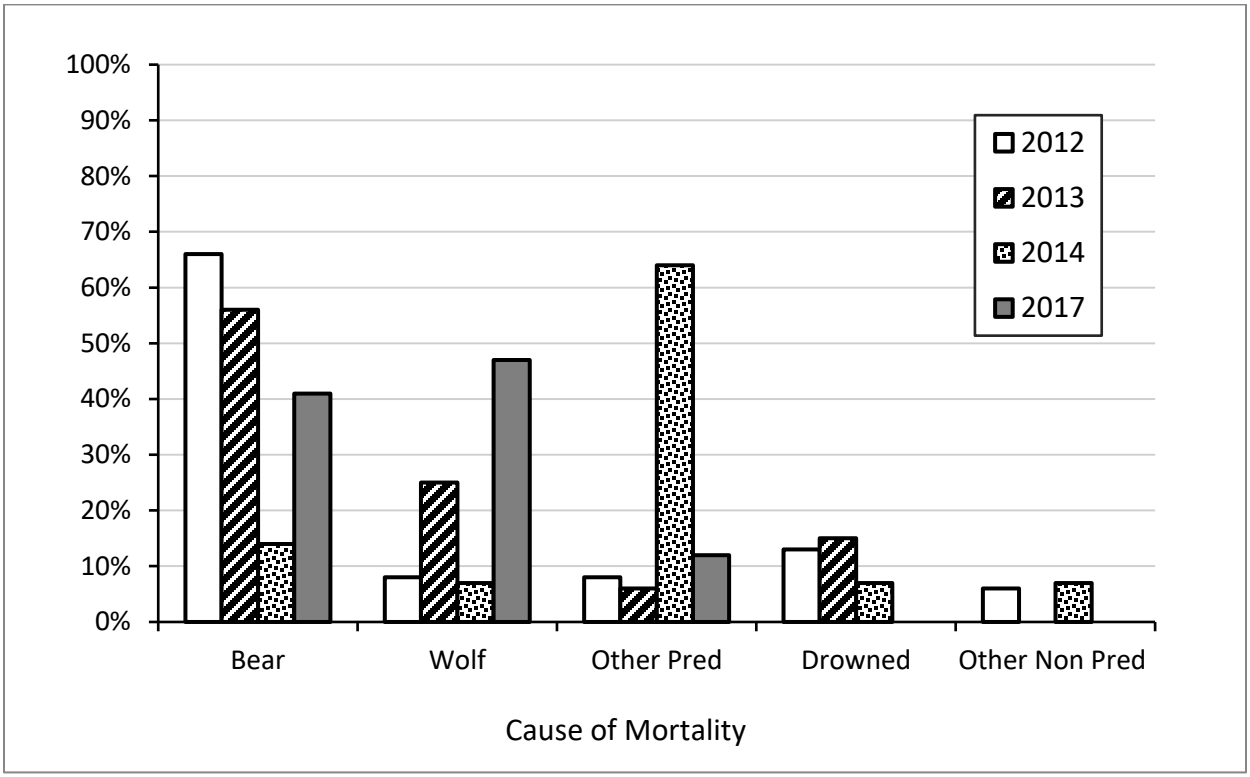

Figure 3. Cause of mortality of MCH caribou calves for summer 2012–2014, and 2017 for the northern calving area.

In recent years the southern calving ground has moved outside the MCHPCA, compromising the department's ability to increase calf survival through wolf removal. Because recent history suggested there was a fair chance the caribou would reoccupy the traditional calving grounds within the MCHPCA, we kept the wolf control area static rather than try and guess where the calving grounds would be on any given year. In spring 2017, our calf mortality study indicated that neonates in the northern calving ground were experiencing high levels of predation mortality (Figure 3), prompting the department to expand the wolf control area to include that area nearest the northern calving grounds in an attempt to enhance calf survival and recruitment.

