OPERATIONAL PLAN FOR INTENSIVE MANAGEMENT OF THE FORTYMILE CARIBOU HERD IN GAME MANAGEMENT UNITS 12, 20B, 20D, 20E AND 25C DURING REGULATORY YEARS 2020–2025

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 the Fortymile Caribou Herd (FCH) during regulatory years (RY) 2020 through 2026 (RY = July 1–June 30, e.g., RY20 = July 1, 2020–June 30, 2021). The IM plan for the FCH is found in Title 5, Alaska Administrative Code, Section 92, Part 113 (abbreviated as 5 AAC 92.113). Based on the biological and management information for this area (Appendix A), this operational plan describes rationale for evidence of limiting factors; choice of indices for evaluating treatment response; and decision frameworks on implementation, suspension, or termination for predation control, habitat enhancement, and prey harvest strategies. *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 the FCH has been developed based on the recommendation of the Upper Tanana Fortymile and Eagle Fish and Game Advisory Committees and at the request of the Alaska Board of Game (board).

BACKGROUND

Residents of the upper Yukon–Tanana drainages expressed concern, since the early 1980s, about chronically low numbers of the Fortymile Caribou Herd (FCH) and moose in Units 12 and 20E. They believed that the low numbers of caribou primarily resulted from wolf predation and low numbers of moose resulted from a combination of wolf and brown bear predation. During board meetings in March 2004 and 2006, the Upper Tanana–Fortymile Fish and Game Advisory Committee and the public provided testimony explaining the problem and requested corrective action.

The board first adopted the Upper Yukon–Tanana Predation Control Implementation Plan (plan) in November 2004 to increase the moose population. The plan authorized control of wolves and brown bears in the Upper Yukon–Tanana Predation Control Area (UYTPCA) in all of Units 12 and 20E, excluding the Yukon–Charley Rivers National Preserve (YUCH). The plan was authorized for January 1, 2005 – December 31, 2009. The board authorized the commissioner to issue public aerial or public land and shoot permits to control wolves pursuant to AS 16.05.783. Baiting of brown bears under a control permit was allowed as a method of brown bear removal beginning in spring of 2005. Using ADF&G discretionary permit authority, the geographic area where public permittees were allowed to take wolves was limited to southern Unit 20E and to Unit 12 north of the Alaska Highway, and the area they were allowed to take bears was limited to southcentral Unit 20E. During January–May 2006 at multiple meetings, the board modified the plan to:

- Add the FCH and expand the UYTPCA to encompass an 18,750 mi^2 portion of the FCH range (all of Unit 20E and portions of Units 12, 20B, 20D and 25C) (Figure 1)
- Expand wolf control to the entire UYTPCA
- Limit brown bear control to southcentral Unit 20E
- Clarify and update key components of the plan that included wildlife population and human use information, predator and prey population levels and objectives, plan justifications, methods and means, and time frame for updates and evaluations.

After these board changes, ADF&G did not use discretionary permit authority to limit the geographic area were control was conducted.

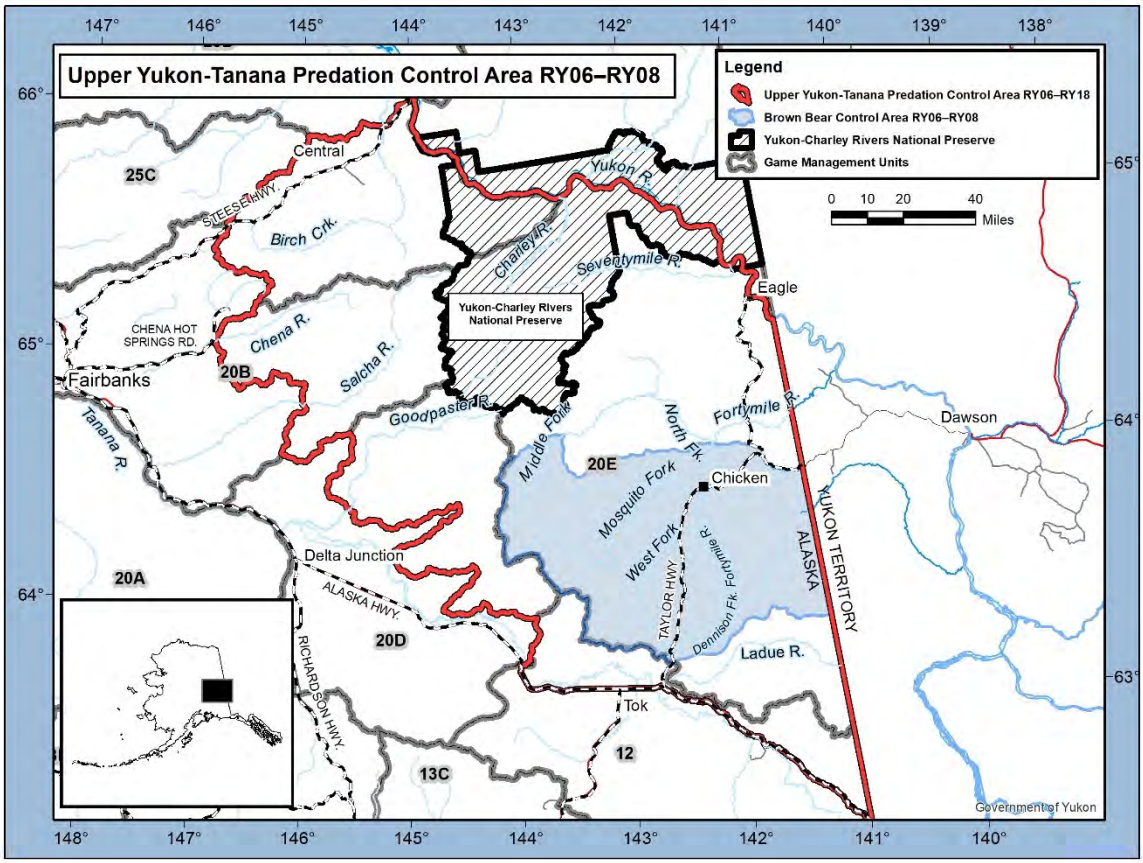

Figure 1. Upper Yukon–Tanana Predation Control Area, regulatory years 2006–2007 through 2008–2009 (18,750 mi^2). Predation control was not authorized within Yukon–Charley Rivers National Preserve.

In March 2009, the board reauthorized the plan for July 1, 2009–June 30, 2014. The reauthorized plan suspended bear control on July 1, 2009 because it was determined to be ineffective due to a combination of ineffective methods and lack of permittee incentives. It retained the 18,750 mi^2 UYTPCA (Figure 2), and reaffirmed public aerial shooting permits or public land and shoot permits for wolf control.

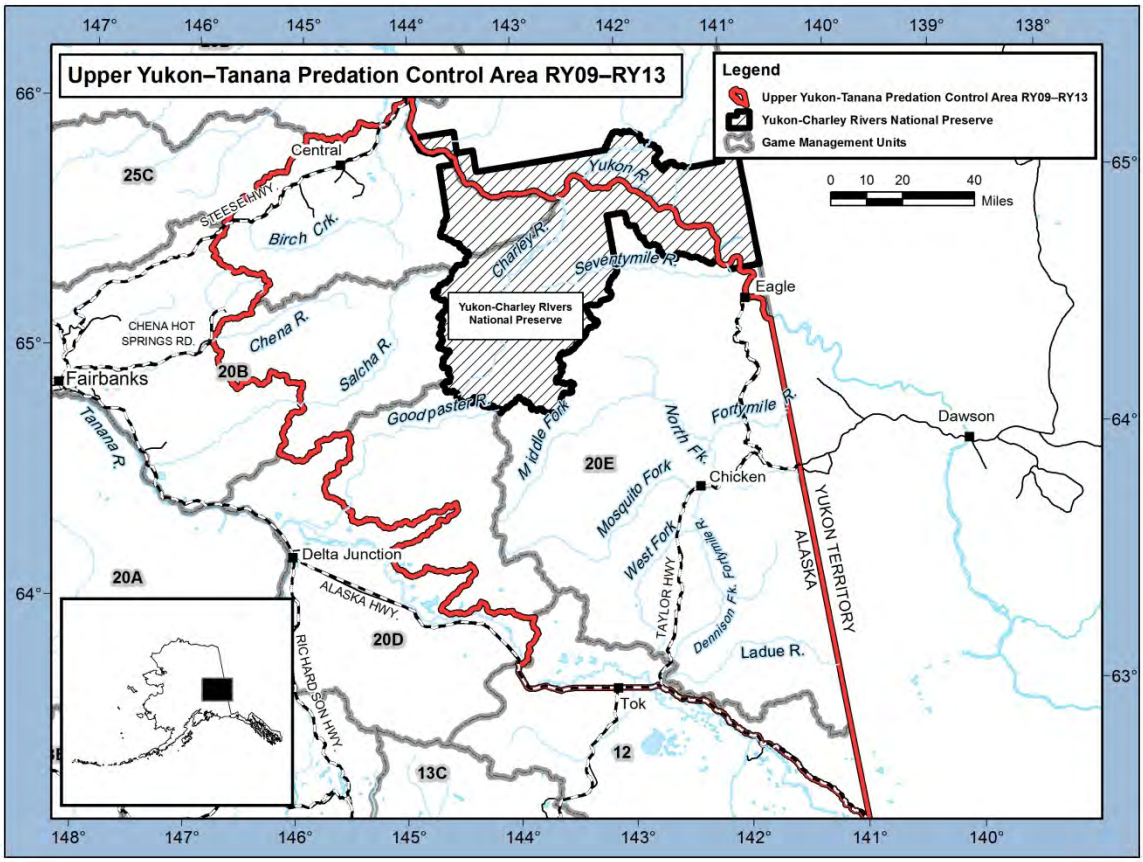

Figure 2. Upper Yukon–Tanana Predation Control Area, regulatory years 2009–2010 through 2013–2014 (18,750 mi^2 area). Predation control was not authorized within Yukon–Charley Rivers National Preserve.

