OPERATIONAL PLAN FOR INTENSIVE MANAGEMENT OF MOOSE IN GAME MANAGEMENT UNITS 12, 20D and 20E DURING REGULATORY YEARS 2024–2029

Prepared by:

DIVISION OF WILDLIFE CONSERVATION

Version 1, March 2025

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 moose in Game Management Units (Units) 12, 20D and 20E during regulatory years 2024 through 2029 (RY24–RY29; RY = 1 July–30 June, e.g., RY24 = 1 July 2024–30 June 2025). The IM plan for moose in Units 12, 20D and 20E 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 the 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 moose in Unit 12, 20D and 20E was developed based on the recommendation of the Upper Tanana–Fortymile Fish and Game Advisory Committee (UTFAC) and approved by the Alaska Board of Game (board).

BACKGROUND

Historically, the 20E moose population has experienced wide fluctuations in size. During the 1950s to the early 1960s, synchronous with a federal predator control program, the moose population in Unit 20E increased to an estimated minimum of 12,000 moose (Gardner 2002). The population declined during 1965 through 1976, reaching an estimated low of 2200 moose. During 1976–2001, the moose population in Unit 20E remained at low densities (0.2–0.6 moose/mi^2). Gasaway et al. (1992) evaluated the roles that predation, nutrition, snow, harvest, and disease played in maintaining the moose population at low densities. They concluded that predation was the primary limiting factor and that other variables had little to no impact.

In response to declining moose and caribou populations in 20E, ADF&G implemented predator management programs between 1981 and 1983 aimed at reducing predation within a 3,800 square mile area of Unit 20E. During these years, department staff conducted wolf control primarily by shooting from helicopters and fixed-wing aircraft, in combination with public trapping and snaring efforts (Gasaway et al. 1992:13), but "this program was terminated prematurely due to political decisions" with lesser take in 1983 (Gardner 2002:410).

Wolf reduction from starting density was estimated at 54%, 47%, and 28% for the years of control (Table 4 in Gasaway et al. 1992:19), but overall brown bears were far greater predators of moose calves (Figure 9 in Gasaway et al. 1992:28). The small reduction in total predation in the study area was attributed to a moderate wolf reduction, a possible reduction in brown bears from increased harvest, and an increase in caribou as alternate prey (Gasaway et al. 1992:31).

In 1981, the fall moose density in the control area was ~0.2 moose/mi^2 and the density of wolves was ~21/1000 mi^2, equating to a moose:wolf ratio of ~11 moose/wolf. This was one of the lowest ratios of prey per predator in North America (Gasaway et al. 1992:27-28). By 1988, moose density in the area had increased to ~0.4 moose/mi^2 and wolf density remained slightly below pre-control levels at ~ 16/1000 mi^2, but still within the range where wolf predation can strongly affect moose population growth (Gasaway et al. 1983). These authors found that moose density in the experimental area was held at <0.5 moose/mi^2 during 1981-1988 by predation and not because of habitat, disease, winter severity, or harvest.

Gasaway et al. (1992) reviewed another 34 case studies in Alaska and Yukon and proposed the concept that moose in boreal forest of this region generally exist in a low-density dynamic equilibrium (LDDE) where large predators are lightly harvested and remain at densities near their food-based carry capacity.

Gasaway et al. (1992) reported that the Unit 20E moose population was maintained at a LDDE (0.2–1.0 moose/mi^2) by wolf and grizzly bear predation and that habitat, harvest, and disease were not limiting population growth. They determined predator management was necessary to increase the moose population and to maintain it at a higher abundance level. Moose density in southwest Unit 20E remained relatively stable through the 1990s and Gardner (2002:410-411) reported 0.42-0.53 moose/mi^2 in Unit 20E in 2001.

The board adopted an IM program to benefit moose using wolf (6,600 mi^2) and brown bear (2,700 mi^2) control in a portion of southern Unit 20E (Figure 1) in spring 2004, and control permits were issued beginning in regulatory year 2004.

In RY06, the wolf control portion of the program was expanded to 18,750 mi^2 to benefit the FCH under the Upper Yukon-Tanana Predation Control Program (UYTPCP), while the brown bear control portion was expanded to 4,050 mi^2 (Figure 2). The bear control portion of the program was removed in RY09 because the bear removal objectives were not being met. Moose were removed from the program in RY14 because no focused wolf control specifically intended to benefit moose had been conducted nor was any planned at that time. However, wolf control to benefit the FCH continued through RY17, and it was assumed that moose within the active wolf control portions of the UYTPCP would continue to benefit to some degree from wolf control.