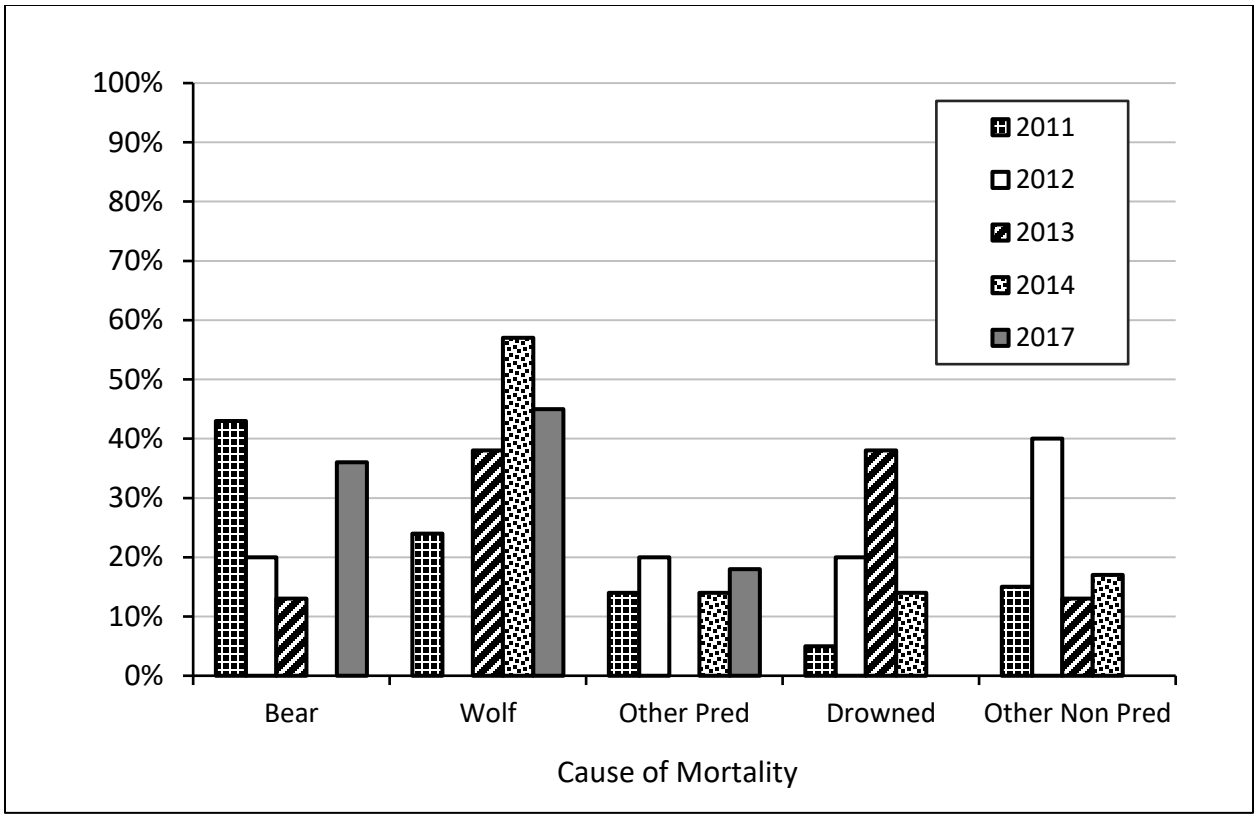

Figure 4. Cause of mortality of MCH caribou calves for summer 2011–2014, and 2017 for the southern calving area.

This action caused the wolf control area to increase from 2,870 mi^2 to 9,844 mi^2 (Figure 2). Land ownership in the wolf control area is largely state-owned, with some Bureau of Land Management (BLM) and private lands. As part of this revision, the original MCHPCA was renamed the Kemuk Wolf Control Area (KWCA), while the newly expanded area that includes part of the northern calving ground was named the Greater Mulchatna Wolf Control Area (GMWCA; Figure 2). The expansion to 9,844 mi^2 provides greater potential for increasing neonatal survival by including wolf packs that likely prey on the calves in the northern calving ground. This addition to the wolf control area also encompasses much of the post-calving range used by the northern calving 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 to recruitment in the fall.

In spring 2017, we 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 both within and adjacent to the MCHPCA. Wolf densities across the wolf control area (KWCA & GMWCA) were extrapolated from these 5 packs and estimated to be 2.2–3.0 wolves per 1,000 km^2. This is very similar to the previous density estimate conducted in RY11 using a minimum count method (McNay 1993; Gardner and Pamperin 2014) whereby we tracked and counted wolves via aircraft and obtained an estimated 2.0 wolves/1,000 km^2.

The following prey and predator population estimates were identified, and objectives specified at the time of program renewal in RY16.

- 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
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The department maintains a sample of radio-collared caribou to facilitate annual spring parturition surveys, summer population estimation, fall composition surveys, tracking seasonal movements, and determining survival of female caribou of animals $\geq$10-months.

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). Lack of an anticipated response may require evaluation of additional criteria or a research project to understand which additional factors may be influencing the system and whether they are feasible to manage.