In addition, department wolf removal using helicopters was implemented under the commissioner's authority to supplement public permittee efforts and help achieve removal objectives. The following IM prey and predator objectives were also specified.

- FCH population objective of 50,000–100,000 and harvest objective of 1,000–15,000;
- Moose population objective of 8,744–11,116 and harvest objective of 547–1,084 in Unit 12 north of the Alaska Highway and in Unit 20E;
- Wolf control objective of maintaining no fewer than 88–103 wolves (mid-point = 96). A minimum population of 88 wolves is approximately a 75% reduction from the minimum pre-control population of 350 and assured that wolves persisted in the UYTPCA.

In February 2014, the board reauthorized the plan for July 1, 2014–June 30, 2020. The reauthorized plan retained the 18,750 mi^2 UYTPCA (Figure 3), and reaffirmed public aerial shooting permits or public land and shoot permits for wolf control.

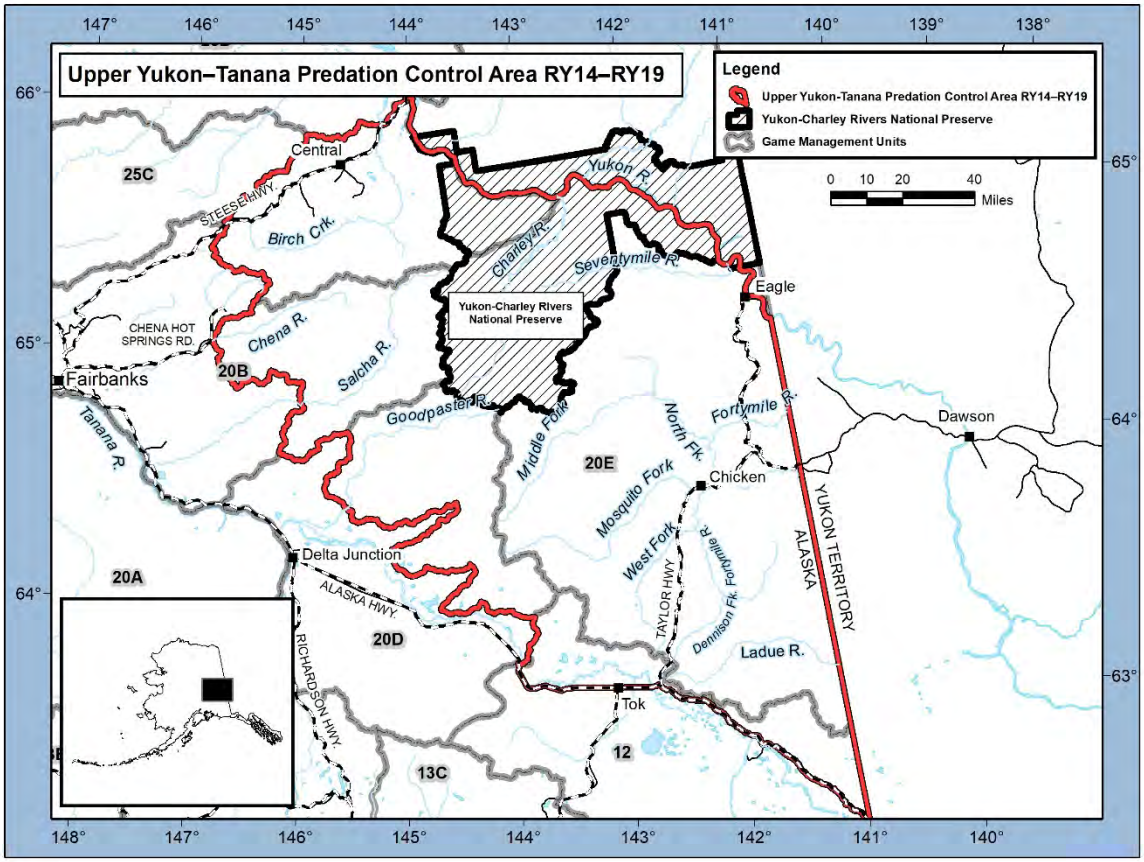

Figure 3. Upper Yukon–Tanana Predation Control Area, regulatory years 2014–2015 through 2019–2020 (18,750 mi^2 area). Predation control was not authorized within Yukon–Charley Rivers National Preserve.

The plan also retained the objectives of the 2009 version of the plan related to the FCH and wolves, but removed portions related to moose. It is assumed that moose would continue to benefit in northern Unit 12 and Unit 20E from continued wolf removal for the primary benefit of the FCH under the plan.

This IM Operational Plan retains the objectives of the 2014 version of the plan related to the FCH and wolves.

ADF&G is maintaining a minimum of 90 VHF collars and 20 satellite GPS collars to facilitate annual spring parturition (natality) surveys, summer photocensuses, and fall composition surveys;

and to track seasonal movements, and document survival rates of individual females beginning at 4 months of age. In addition, the radiocollared sample is used to monitor herd distribution to assist with harvest management.

Since being added to the plan in 2006, the FCH has increased from an estimated 43,000 in June 2006 (based on a herd demographics model) to 83,659[1] in July 2017 (based on photocensus results adjusted for missing caribou using a technique developed by Rivest et al. 1998). The herd first exceeded the lower end of the IM Population Objective in 2010, based on the minimum count from photographs taken during a successful photo census in June of that year. Harvest of the herd is guided by the Fortymile Caribou Herd Harvest Plan, which includes a quota system designed to manage harvest for the desired population trend. Through RY18, quotas were set to encourage herd growth by taking less than the harvestable surplus. Beginning in RY19, the quota was set at a level intended to begin a slow reduction in herd size to address ongoing concerns about reduced herd nutrition.

During RY06–RY10 reported harvest was 729–1,094 annually (Table 1). During RY11–RY19, both the FCH population and harvest have remained within the IM Objectives.

Table 1. Fortymile caribou reported harvest, regulatory years 2006–2007 through 2019–2020.

Regulatory Year	Reported on registration permit[a]				Reported on general harvest report	Total
	M	F	Unk	Total		
2006–2007	601	247	4	852	12	864
2007–2008	746	262	4	1,012	20	1,032
2008–2009	681	217	0	898	9	907
2009–2010	881	192	10	1,083	11	1,094
2010–2011	630	89	6	725	4	729
2011–2012	935	125	6	1,066	18	1,084
2012–2013	1,081	190	26	1,297	12	1,309
2013–2014	1,152	14	20	1,186	10	1,196
2014–2015	690	283	14	987	19	1,006
2015–2016	830	291	10	1,131	8	1,131
2016–2017	648	334	8	990	3	993
2017–2018	1,314	637	1	1,952	10	1,962
2018–2019	1,940	495	4	2,439	13	2,452
2019–2020[b]	1,644	987	26	2,657	8	2,665

[a] Data from RC860 and RC867 harvest reports.
[b] Preliminary harvest data.

[1] The 2017 FCH population estimate is the most current herd population estimate available.

ADAPTIVE MANAGEMENT FRAMEWORK

Adaptive management is a process in which programs are designed to maximize what can be learned from management actions for potential application elsewhere, not simply modifying management in light of experience (National Research Council 1997:122). Managers wishing to use the best available information for management decisions or recommendations often need to generate new information for specific field 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. 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:*

Department FCH research projects (1994–2003) indicated wolf predation, primarily on calves, is the major limiting factor on population growth (Boertje and Gardner 1998, Boertje and Gardner 2000, Boertje et al. 2008). During this research, an average of 69% of calf mortality (calves born in 1994–1999), occurred during the calving/post-calving periods in May and June (Boertje and Gardner 2000).

The current UYTPCA encompasses the FCH calving/post-calving range (Figure 4).