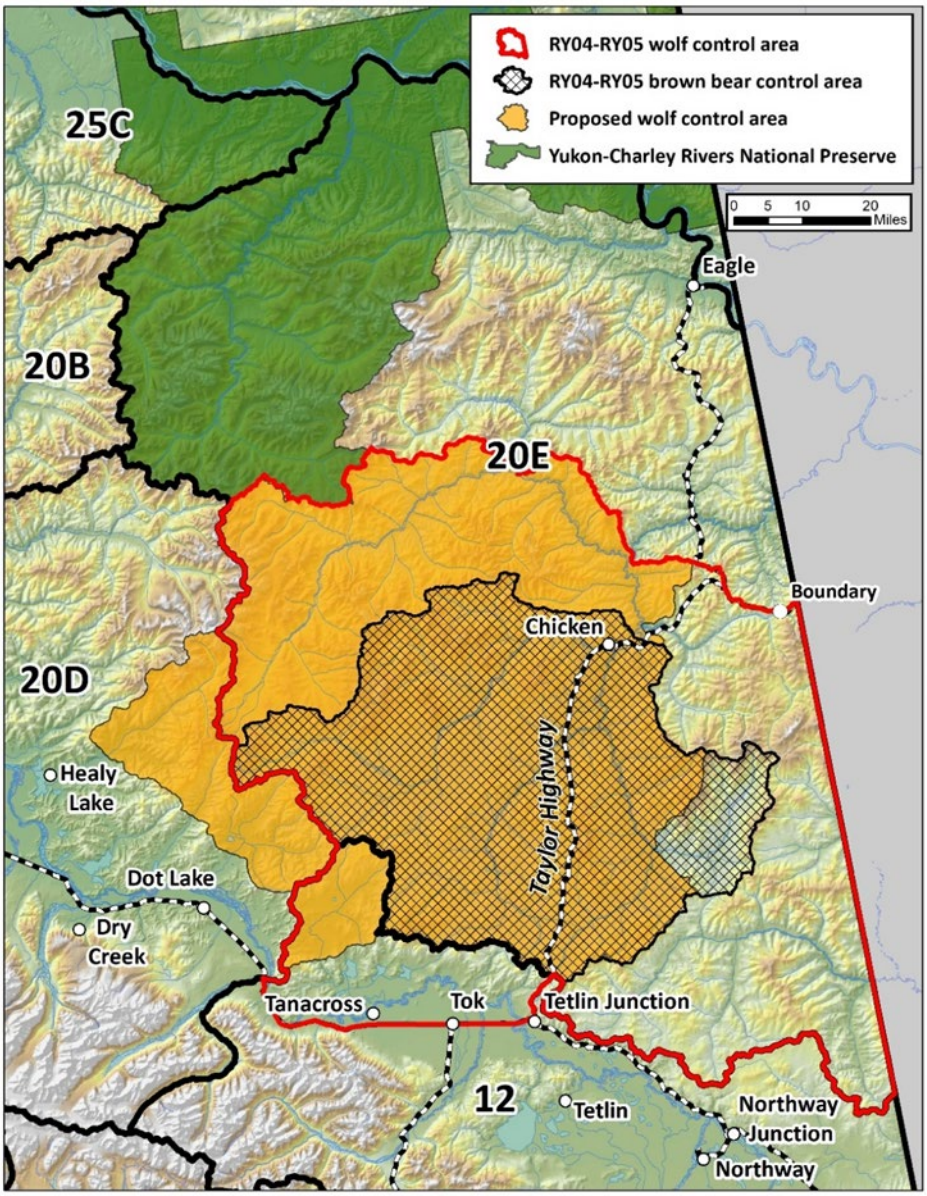


Figure 1. RY04–RY05 Unit 20E Predation Control Area (wolf control area – 6,600 mi^2, bear control area – 2,700 mi^2)