I. TREATMENTS

A. *Predation Control:*

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

In spring 2012 the department conducted a minimum density 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.

Department research on MCH calf mortality (2011–2017) indicates that wolf predation on calves is one of the major limiting factors on population growth of the MCH. Although most 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 WCA), 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 southern (Kemuk) calving ground. The department limited the aerial wolf hunting season to February 1–April 30 because of concerns by residents who wanted a chance 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 3).

Table 3. Wolf removal from wolf assessment area and wolf removal area, RY11 through RY16.

Period	Regulatory Year	Non-SDA Harvest Removal from Area wolf assessment area (7,612 mi^2)		Department Control Removal from predation control area (2,870 mi^2)	SDA Public Control Removal from predation control area	Total Removal from wolf assessment area	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	-

Although there is great interest in this program with an average of 26 pilots signing up each year, only 2–3 pilot days per year were realized. Snow and appropriate flying conditions are major limitations that impact effective wolf tracking and harvesting by permitted pilots. Most pilots who signed up for the program are also from distant communities, requiring a window of several good days to make it worth their while to attempt a hunting trip, and this seldom occurred. Additional factors limiting success have been the February 1 starting date for aerial hunting, as in some years there were windows of good conditions prior to this date that the aerial gunners could not use; and during those rare periods of good snow,

department staff closed down the aerial hunting program on several occasions to allow staff to safely survey moose and/or capture wolves for study. The expansion of the wolf control area will allow for a much larger area for wolf hunters to look for and pursue wolves, and while the aerial hunting season in the original Kemuk WCA will remain Feb. 1–April 30, the season in the much larger Greater Mulchatna WCA will run from November 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 hunting program, harvest of wolves under authority of ordinary hunting and trapping seasons has been very effective within the wolf control area during years with adequate snow cover for snowmachine travel (Table 3).

Increasing neonatal calf survival by reducing predation mortality is the vital rate that can be most improved to increase the caribou population and harvest. Calf production is relatively high and offer little room for improvement. Neonatal mortality is typically more additive than mortality on older animals because even very fit, high-quality individuals are more vulnerable to predators when they are very young.

This program targets wolves over other predators because wolves are known to be a significant predator on neonatal caribou, and unlike bears, wolf reduction can often be conducted by public permittees resulting in little cost to the department. Wolf reduction to meet prey objectives when centered on caribou calving grounds has been shown to be effective on the Southern Alaska Peninsula herd (Riley 2011), and we hope to realize similar success in this area. Although the IM program for the MCH has had minimal effects on the caribou population thus far, we anticipate that with a couple of years of good snow conditions, aerial hunters permitted under this program could harvest enough wolves to make this program successful. Removal of wolves to enhance caribou calf survival and recruitment has been shown to be effective in other areas (Boertje et. al. 1996; Gasaway et. al. 1983; Hayes et. al. 2003).

Bears are also known to be significant predators of young caribou calves. Because bears take primarily very young calves, it is most likely highly additive mortality. However, bears are much more numerous than wolves on most calving areas simply because bears occur at much higher densities than wolves. Essentially, many more bears would have to be removed to have the same effect as removing a relatively small number of wolves. Bear populations also take much longer to rebound following population reductions because of lower reproductive potential and lower rates of immigration from untreated areas. Finally, lethal bear population reductions within the state have to date been largely unsuccessful because of low demand/participation from the public to take bears as well as public opposition to large-scale efforts by state staff.

B. *Habitat Enhancement:*

There are no known methods to enhance habitat for caribou except, perhaps, fire suppression on lichen-rich winter ranges. The MCH range is not subject to frequent wildfire and there is no indication that fire has compromised winter range for the MCH. Indices related to the nutritional condition of the MCH (weights of short-yearling females (Figure 5), and pregnancy rates of two- and three-year-old females) (Table 2) suggest the caribou and the habitat supporting them are in good condition.