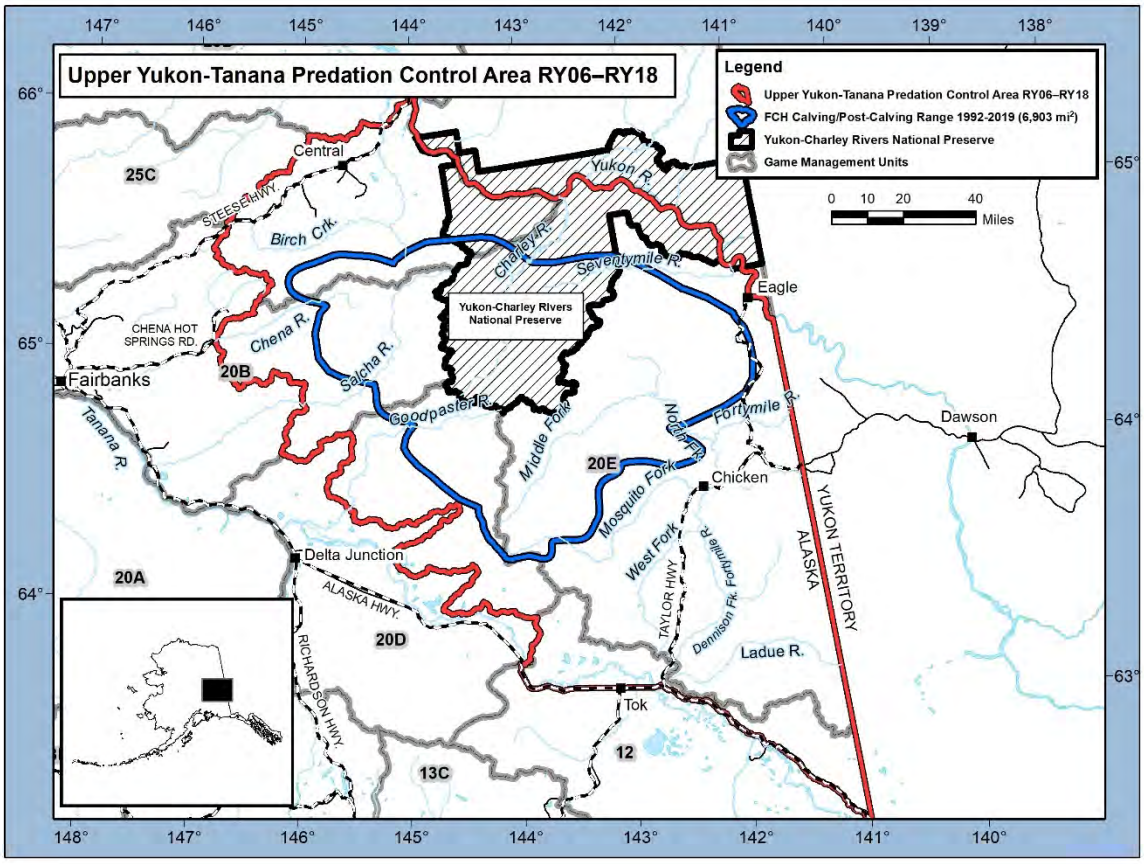

Figure 4. Upper Yukon–Tanana Predation Control Area in regulatory years 2006–2007 through 2018–2019 (18,750 mi^2 area), with the Fortymile Caribou Herd calving/post-calving range (6,903 mi^2). Predation control was not authorized within Yukon–Charley Rivers National Preserve. Calving/post-calving range includes the portion of the herd's range used during 11 May–30 June, during 1992–2019 (Gross, unpublished data, ADF&G Tok).

Public harvest of wolves and bears under current trapping and hunting regulations will continue to be encouraged. Public aerial shooting permits for removal of wolves in the UYTPCA, with the exception of YUCH, will continue to be available to members of the Alaska public in years when control is active, as authorized in 5 AAC 92.110. Predator harvest incentive programs for hunters and trappers initiated and funded by non-government organizations may also occur. Public participants will be encouraged, but not required, to concentrate wolf removal efforts on packs that occur within the FCH calving/post-calving range.

Aerial removal of wolves by department staff will be used to supplement public permittee efforts in years of active control and will be focused primarily within the FCH calving/post-calving range, excluding YUCH. We will attempt to temporarily reduce wolves in packs or the

number of packs with territories that overlap the calving/post calving range to the lowest level possible.

The department will use airplanes and helicopters to locate and lethally remove wolves. Removal will occur either in early winter (October–early December) or late-winter (mid-February–mid-April) to take advantage of longer daylight hours and warmer temperatures during these periods. Radio collars may be utilized to aid in locating and removing non-radiocollared pack members.

Presently known alternatives to predator control for reducing the number of predators are ineffective, impractical, or uneconomical in the control area (Boertje et al. 1995.) Hunting and trapping conducted under authority of ordinary hunting and trapping seasons and bag limits alone is not an effective reduction technique in sparsely populated areas such as the UYTPCA. Numbers of hunters and trappers are relatively low and educational programs to stimulate interest and improve skills in taking wolves have been unsuccessful because of the inherent wariness of wolves and difficult access to much of the area. Application of the most common sterilization techniques (surgery, implants, or inoculation) are not practical reduction techniques because they require extensive and time-consuming veterinary care, which has proven impractical in remote areas. Also, relocation of wolves is impractical because it is expensive, and it is very difficult to find publicly acceptable places to relocate the animals.

B. *Habitat Enhancement:*

The most recent review of abundance, nutrition, and range expansion of the FCH (Boertje et al. 2012) examined nutritional status of the FCH in relation to habitat and other factors. Declines in 36-month-old parturition rate and fall calf weights (Figures 5 and 6) suggest that nutritional status of the herd has declined since about the early 2000s. Boertje et al. (2012) provided evidence that suggested overgrazing of the herd's summer range was a likely causative factor for the decline in these indices. In addition, recent fires may have reduced lichen biomass on portions of the herd's winter range. However, Boertje et al. (2012) did not identify winter range as a likely cause for the decline in herd nutrition. Techniques to enhance habitat on a scale that would improve the nutritional status of the FCH are not well understood, and there are presently no habitat enhancement projects proposed in this plan.

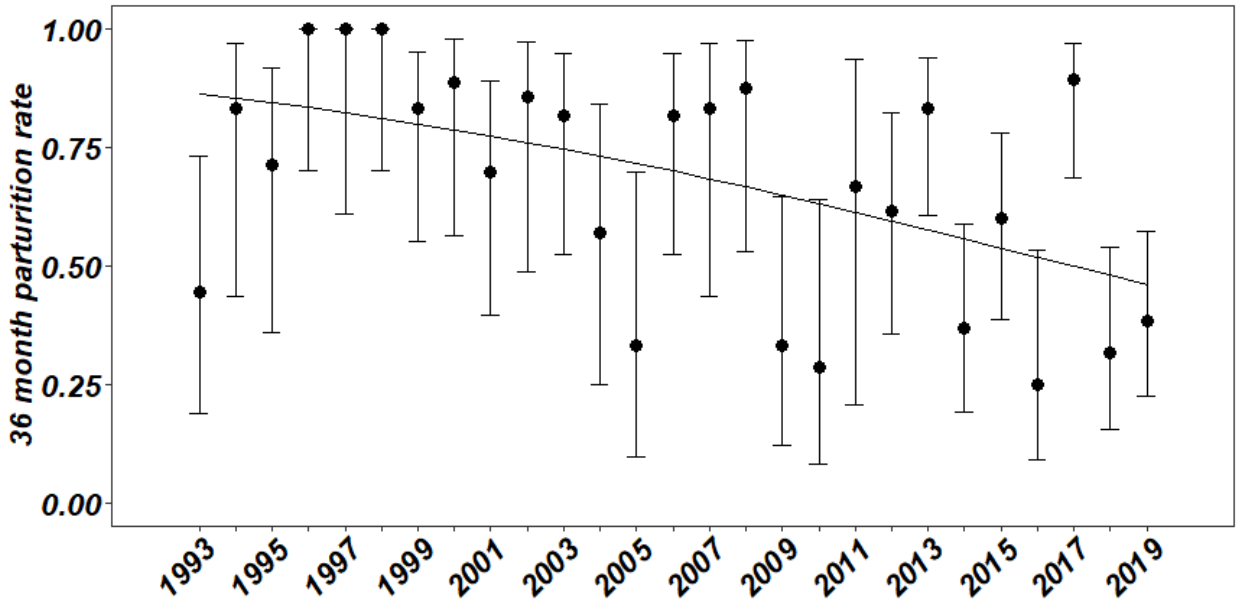

Figure 5. Parturition rates and 95% CIs among radiocollared 36-month-old female caribou in the Fortymile herd, 1993–2019. A significant decline in trend of 36-month-old parturition ocurred during these years using annual data and logistic regression (generalized linear model) in Program R (slope on the logit scale = −0.077 [SE = 0.027], *P* = 0.0009). Annual sample sizes ranged from 3 to 26 ($\bar{x}$ = 13.64).