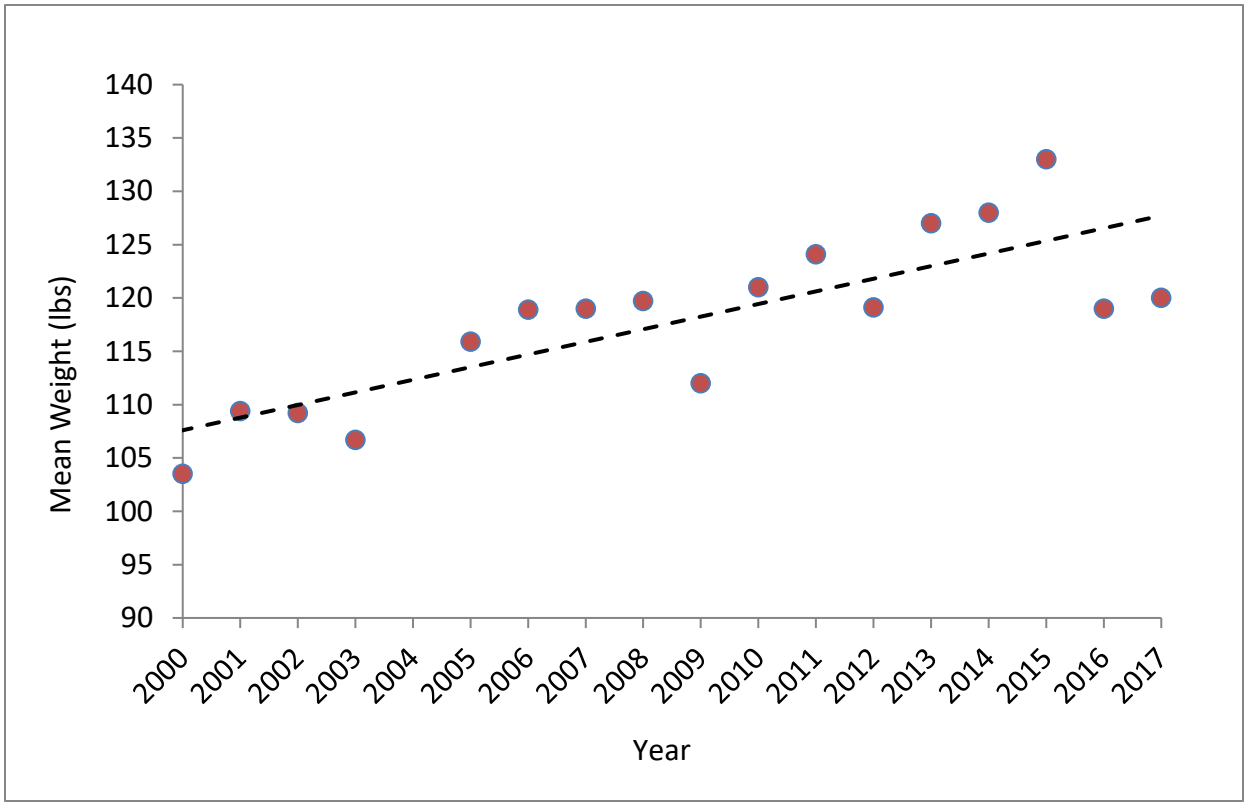


Figure 5. Body mass (lbs.) of MCH short-yearlings as an indices of body condition, by calendar year

C. *Prey Harvest:*

The current bag limit for the MCH has been revised in recent years to allow hunters to take 2 caribou of either sex; a change from the previous regulation that allowed only 1 bull and only 1 caribou during Aug. 1–Jan. 31. This change was in response to a steady increase in the bull-to-cow ratio that has met our objectives during 3 of the past 4 years, and a reported harvest that is far below the harvestable surplus. Simplification of the regulations helps subsistence hunters especially who can harvest their 2 caribou anytime throughout the

season, saving time and gas money, as well as taking advantage of the harvest opportunity when it presents itself. Currently, there is substantial demand for caribou among the numerous and widely distributed villages within the range of the herd in addition to nonlocal residents and nonresidents (Table 4). The nonresident season has been closed since 2008.

Table 4. Mulchatna caribou annual hunter residency and success, regulatory years 1991–2016.

	Successful				Unsuccessful				
Reg. Year	Local resident[a]	Nonlocal resident	Non resident	Total (%)	Local resident[a]	Nonlocal Resident	Non resident	Total (%)	Total hunters[b]
1991	89	562	599	85	9	136	69	15	1,464
1992	82	542	651	91	12	82	26	9	1,391
1993	47	718	725	85	5	171	77	15	2,394
1994	61	812	896	83	11	227	124	17	2,954
1995	52	1,035	928	87	15	188	86	13	3,127
1996	56	647	824	85	25	139	101	15	1,822
1997	85	564	1,277	84	33	178	152	16	2,301
1998	178	1,130	1,877	78	142	320	414	22	4,131
1999	174	1,024	1,697	72	120	453	553	28	4,039
2000	188	817	1,713	68	148	427	691	32	3,989
2001	270	843	1,377	74	159	351	368	26	3,406
2002	169	556	1,028	63	210	383	450	37	2,831
2003	312	762	1,111	71	181	352	378	29	3,129
2004	256	573	764	62	133	357	501	38	2,634
2005	418	427	485	56	229	322	497	44	2,405
2006	207	208	273	53	182	207	226	47	1,312
2007	334	148	125	58	184	163	105	42	1,084
2008	269	130	61	54	165	140	85	46	850
2009	180	63	0	49	197	82	0	53	540
2010	270	58	0	58	174	66	0	42	589
2011	305	87	0	70	115	53	0	30	575
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

[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.

Generally, most caribou harvest by local hunters takes place in the late winter if snow conditions are conducive for snowmachine travel (Table 5). 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 5. Mulchatna caribou annual harvest chronology percent by month[a], regulatory years 1991 through 2016.

Reg.	Harvest Periods										
Year	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total[b]
1991	-	29	43	6	0.4	2	1	4	12	0	1,573
1992	-	30	54	5	1	0.3	0.2	1	8	0	1,602
1993	-	36	50	5	0.4	1	1	1	5	2	2,804
1994	-	35	50	5	0.4	1	1	1	5	2	3,301
1995	-	33	50	6	1	2	1	1	5	2	4,449
1996	-	25	52	5	1	1	1	2	11	2	2,366
1997	-	33	53	4	0.3	0.4	1	3	4	0.3	2,704
1998	-	25	55	6	0.6	0.6	2	2	7	1	4,770
1999	0.1	24	52	5	0.5	1	3	5	8	2	4,467
2000	0.2	27	55	6	0.3	0.3	2	3	4	1	4,096
2001	0.2	23	49	3	1	2	2	4	9	5	3,830
2002	0.2	23	55	4	0.6	1	3	2	6	2	2,537
2003	0.2	19	45	4	0.5	4	5	5	12	2	3,182
2004	0.2	20	46	2	1	2	2	2	10	9	2,236
2005	0.2	15	32	2	4	2	3	6	25	7	2,175
2006	-	13	38	1	3	5	4	10	21	1	921
2007	-	3	26	2	2	6	7	28	26	-	767
2008	-	3	23	3	5	4	6	25	30	1	510
2009	-	7	12	7	17	5	9	10	30	-	328
2010	-	3	7	1	3	14	7	19	44	-	474
2011	-	2	9	2	4	2	18	18	43	-	482
2012	-	3	7	1	2	12	6	16	52	-	336
2013	-	16	28	8	18	12	2	8	8	-	106
2014	-	19	32	10	3	18	2	11	5	-	188
2015	-	17	23	5	10	16	7	17	4	0.4	245
2016	-	9	11	5	2	8	7	20	38	-	341

[a] July opening date for Unit 9B established starting 1 Jul 1999. Starting 2006, opening date Aug 1. Starting 2008, all closing dates March 15. Starting fall 2015, Unit 17 and 9B closing date moved to March 31.

[b] Collected from harvest report cards and includes unknown harvest date.

Managing caribou harvest can be difficult because caribou distribution and winter weather can vary dramatically, affecting access to the animals for harvest. When hunters either have a difficult time finding caribou or getting to them, an increase in abundance

may not equate to an equally proportionate increase in harvest. The department initiated caribou SDA during the population's most recent peak of ~200,000 animals to provide greater access to animals and as a management tool. If efforts are successful in enhancing calf survival and recruitment that leads to a rapid population rate of increase, the department may need to liberalize seasons and bag limits and allow different methods of harvest to meet our harvest objectives. Poor snow conditions and other issues with access may pose a challenge towards ensuring population regulation through harvest.

II. ANTICIPATED RESPONSES TO TREATMENTS

A. *Predator Abundance:*

A multi-day wolf survey conducted in 2012 in the 7,612 mi^2 wolf assessment area estimated a minimum wolf density of 2.0 wolves/1,000 km^2. Inadequate snow conditions have prevented follow-up surveys. To address this issue, the department began radiocollaring wolves in spring of 2017 to collect demographic and abundance information. Through collecting data on pack size during collaring, as well as enumerating wolves during the summer months after recruitment of pups, the estimated density of wolves in the wolf control area (KWCA and GMWCA) which includes the wolf assessment area was 2.2–3 wolves/1,000 km^2. Efforts will continue to capture and radiocollar wolves in spring 2018 with the goal of deploying collars on all packs within the 9,844 mi^2 wolf control area (GMWCA). This project will provide the necessary information to estimate wolf abundance annually and help evaluate the success of the MCHPMA.