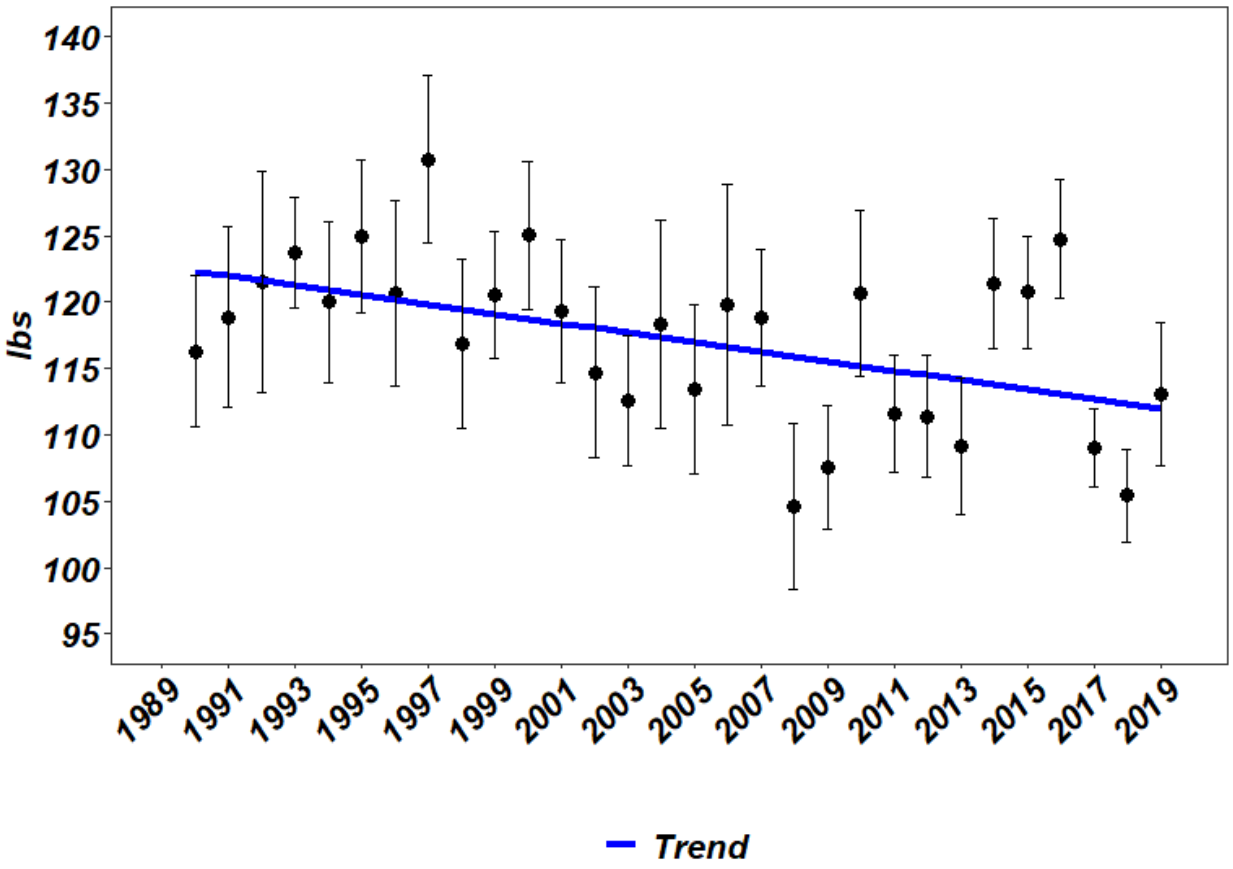

Figure 6. Trend analysis on female calf weights at 4 months of age in the Fortymile caribou herd, 1990–2019. Annual sample sizes ranged from 14 to 26. The linear mixed effects model indicated a significant linear decrease of 0.36 lb/yr (*P* = 0.006). We provided 95% CIs for sample estimates.

C. *Prey Harvest:*

Harvest of the FCH is guided by the Fortymile Caribou Herd Harvest Plan 2019–2023 (FCH harvest plan), which was developed by the Harvest Management Coalition consisting of members of the Anchorage, Central, Delta, Eagle, Fairbanks, and Upper Tanana Fortymile advisory committees, Eastern Interior Regional Subsistence Advisory Council, Yukon Fish and Wildlife Management Board, Tr'ondëk Hwëch'in, and Dawson District Renewable Resource Council, in cooperation with the Bureau of Land Management, the Alaska Department of Fish and Game and Yukon Department of Environment (Harvest Management Coalition, 2019). Included in the FCH harvest plan are strategies for harvest of the FCH as it grows and expands its range and guidelines for increasing harvest to stabilize or reduce herd numbers if herd nutrition becomes compromised. Currently, harvest of the FCH is based on a proportion of the herd size that is intended to promote a slow reduction in the population by

taking slightly more than the harvestable surplus to address ongoing concerns about reduced herd nutrition.

II. ANTICIPATED RESPONSES TO TREATMENTS

A. *Predator Abundance:*

We estimated the pre-control UYTPCA wolf population during November 2004 was 350–410 in 50–70 packs or approximately 19–22 wolves/1,000 mi^2. This estimate was based on department wolf surveys (Gross 2006), wolf research in Interior Alaska and Yukon (Gasaway et al. 1983, Boertje et al. 1996, McNay and DeLong 1998, Hayes 2003), anecdotal observations, trapper and hunter interviews, and sealing records. The portion of this population in packs with territories that overlap the FCH calving/post-calving range (Figure 4) was estimated at 150–210 (mid-point = 180 wolves) in 25–35 packs (Gross, unpublished data, ADF&G Tok).

Our most recent areawide (18,750 mi^2) UYTPCA wolf population estimate (Nov. 2018) was 390–427 (mid-point = 408 wolves). It was developed using 25 iterations of the PredPrey model (Version 1.5; McNay and DeLong 1998). Model inputs included 2017–2018 population and harvest data for wolves, moose and caribou (Gross, unpublished data, ADF&G Tok). Mathematical equations in PredPrey, which define model functions, were taken from published predator–prey studies conducted across North America.

The department control permittees, hunters, and trappers removed an average of 132 wolves annually (range 60–236) across the entire 18,750 mi^2 control area during RY06–RY17 (Table 2). The November 2018 estimate of 390–427 (21–23 wolves/1,000 mi^2) was close to our November 2004 pre-control estimate of 350–410 (19–22 wolves/1000 mi^2). During RY06–RY17, relatively low areawide annual removal rates (23–62%, average 40%, using mid-point estimates) (Table 3) have allowed the wolf population to rebound to near pre-control levels by the following fall in most years (ADF&G 2019).

Wolf control was suspended in the UYTPCA in RY18, as part of a 9–year evaluation of the program being conducted during RY15–RY23. This research will document the recovery of the wolf population in the control area as part of this evaluation. (see Section II. B. for additional information on the program evaluation).

Table 2. Annual wolf removal within UYTPCA since program was expanded to include the FCH in Regulatory Year 2006.

Regulatory year	Harvest removal		Dept. control removal	Public control removal	Total removal	Spring abundance (range)[a]
	Trap	Hunt				
2006–2007	73	7	N/A	23	103	259 (197–322)
2007–2008	57	14	N/A	27	98	284 (268–300)
2008–2009	82	11	84	49	226	146
2009–2010	31	4	15	10	60	175
2010–2011	26	11	0	25	62	212 (200–223)
2011–2012	62	17	56	8	145	184 (170–197)
2012–2013	41	12	40	78	171	215 (197–232)
2013–2014	45	12	31	31	119	240 (222–257)
2014–2015	37	11	33	24	105	269 (252–288)
2015–2016	52	14	19	29	114	291 (273–309)
2016–2017	59	12	88	18	177	215 (195–235)
2017–2018	62	10	50	19	141	251 (232–269)

[a] Fall estimate minus all known wolf kills.

Table 3. Percent reduction in wolf numbers (estimated or confirmed number remaining by 1 May each regulatory year) from pre-control (fall 2004) levels since program was expanded to include the FCH in Regulatory Year 2006.

Regulatory Year	% reduction in UYTPCA (18,750 mi^2) Wolf Population	% reduction in wolves from packs overlapping FCH Calving/Post-Calving Range (6,903 mi^2)
2006–2007	32	-[a]
2007–2008	25	-[a]
2008–2009	62	69
2009–2010	54	71
2010–2011	44	-[a]
2011–2012	52	62
2012–2013	43	84
2013–2014	37	>70
2014–2015	29	>70
2015–2016	23	>65
2016–2017	42	>80
2017–2018	34	>80

[a] Inadequate information available to estimate wolf numbers and % reduction.

While areawide reductions in wolves have proven difficult to achieve since the UYTPCA was expanded in 2006, wolves from packs that overlap the smaller FCH calving/post-calving range (Figure 4), were reduced by >65% (Table 3) from pre-control levels during RY12–RY13 and RY17–RY18 (Gross, unpublished data, ADF&G Tok). This was due to the combined efforts of trappers, hunters, control permittees and department removal during these years.

B. *Predation Rate:*

By focusing much of the wolf removal efforts on the FCH calving/post calving range, we are targeting wolf predation on calves during May and June, which is the major factor limiting FCH growth (Boertje and Gardner 1998, Boertje and Gardner 2000, Boertje et al. 2008).

Previous research on benefits of lethal wolf removal for caribou in Alaska and Yukon have generally involved the reductions of wolves throughout entire herd ranges (Gasaway et al. 1983, Boertje et al. 1996, Hayes et al. 2003), rather than a portion of them, such as the calving/post-calving range. Additional research began in 2016 to further evaluate the benefit of removal methods used in this program. This research is primarily focused on early calf mortality (first 6 weeks of life) following wolf removal from packs in the FCHs calving/post-calving range (RY15–RY17), during years of wolf recovery (RY18–RY20), and during years after wolf recovery (RY21–RY23) following the suspension of the control program in RY18. In addition, mortality rates of all other ages classes (1–year old and older) of caribou is being monitored during these years.

C. *Prey Abundance:*

The FCH experienced an average 6% annual rate of increase during 1996–2010, concurrent with wolf control programs (Boertje et al. 2012) and an average of 4–6% growth during 2011–2017 (Gross, unpublished data, ADF&G Tok). Continued growth could be expected if similar conditions occur. Those conditions include: reimplementing wolf reductions focused on calving/post calving range, quota-based harvest tied to a herd harvest rate set to encourage herd growth under the FCH harvest plan, adequate herd nutritional condition, and favorable weather conditions.