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. More likely, the program will be successful in removing several wolf packs in strategic areas adjacent to the northern calving grounds while outlying areas will retain the bulk of their wolf numbers. 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.

B. *Predation Rate:*

We will continue to monitor calf survival by collaring and tracking neonates. This will be followed by annual fall composition surveys which provide recruitment information on ~4-month-old calves. Although this study does not allow us to directly assess predation rates, we can assess calf survival via the fall composition survey.

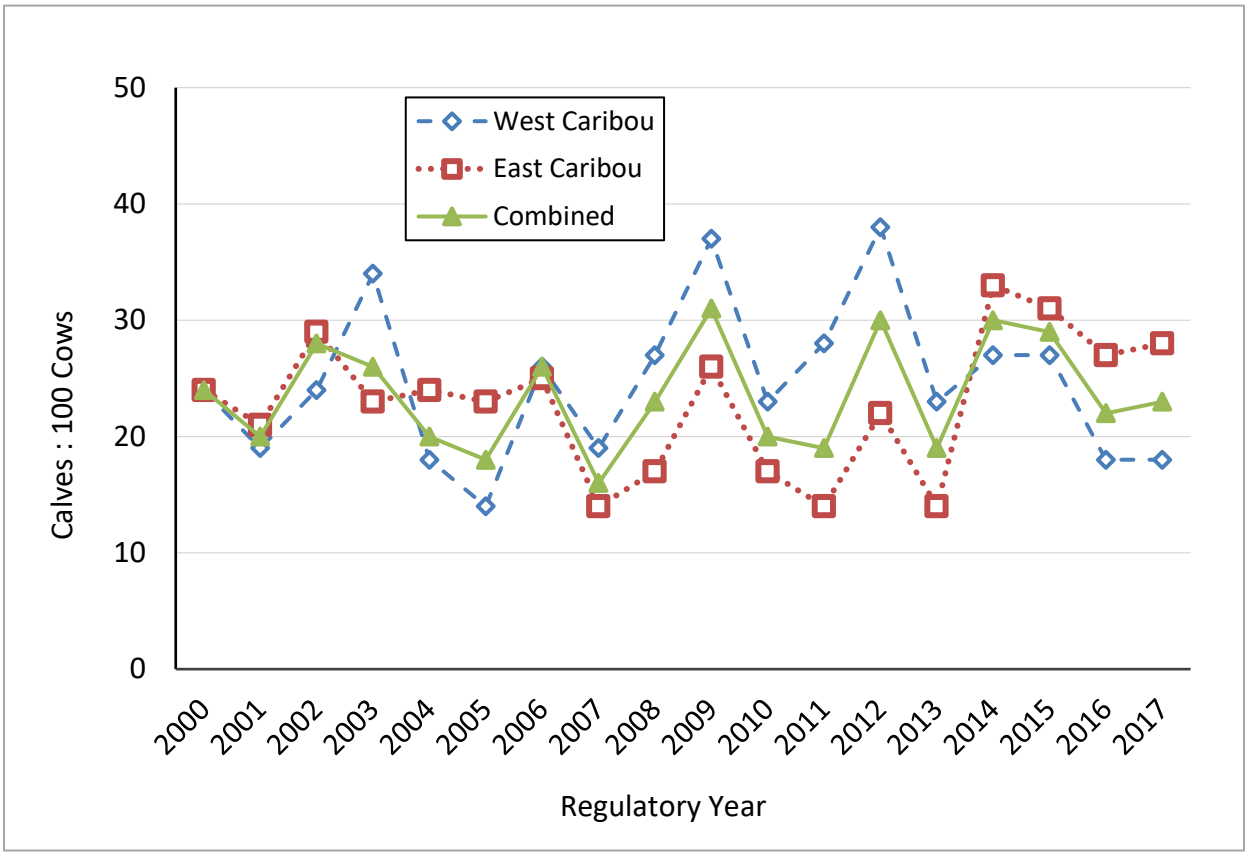
C. *Prey Abundance:*

Deploying radio collars on neonates will provide the opportunity to assess calf survival from capture through the summer into the period of fall composition surveys. With a

successful wolf removal program, 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. A higher survival of calves should ultimately lead to growth of the MCH and achieve population objectives.

D. *Prey Recruitment:*

Data from calf mortality studies indicates wolves are active predators on caribou calves and reducing wolf predation should provide for higher calf survival and recruitment to fall and the one-year age class. Although it is hard to speculate how much of a positive effect this program will have on the fall calf-to-cow ratio, any increase in that ratio can only help



this herd become more productive and begin increasing toward the IM objectives. Through radiotracking collared neonates, a direct estimate of calf survival through early to mid-summer will defined. The fall composition surveys will provide us with a broader assessment of survival and recruitment at the population level later in the year (Figure 6).

Figure 6. MCH fall composition survey data (calf-to-cow ratios), RY00 through RY17.

E. *Prey Productivity or Nutritional Condition:*

We do not expect to see any noticeable changes in these metrics during this IM action. This population is well below previous high numbers, and all indications are that the caribou on the landscape are in good health and very productive. However, we will continue to collect data annually on weights of neonates as well as 11-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. Any density dependent effects to these metrics is not expected to be felt until the population reaches a much higher level than what it is today.

F. *Harvest:*

If increases in neonatal calf survival result in increased recruitment, opportunity will increase as soon as biologically feasible through restoration of pre-decline season length and bag limits. One consideration is the effects of climate change on hunting access and therefore success. If recent winters are any indication of what is in store for future weather patterns, long periods of minimal harvest due to the inability of hunters to access caribou may occur.

G. *Use of Nontreatment Comparisons:*

During the first few years of wolf control, a non-treatment comparison area (northern calving grounds) existed to contrast with the treatment area (southern calving grounds). However, since spring of 2015, the southern calving group has calved out of the wolf removal area, compromising this aspect of the program. Currently the wolf control area covers a portion of the northern calving area and lies adjacent to where the southern calving area has been the past three years. Thus, removal of wolves within the control area could well effect calf survival in the southern calving area, confounding any conclusions drawn. Additionally, the caribou that utilize the southern calving area spend all but 3–4 weeks (at parturition) west of the Tikchik lakes country, in western Unit 17B and eastern Unit 18. Comparing this group of calves to those from the northern calving area is somewhat problematic given the likelihood of 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. However, the NPH began growing again in 2008 and it was only through aggressive harvest of more than 25% of the herd that it was possible to bring the population down to objectives.

H. *Other Mortality Factors:*

Frequency of winters with deep snow, or ice on snow events could hinder access to forage and reduce overwinter survival of young despite reduced predation. This may confound treatment responses. Recent winters have been much warmer than the long-term average, and the likelihood of ice-on-snow events is likely higher than in the past.

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:*

Within the wolf removal area, wolfs have been radiocollared to aid in the understanding of wolf abundance, range, spatial distribution, pack size, litter size, etc. during the active stage of this program, and will continue this effort for four years after this program is terminated. This understanding of wolves will likely include areas adjacent to the treatment area since some wolf pack home ranges will extend beyond the wolf control area borders. If the program is successful in lowering the density of wolves across this broad area, it is expected that this population returns to pre-treatment levels within 3–5 years post reduction (National Research Council 1997:52–53). Based on data collected since spring of 2017 via the use of radiocollared wolves, the density of wolves within the wolf removal area is estimated at 2.2–3 wolves/1,000 km^2. The objective of this predator control program is to reduce wolf numbers to enhance calf survival and allow the Mulchatna herd to increase meeting the IM objectives set forth within the IM plan. 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.

B. *Habitat and Forage Condition:*

Although not part of this program, ongoing departmental 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 forage relative to any population increases resulting from this active IM program.

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

The abundance objective for caribou under the IM program is 30,000–80,000 caribou. The department should attempt to assess the MCH population every year. However, a successful survey depends on funding, weather patterns, and availability of pilots. If a poor survey results from inadequate aggregations in a given year, then another survey should become a priority for the following year.

Composition surveys will be conducted annually. Composition ratio data has some well-known weaknesses in that a change in one parameter 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 via radiocollared animals.

The department will monitor nutritional condition by measuring body mass of calves at birth and at 11 months of age as well as estimate age-specific pregnancy rates through standard parturition surveys of radiocollared adult females. Body mass of calves at birth may only be useful for identifying strong stochastic events that limit nutrition as subsequent foraging conditions during growth can allow lighter weight cohorts to compensate and vice-versa. Sample sizes for body mass at 11 months and pregnancy will be too small to detect small short-term changes; however, the sample sizes are believed to be adequate to determine longer-term trends.