However, harvest of the FCH is currently being managed to promote reduction in the population to allow nutrition condition of the herd to improve. If the nutritional condition of the herd improves and it is determined that habitat can sustain a current or larger population size the control program could be reactivated to maintain or grow the herd to maximize hunter harvest as long as harvest is sufficient to achieve desired herd trend.

D. *Prey Recruitment:*

Boertje and Gardner (1998, 2000), and Boertje et al. (2008) provided direct evidence that wolf predation, primarily on calves during May and June (first 6 weeks of life), was the dominant factor influencing FCH population trend during 1994–2003. If wolves are temporarily reduced by at least 60% of the pre-control level in the calving/post-calving areas, we anticipate that wolf predation, particularly on calves, will decline. Assuming bear predation on calves does not increase, this decline in wolf predation is anticipated to increase or maintain recruitment.

Fall calf:cow ratios that are obtained during composition surveys are an estimate of calf survival to fall and an indicator of potential recruitment. Ratios averaged 30 calves:100 cows (range 18–37) during RY06–RY18 (Table 4). Wolf control to benefit the FCH was conducted during all of these years. The rate of removal from packs that overlap the FCH calving/post-

calving range during most of these years (Table 3) had the potential to improved calf survival. However, the effect of wolf control is impossible to quantify using only fall calf:cow ratios.

Table 4. Fortymile Caribou Herd fall composition counts, Regulatory Years 2006 through 2018.

Regulatory year[a]	Date of composition count	Calves: 100 Cows	Composition sample size
2006–2007	10/5/06	34	4,995
2007–2008	10/4/07	37	5,228
2008–2009	10/7–8/08	33	4,119
2009–2010	10/7/09	34	4,503
2010–2011	10/2/10	32	7,169
2011–2012	10/5/11	25	3,949
2012–2013	10/9/12	22	4,832
2013–2014	10/6–10/13	28	3,921
2014–2015	10/9/14	25	4,794
2015–2016	10/14/15	35	5,662
2016–2017	10/7/16	32	3,288
2018–2019	10/9/18	18	4,429

[a] No composition count was conducted in RY17 or RY19.

E. *Prey Productivity or Nutritional Condition:*

Parturition rates are determined annually by observing known-age radiocollared females from a Piper PA-18 during calving season in May. Caribou observed with calves, hard antlers, or distended udders are classified as parturient (Whitten 1995). Parturition rates of known-age cows have been monitored in the Fortymile herd since 1993 (Table 5).

Table 5. Fortymile caribou parturition rates of known-age radiocollared females, 1993–2019.

Year	3-year-olds[a]	(%)	≥4-years-old[a]	(%)	All cows ≥3-years-old[a]	(%)
1993	4/9	(44)	28/38	(74)	32/47	(68)
1994	5/6	(83)	32/39	(82)	37/45	(82)
1995	5/7	(71)	30/34	(88)	35/41	(85)
1996	9/9	(100)	29/30	(97)	38/39	(97)
1997	6/6	(100)	33/40	(83)	39/46	(85)
1998	9/9	(100)	38/39	(97)	47/48	(98)
1999	10/12	(83)	49/56	(88)	59/68	(87)
2000	8/9	(89)	48/53	(91)	55/61	(90)
2001	7/10	(70)	43/47	(91)	50/57	(88)
2002	6/7	(86)	44/46	(96)	50/53	(94)
2003	9/11	(82)	27/42	(64)	36/53	(68)
2004	4/7	(57)	37/40	(93)	41/47	(87)
2005	2/6	(33)	28/33	(85)	30/39	(77)
2006	9/11	(82)	40/50	(80)	49/61	(80)
2007	5/6	(83)	50/55	(91)	55/61	(90)
2008	7/8	(88)	46/51	(90)	53/59	(90)
2009	3/10	(30)	36/47	(77)	39/57	(68)
2010	2/7	(29)	41/53	(77)	43/60	(72)
2011	2/3	(67)	47/55	(85)	63/73	(86)
2012	8/13	(62)	42/47	(89)	58/71	(82)
2013	15/18	(83)	50/57	(88)	71/81	(88)
2014	7/19	(37)	57/83	(69)	64/102	(63)
2015	12/20	(60)	70/76	(92)	82/96	(85)
2016	3/12	(25)	75/93	(81)	78/105	(74)
2017	17/19	(89)	72/79	(91)	89/98	(91)
2018	6/19	(32)	53/79	(67)	59/98	(60)
2019	10/26	(38)	78/93	(84)	88/119	(74)

[a]Number of radiocollared cows with calf, plus radiocollared cows with no calf, but with hard antlers or udder, divided by the number of radiocollared cows observed.

Natality rate (also referred to as parturition rate) is a useful index to assess herd nutrition (Valkenburg et al. 2000). Parturition rates of 3-year-old cows during different phases of herd growth (increasing population phase, stable/high population phase, and decreasing population phase) were a more sensitive indicator of herd nutrition than parturition rate of other age classes in the George River herd in northeastern Quebec and northern Labrador (Bergerud et al. 2008), as well as the Delta and Nelchina herds in Alaska (Valkenburg et al. 2003).

Analysis of parturition rates of known-age cows in Alaska caribou herds indicates that a 5-year moving average of 3-year-old parturition rates of <55% could indicate nutritional stress (Boertje et al. 2012). In 2012, the 5-year average fell below 55% for the first time since FCH parturition data started being collected in 1993 (Table 5). Boertje et al. (2012) recommends if the 5-years moving average falls below the 55% threshold for several years in a row, management actions to stabilize or reduce the herd should be considered, if overgrazing , not adverse weather, is the most likely cause for low nutrition. Although the 5-year moving

average of 3-year-old parturition rate increased above the threshold in 2013, and hovered near the 55-60% level through 2017, the average fell to 51% in 2018 and 50% in 2019 (Figure 7). Additional information about the nutritional status of the FCH can be found in Boertje et al. (2012).

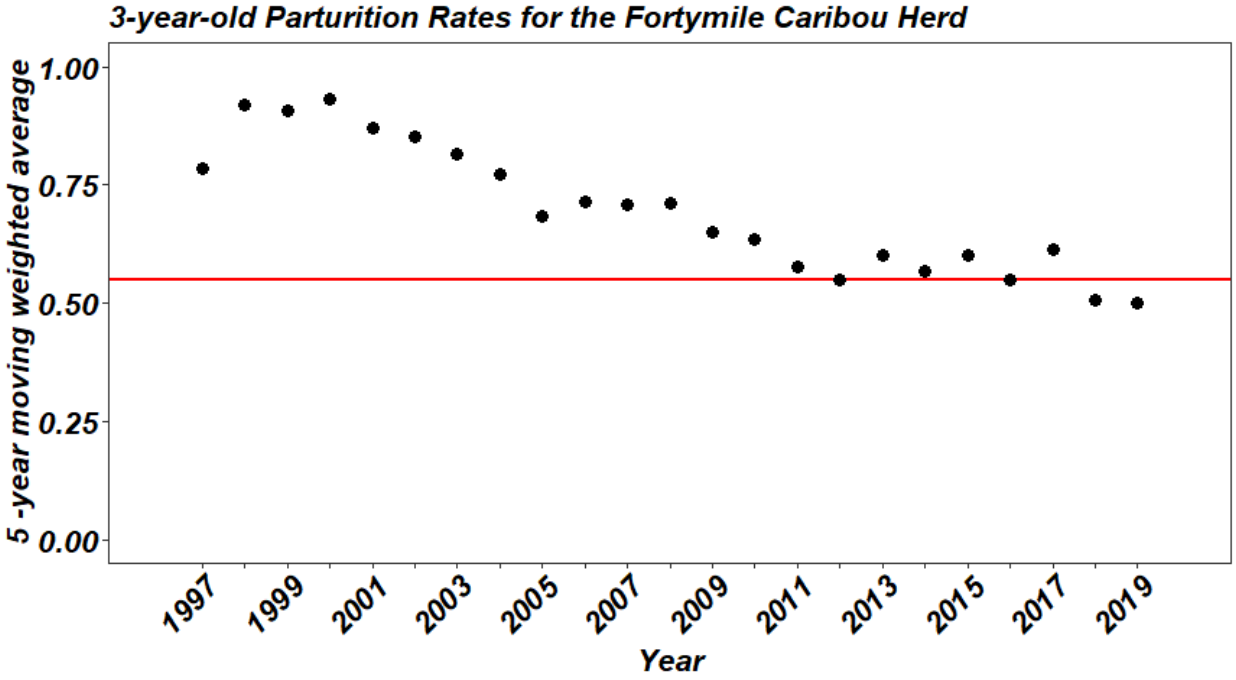

Figure 7. Five-year moving average of parturition rates in the Fortymile caribou herd, 1997–2019.

In addition to natality (parturition) rates, weights of 4-month-old female calves have also been monitored as an index of herd nutrition. Autumn calf weights have been collected on the FCH since 1990. Although calf weights have declined, indicating decline in general herd nutrition, the relationship between a given percentage decline and the nutritional status of a caribou herd has not been well documented in the literature. However, fall calf weights will continue to be collected annually in anticipation that those data, in addition to other research, eventually may be correlated with general herd nutritional status. As discussed in Section I. B. above, female calf weights at 4–months of age declined by 0.36 lb/yr (P = 0.006), during 1990–2019 (Figure 6).

In 1998, for the first time in 3 decades, FCH density exceeded 1.3 caribou/mi^2 (0.5 caribou/km^2). Beginning in 2001, the herd expanded its range use, possibly as a result of increased herd size. The herd moved farther west near the Steese Highway in fall 2001 and used winter range in Yukon, Canada during winters 2000–2001 through 2012–2013. In fall of 2013, the FCH expanded further into Yukon, with the herd reaching areas along the Dempster Highway northeast of Dawson never before documented within the herd's historic range and to the southeast across the White River northeast of Beaver Creek. In addition, the herd has continued expanding to the west in the White Mountains in Alaska since 2013 and crossing

the Elliot Highway each winter since the winter of 2017–2018. Much of the habitat in Yukon and in the White Mountains has abundant lichen and the potential to provide better nutrition for the herd when they move into these areas.

F. *Harvest:*

The primary management goal for the FCH, identified in both the current FCH Federal Aid Management Report (Gross, 2015) and FCH Harvest Plan, is to restore the herd to as much of its traditional range in Alaska and Yukon as possible, within sustainable levels, and without significantly compromising herd health and habitat condition. A secondary goal outlined in the FCH harvest plan is to increase the allowable harvest of the FCH as the herd grows and as the herd can sustain harvest within the constraints of the primary goal. Initially, predation control in the UYTPCA was conducted to promote growth of the FCH. However, as previously mentioned, harvest is currently being managed to reduce herd size to allow nutritional condition of the herd to improve.

G. *Use of Nontreatment Comparisons:*

Other than general comparisons to adjacent herds, a similar nontreatment area is not available and no specific comparisons will be identified at this time. This constrains our ability to evaluate responses to treatments.

H. *Other Mortality Factors:*

Antibody screening of blood samples collected during 1975–2001 (n=159) and 2012 (n=16) indicate there were no significant infectious diseases affecting population dynamics of the herd (Zarnke 2001, Bentzen, unpublished data, ADF&G Fairbanks).

Frequency of severe weather events in the herd's range are low and weather has not been identified in past research as a major factor influencing FCH trend. However, Boertje et al. (2012) pointed out that weather patterns in the vast, remote Fortymile herd range were inadequately measured during 1990–2010.

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 (Walters 1986). Evaluation will be reported to the board in February each year.

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

During years of active control, we will estimate wolf abundance each November using methods listed in Section II. A. and will monitor removal yearlong. Wolf control and trapping and hunting harvest will be suspended at any time in any given year if <88 wolves are estimated to be remaining in the UYTPCA.

Wolf abundance over the entire UYTPCA (18,750 mi^2) is currently similar to pre-control (Section II. A). Based on relatively low removal rates annually during 2006–2007 through 2018–2019 (ADF&G 2019) over the entire UYTPCA, we expect wolves to remain at near pre-treatment levels even in years of active control (Table 3).

A wolf research project was initiated in RY18, following suspension of the wolf control program in RY18, to document the recovery of wolves in packs previously reduced in the UYTPCA.

B. *Habitat and Forage Condition:*

No criteria or thresholds of forage production or utilization exist for recommending change in management actions for this herd. However, research efforts to assess FCH habitat have been discussed with Alaska partners: United States federal agencies Bureau of Land Management (BLM) and National Park Service (NPS), and Canadian agency Yukon Department of Environment. These efforts are anticipated to be costly and logistically difficult and are still in the initial stages of development and implementation.

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

The FCH IM population objective is 50,000–100,000.

In addition, the 2019–2023 FCH harvest plan details the following population goals and objectives, which if achieved will contribute to continued achievement of the IM objective.

Goal:

- Promote continued sustainable growth and restore the herd to its historic range in both Alaska and Yukon.

Objectives:

- Manage for a population of 50,000–100,000

A census will be attempted annually between late-June and mid-July to assess herd size relative to goals and objectives using the modified aerial photo direct count technique (Davis et al. 1979). However, a census may not be achievable every year due to various factors generally related to weather and insect abundance.

Captures of known-age females will be conducted during late September through mid-October to deploy VHF radio and satellite collars. Collars are needed to facilitate censuses, sex and age surveys, and parturition surveys needed to evaluate IM treatments.

Parturition surveys will be done during May to assess nutritional condition of the herd. Known-age radiocollared females will be observed from a Piper PA-18 during calving season. Caribou observed with calves, hard antlers, or distended udders will be classified as parturient (Whitten

1995). Parturition rates of know age cows will be used as the primary index for monitoring nutritional condition of the FCH (see Section II.E. and IV. C.2 for more detail).

Prey Harvest:

The FCH IM harvest objective is 1,000–15,000.

In addition, the 2019–2023 FCH harvest plan details the following harvest goals and objectives, which if achieved will contribute to continued achievement of the IM objective.

Goals:

- Increase the allowable harvest of the FCH as the herd grows and as the herd can sustain harvest within the constraints of the Herd Population Goal.
- Provide reasonable opportunity for Alaska subsistence uses.
- Manage Alaska hunts to allow opportunity for nonsubsistence hunters while staying within the constraints of all other goals.

Objectives:

- Determine annual harvest based on the most recent pre-hunt modeled population estimates

D. Calf and adult mortality

A caribou research project was initiated in RY15 to look at early calf mortality (first 6 weeks of life) and annual calf and adult survival, during years of wolf removal from packs overlapping the Fortymile herd's calving and post-calving range (RY15–RY17), during years of wolf recovery (RY18–RY20), and during years following wolf recovery (RY21–RY23). Information from this research, combined with information from the wolf research project (RY18–RY23), will be used to evaluate potential impacts to caribou survival associated with wolf removal under this program (see Section II. B.)

IV. Decision Framework to Implement or Suspend a Treatment

A. *Predation Control:*

1. Prey Population Abundance.

Consistent with the FCH harvest management plan, wolf control will be suspended if the point estimate resulting from a photocensus is >100,000, and herd growth cannot be stabilized or reduced through harvest alone. However, there is uncertainty about how many caribou the range can support. Therefore, a population-based threshold value alone triggering treatments is not sufficient. Instead, nutritional indices and harvest strategies discussed later in this section will provide guidelines and threshold values that will be used to trigger IM actions.

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, but are not limited to, weather, water levels, fuel cost, the day of the week the season opens and caribou availability along road and trail systems.

B. *Habitat Enhancement:*

We do not have data on range condition and can only speculate on how fire may affect nutritional condition of caribou (see Section I. B.). Therefore, we will not recommend a habitat metric for management decisions at this time.

C. *Prey Harvest Strategy:*

1. Prey Nutritional Index.

Parturition rates of known-age cows, will be used as the primary index for monitoring nutritional condition of the FCH (see Section II. E). A 5-year moving average of 3-year-old parturition rates >60% likely indicates nutritional status sufficient for the current population level, an average of 55-60% should be viewed as a cautionary signal and nutritional indicators should be closely monitored and an average <55% is a signal that nutritional status of the herd may be notably reduced (Boertje et al. 2012).

2. Prey Harvest.

Wolf control will either be implemented or suspended, in conjunction with the appropriate level of harvest for the herd, to achieve a desired population trend for the herd.

Consistent with the 2019–2023 FCH Harvest Plan, harvest of the herd will be monitored relative to the IM objective through registration and drawing permit harvest reports. Harvest management alternatives for the FCH, incorporating harvest objectives discussed in the FCH harvest plan and nutritional considerations IV. C. 1. above, are described below.

- Manage for desired population trend based on herd nutritional status using the following alternatives:

    a. Slow growth alternative (preferred):
        - When the 5-year moving average of 3-year-old parturition rates is >60% for 2–3 consecutive years, indicating nutritional status is likely sufficient for the current population level, further herd growth may be considered.
        - Slow growth could likely be achieved through a reduced annual herd harvest rate, reimplementation of the wolf control program or a combination of both.
        - Rate of growth should be kept low (0–3% annually) to provide managers the opportunity to closely monitor any changes in nutritional condition of the herd as it grows to ensure the population remains within sustainable levels.

- If additional growth is desired, and herd size is greater than 70,000, set harvest levels to attempt to maintain a growth rate of 1–2%.
- Nutritional indicators should be closely monitored.

b. Stabilize population alternative:
   - When the 5-year moving average of 3-year-old parturition rates is 55–60%, set harvest to stop herd growth and maintain population size.
   - Annual harvest of the FCH will be based on a proportion of the herd size that is intended to stabilize the population by taking the annual harvestable surplus.
   - If herd stabilization or reduction is unsuccessful through harvest alone, wolf control will remain suspended.
   - Nutritional indicators should be closely monitored.

c. Deliberate population reduction alternative:
   - Following recommendations by Boertje et al. (2012), when the 5-year moving average remains below the 55% threshold for 2–3 consecutive years and overgrazing, not adverse weather, is the most likely cause for low nutrition, management actions to stabilize or reduce the herd will be implemented to allow nutritional condition of the herd to improve.
   - Annual harvest of the FCH will be based on a proportion of the herd size that is intended to promote a slow reduction in the population by taking slightly more than the annual harvestable surplus.
   - If herd stabilization or reduction is unsuccessful through harvest alone, wolf control will remain suspended.
   - Nutritional indicators should be closely monitored.

d. If the population declines naturally, set harvest and implement other management tools to stop or slow decline caused by poor health and nutritional stress.