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 harvest has remained <500 since 2008. Harvest and effort are assessed using a single registration permit that covers nearly the entire Mulchatna range. Harvest reporting is considered unreliable in portions of the range which is problematic for harvest assessment. Subsistence household surveys indicate the actual harvest is substantially higher than what is reported through harvest reports. Although the harvest reports transitioned from a general season harvest ticket to a registration permit in 2013 to increase reporting, we are now starting to see signs that hunters are beginning report their information in a timely manner. Efforts at outreach via community visits or social media need to continue to try and improve harvest reporting. Only through diligence in this area can improved reporting reach a point where our data reflects the actual level of harvest.

IV. Decision Framework to Implement or Suspend a Treatment

A. *Predation Control:*

The decision-making framework to evaluate, suspend, or terminate wolf 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
- If nutrition is not considered the primary factor limiting caribou population growth.

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;
- If after three years, the harvest of wolves is not sufficient to make progress towards the population objectives for wolves; or
- When declining trends in caribou weights or other index of nutritional status are observed and indicate objectives may be too high.

When caribou nutritional indices, such as pregnancy rates, calf and adult body mass, or other condition indices, exhibit a declining trend from current values and the bull-to-cow ratio is greater than 20 bulls:100 cows;

- Fall caribou calf ratios remain below 20 calves per 100 cows for three consecutive years of wolf removal from the control area;
- May continue to reduce wolf numbers in the control area until the following thresholds are met without the benefit of wolf control:
  - The bull to cow ratio can be sustained within management objectives and the fall calf-to-cow ratios can be sustained above 30 calves-per-100 cows;
  - The population can grow at a sustained rate of 5% annually without the benefit of wolf control or caribou population objectives are met; or
  - Calf recruitment and survival during the first four weeks of life is less than 50%.

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 is used for nearly all hunting of Mulchatna caribou. Hunters are allowed 2 caribou of either sex. Seasons vary across the range of the Mulchatna herd with all areas beginning on August 1, but some ending March 15, while others end March 31. If the Mulchatna abundance declines and recruitment indicates the current harvest strategy is too liberal and works against our IM objectives, actions would be taken through the board of game to change the seasons and bag limits to a more conservative strategy.

      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 is not uncommon. However, coming up with a reliable estimate that can be used in modeling the true harvest is difficult.

   2. Prey Nutritional Index.

      The weights of neonates and 10-month-old females will be collected each year 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. Interest in the pilot/gunner program for

wolf removal is high in Dillingham, and discussions with permittees also help with dissemination of information to the public.

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. If the public are unable to effectively remove wolves at a recommended rate, direct removal by department staff may be warranted.

D. *Monitoring and Mitigation of Hunting Conflict:*

Although hunter conflict has been minimal in recent years given the low population level of the Mulchatna herd and the low harvest, advisory committee and board processes will be used to monitor and mitigate user conflict. Communication between committees and other users such as air taxi's 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 interest spikes to a much higher level, it is unlikely conflicts will be a concern.

VI. OTHER CONSIDERATIONS

This IM program and the predation control components have been renewed once since original authorization in 2011. The current wolf removal effort to permit private pilots and gunners has struggled during the first 6 years of this program. This has been largely due to inadequate snow conditions that are necessary to allow airplane hunters to track and find wolves, and then be able to land and retrieve them. Additionally, during short windows of good weather, the department has closed the area to SDA hunters for safety reasons while we've 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 (9,844 mi^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 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.
Biological and Management Situation	
Prey population	IM objectives: 30,000–80,000 Estimated in June 2016: 27,242 (± 5,896)
Prey harvest (human use)	IM harvest objective: 2,400–8,000; Reported harvest in RY2016: 340 caribou. 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 and pregnancy rates of 2 and 3-year-old females indicate caribou are in good condition and habitat is not limiting currently (Table 2 and Figure 5).
Habitat status and enhancement potential	Habitat does not appear to be limiting. 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).
Predator(s) harvest	During RY11–16 the wolf assessment area in Units 17 and 9B was 7,612 mi^2 and encompassed the Kemuk WCA. The average wolf harvest during this period was 30 wolves, with a range of 0-77. However, only 14 of these wolves were taken under the SDA program; the remainder was 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	2017 caribou calf mortality study-birth to 4 months of age: • 84% mortality in northern calving ground • 59% mortality in southern calving ground 17% of mortality attributed to wolves, 15% to brown bear, and 28% 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 can't 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. However, we believe that in combination with normal hunting and trapping efforts, 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.
Other mortality	Icing events that lock up forage could play a larger role with recent trends toward warmer winters.