As mentioned in Section II. E. above, the 5-year moving average of 3-year-old parturition rate fell to 51% in 2018 and 50% in 2019 (Figure 7); therefore, harvest was increased in RY19 to begin a reduction in the herd to reduce the number of caribou on the herd's range and allow nutritional condition of the herd to improve. Specifically, the herd will be reduced through harvest until it reaches a level where the 5-year moving average is >60% for 2–3 consecutive years. The herd will then be stabilized to assess the herd's nutritional condition at that herd size, engage with stakeholders and decide if further growth is desired.

V. PUBLIC INVOLVEMENT

A. *Continued Outreach by Department:*

Primary engagement with the public will take place through the state fish and game and federal regional advisory committee processes. In particular, state and federal committee members involved in the Harvest Management Coalition will be engaged by the department as herd management issues arise or when the FCH harvest plan is due for revision.

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

We will continue to engage the Harvest Management Coalition as we apply criteria chosen for evaluating success including achieving and evaluating FCH numbers and harvest.

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

Public aerial wolf control has been an important component of removing wolves and could be reimplemented in the future. Local hunters and trappers will also be encouraged to continue harvest of wolves to help regulate the numbers post-treatment to prolong the effectiveness of predator control. Predator harvest incentive programs initiated and funded by non-government organizations may also occur.

D. *Monitoring and Mitigation of Hunting Conflict:*

Hunting conflicts will be primarily monitored using hunter check stations, hunter contacts in the field and at AFG&G offices, and registration permit hunt reports. Harvest management, including addressing hunting conflicts as they arise, will continue to be guided by recommendations in the FCH harvest plan and through ongoing engagement with the Harvest Management Coalition.

VI. OTHER CONSIDERATIONS

Success of aerial wolf control by the public has been variable during the life of the program, largely depending on late-winter tracking conditions. Additional department effort will be necessary in years of active control when public permittees have reduced success. department-conducted wolf control in RY08–RY17 required considerable operational funding and staff time. This will continue to be a major consideration in the future when department wolf control is conducted.

LITERATURE CITED

ADF&G (ALASKA DEPARTMENT OF FISH AND GAME). 2011. Intensive management protocol. Juneau, Alaska. file:///C:/Users/jagross/AppData/Local/Microsoft/Windows/INetCache/IE/N2WKJJ5B/intensive_management_protocol.pdf (Accessed 27 February 2020).

ADF&G. 2019. Annual report to the Alaska Board of Game on intensive management for Fortymile caribou with wolf predation control in the upper Yukon-Tanana predation control area of Game Management Units 12, 20B, 20D, 20E, and 25C. Division of

Wildlife Conservation, Juneau. file:///C:/Users/jagross/AppData/Local/Microsoft/Windows/INetCache/IE/FMHIXP1K/2019_uytpcp_intensive_management_annual_report.pdf (Accessed 27 February 2020).

BERGERUD, A. T., S. N. LUTTICH, AND L. CAMPS. 2008. The return of caribou to Ungava. McGill–Queen's University Press. Montreal, Canada.

BOERTJE, R. D., D. G. KELLYHOUSE, and R. D. HAYES. 1995. Methods for reducing natural predation on moose in Alaska and Yukon: An evaluation. Pages 505–513 [In] L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and Conservation of Wolves in a Changing World. Proceedings of the 2nd North American Symposium on Wolves, 25-27 August 1992, Edmonton, Alberta. Canadian Circumpolar Institute, Occasional Publication No. 35, Edmonton, Canada.

BOERTJE, R. D., P. VALKENBURG, AND M. E. MCNAY. 1996. Increases in moose, caribou, and wolves following wolf control in Alaska. Journal of Wildlife Management 60:474–489.

BOERTJE, R. D., AND C. L. GARDNER. 1998. Factors limiting the Fortymile caribou herd. Alaska Department of Fish and Game, Federal Aid in Wildlife Restoration, Research Final Performance Report 1 July 1992–30 June 1997, Study 3.38, Juneau, Alaska. file:///C:/Users/jagross/AppData/Local/Microsoft/Windows/INetCache/IE/6Q59F6WW/98338fnl.pdf (Accessed 27 February 2020).

BOERTJE, R. D. AND C. L. GARDNER. 2000. Reducing mortality on the Fortymile caribou herd. Alaska Department of Fish and Game, Federal Aid in Wildlife Restoration, Research Performance Report 1 July 1999–30 June 2000, Study 3.43, Juneau, Alaska. file:///C:/Users/jagross/AppData/Local/Microsoft/Windows/INetCache/IE/FMHIXP1K/3.43_00.pdf (Accessed 27 February 2020).

BOERTJE, R. D., C. L. GARDNER, AND J. A. GROSS. 2008. Monitoring of Fortymile ungulates and wolves following wolf sterilization and translocation. Alaska Department of Fish and Game, Federal Aid in Wildlife Restoration, Research Final Performance Report 1 July 2007–30 June 2008, Study 3.48, Juneau, Alaska. file:///C:/Users/jagross/AppData/Local/Microsoft/Windows/INetCache/IE/RRHDQXGW/ca-40mi08final.pdf (Accessed 27 February 2020).

BOERTJE, R. D., C. L. GARDNER, K. A. KELLIE, AND B. D. TARAS. 2012. Fortymile caribou herd: Increasing numbers, declining nutrition, and expanding range. Alaska Department of Fish and Game, Wildlife Technical Bulletin 14, ADF&G/DWC/WTB-2012-14. Juneau, Alaska, USA.

DAVIS, J. L., P. VALKENBURG, AND S. HARBO. 1979. Refinement of the aerial photo-direct count-extrapolation caribou census technique. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Progress Report. Project W-17-11. Job 3.25R. Juneau, Alaska, USA.

GASAWAY, W. C., R. O. STEPHENSON, J. L. DAVIS, P. E. K. SHEPHERD, AND O. E. BURRIS. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. Wildlife Monographs 84.

HARVEST MANAGEMENT COALITION. 2019. Fortymile caribou herd harvest plan 2019–2023. Alaska Department of Fish and Game, Fairbanks, Alaska.

HAYES, R. D., R. FARNELL, R. M. P. WARD, J. CAREY, M. DEHN, G. W. KUZYK, A. M. BAER, C. L. GARDNER, AND M. O'DONOGHUE. 2003. Experimental reduction of wolves in the Yukon: Ungulate responses and management implications. Wildlife Monographs 152:1–35.

GROSS, J. A. 2006. Unit 20E wolf. Pages 176–187 *in* P. Harper, editor. Wolf management report of survey and inventory activities 1 July 2002–30 June 2005. Alaska Department of Fish and Game. Project 14.0. Juneau, Alaska, USA.

GROSS, J. A. 2015. Units 20B, 20C, 20D, 20E, and 25C caribou. [In] P. Harper, editor, Caribou management report of survey and inventory activities 1 July 2012–30 June 2014, Alaska Department of Fish and Game, Species Management Report, Juneau, Alaska.

MCNAY, M. E., AND R. A. DELONG. 1998. Development and testing of a general predator–prey computer model for use in making management decisions. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration, Research Final Report, Grants W-24-1 and W-24-5, Study 1.46. Juneau, Alaska.

NATIONAL RESEARCH COUNCIL. 1997. Wolves, bears, and their prey in Alaska: Biological and social challenges in wildlife management. National Academy Press, Washington, D.C.

RIVEST, L. P., S. COUTURIES, H. CREPEAU. 1998. Statistical Methods for Estimating Caribou Abundance Using Postcalving Aggregations Detected by Radio Telemetry. Biometrics 54:865.

VALKENBURG, P., T. H. SPRAKER, M. T. HINKES, L. H. VAN DAELE, R. W. TOBEY, AND R. A. SELLERS. 2000. Increases in body weight and nutritional status of transplanted Alaskan caribou. Rangifer Special Issue 12:133–138.

VALKENBURG, P., R. W. TOBEY, B. W. DALE, B. D. SCOTTON, AND J. M. VER HOEF. 2003. Body size of female calves and natality rates of know-age females in two adjacent Alaskan caribou herds, and implications for management. Rangifer Special Issue 14:203–209.

WALTERS, C. 1986. Adaptive Management of Renewable Resources. Macmillan, New York.

WHITTEN, K. R. 1995. Antler loss and udder distension in relation to parturition in caribou. Journal of Wildlife Management. 59:273–277.

ZARNKE, R.L. 2001. Serologic survey of Alaska wildlife for microbial pathogens. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration, Research Performance Report, 1 July 2000–30 June 2001, Grant W-27-4, Study 18.71. Juneau, Alaska.

APPENDIX A. Summary of supporting information.

Geographic Area and Land Status	
Management area(s)	Prey abundance assessment (FCH hunt area – 25,217 mi^2), prey harvest assessment (FCH hunt area – 25,217 mi^2) (Figure 8) Predator abundance assessment (18,750 mi^2) (Figure 3)
Land status	4,466 mi^2 (23.8%) federal land (NPS/BLM/US military/USFWS), 3,184 mi^2 (17.0%) Alaska Native corporation land, 11,093 mi^2 (59.2%) State of Alaska (Figure 9)
Biological and Management Situation	
Prey population	FCH IM objectives: 50,000–100,000 FCH – Estimated in 2017 (most recent census): 83,659 caribou
Prey harvest (human use)	IM objectives: 1,000–15,000 Reported in RY2019: 2,689 (3.2% of the population) Amount necessary for subsistence: FCH 350–400. Determined in 1992.
Feasibility of access for harvest	Access is primarily along Taylor and Steese highways and the extensive trail systems accessed from these highways. Access is also available along numerous river systems and from small airstrips scattered throughout the UYTPCA and Fortymile hunt areas. Season dates allow for fall and winter access opportunities. Unleaded gasoline (average among communities): \$4.00–\$6.50/gal. unleaded, 100 octane low lead aviation fuel (average among communities): \$5.50–7.00/gal.
Nutritional condition	5-year (2015–2019) moving average of 3-year-old parturition rates = 50% in 2019.
Habitat status and enhancement potential	Wildfires and floods regularly reset succession to early seral stages. No enhancement is anticipated.
Predator(s) abundance	Estimated in fall (Nov. 1) 2017: 372–409 wolves, based on 25 model iterations using PredPrey (Version 1.5)

Predator(s) harvest	Reported in RY17 (last year of active wolf control): Within UYTPCA wolf control kill and hunter–trapper harvest = 140 (36% reduction from estimated midpoint of fall population of 391).
Evidence of predation effects	Department research projects on the FCH (1994–2003) indicated wolf predation, primarily on calves, is the major limiting factor on population growth in the FCH (Boertje and Gardner 1998, Boertje and Gardner 2000, Boertje et al. 2008). During this research project an average of 69% of calf mortality (calves born in 1994–1999), occurred during the calving and post calving periods in May and June (Boertje and Gardner 2000).
Feasibility of predation control	The FCH experienced an average 6% annual rate of increase during 1996–2010, concurrent with wolf control programs (Boertje et al. 2012) and an average of 4–6% growth during 2011–2017 (Gross, unpublished data, ADF&G Tok). Continued growth could be expected if similar conditions occur. Those conditions include: reimplementing wolf reductions focused on calving/post calving range, quota-based harvest tied to a herd harvest rate set to encourage herd growth under the FCH harvest plan, adequate herd nutritional condition, and favorable weather conditions.
Other mortality	Antibody screening of blood samples collected during 1975–2001 (n=159) and 2012 (n=16) indicate there were no significant infectious diseases affecting population dynamics of the herd (Zarnke 2001, Bentzen, unpublished data, ADF&G Fairbanks). Boertje et al. (2012) points out that “weather patterns in the vast, remote Fortymile herd range were inadequately measured” during 1990–2010. However, frequency of severe weather events in the herds range are low and weather has not been identified in past research as a major factor influencing FCH trend.

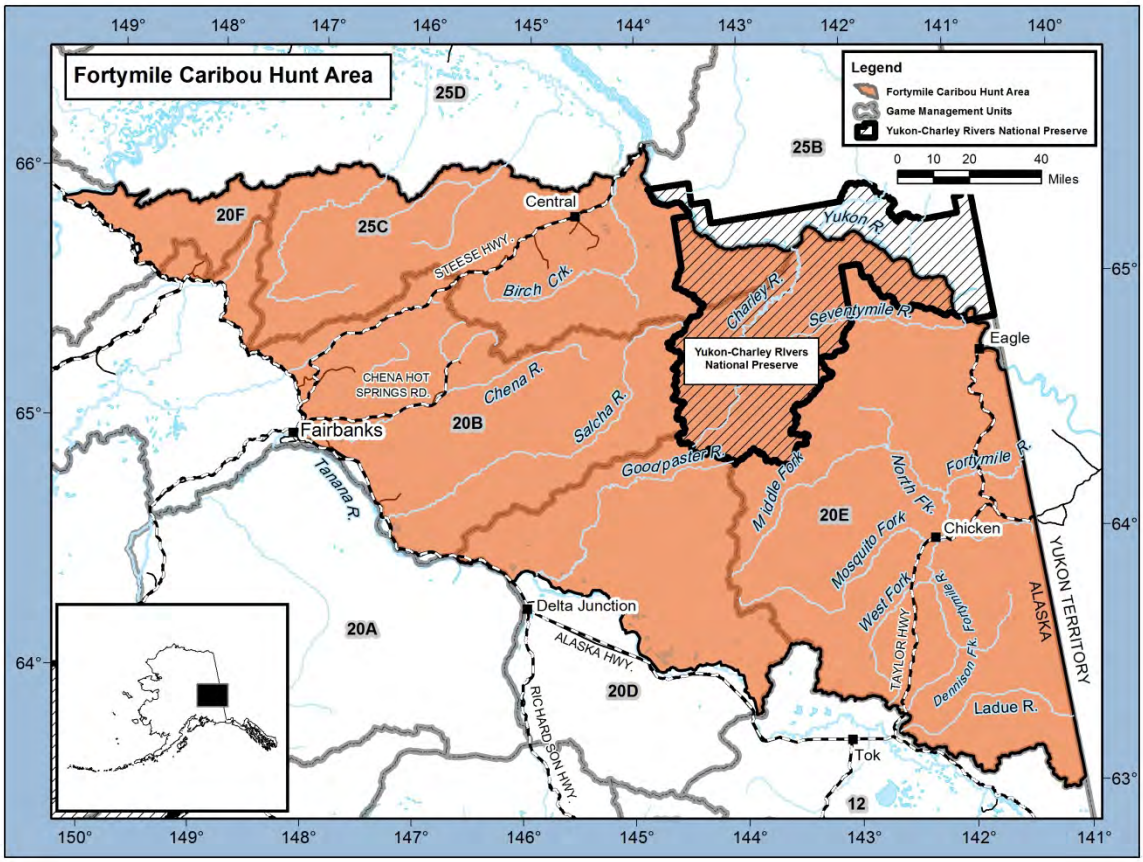

Figure 8. Fortymile Caribou Herd Hunt Area (25,217 mi^2).

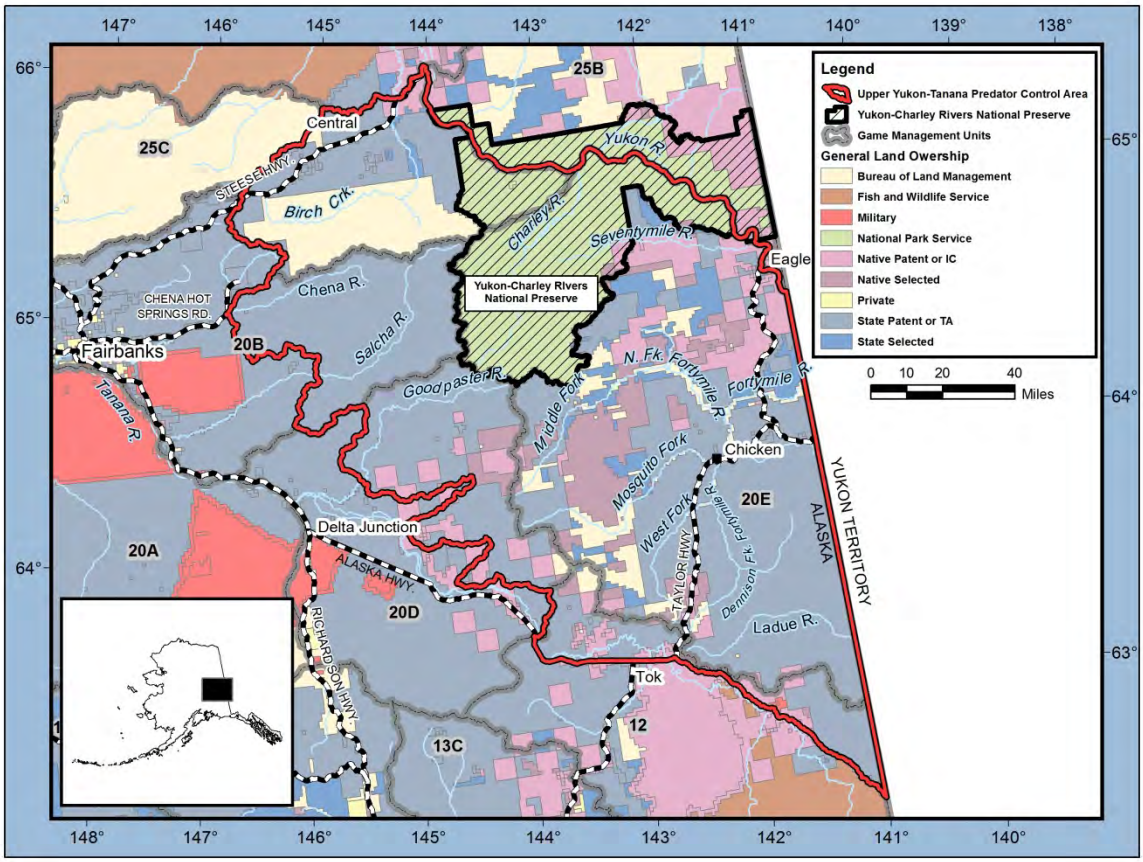

Figure 9. Land ownership within the Upper Yukon–Tanana Predator Control Area.