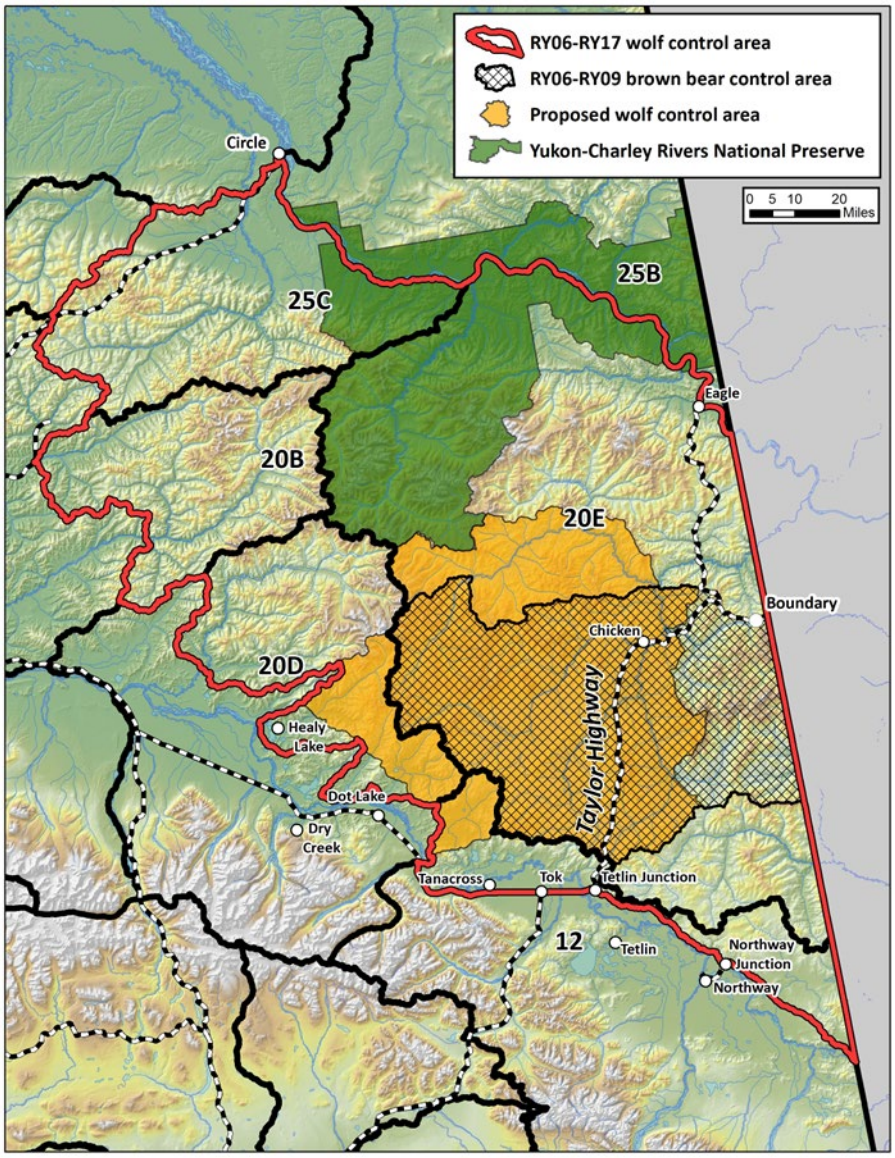


Figure 2. RY06–RY17 Upper Yukon -Tanana Predation Control Area (wolf control area – 18,750 mi^2, bear control area (RY06–RY09 only – 4,050 mi^2)

Moose density increased during 2005–2018, (0.032/mi^2/yr, $p = 0.004$) in southern Unit 20E, within the Tok West Moose Survey Area (TWSA, 2,452 mi^2), from 0.7 to 1.3 observable moose/mi^2, after implementation of IM for moose in 2004 (Figure 3; Paragi 2022, ADF&G unpublished case study), Gross 2008, Wells 2024). Achieving >1 moose / mi^2 (upper threshold of LDDE) during this period, was coincident with habitat enhancement from large scale wildland fires in southern Unit 20E, during 2004 (Figure 4) and subsequent expansion of wolf control starting in 2006 to benefit caribou (T. Paragi, ADF&G unpublished case study). During 2005–2018, moose density increased more slowly (0.02/mi^2/yr, p = 0.065), but remained within LDDE, in the Tok Central Moose Survey Area, where fire was less prevalent (Figure 4). The Yukon Charley Rivers National Preserve, which is adjacent to the 20E West Moose Survey Area, did not have wolf control and moose surveys in the YCRNP did not show trend in abundance (0.01/mi^2/yr, $p = 0.12$ and 0.01/mi^2/yr, $p = 0.18$, respectively) during these same years, despite YCRNP having substantial fire. The Unit 20E survey areas overlapped with winter range of an increasing Fortymile caribou herd. When caribou were locally concentrated, they may have served as alternative prey for wolves and reduced predation on moose.

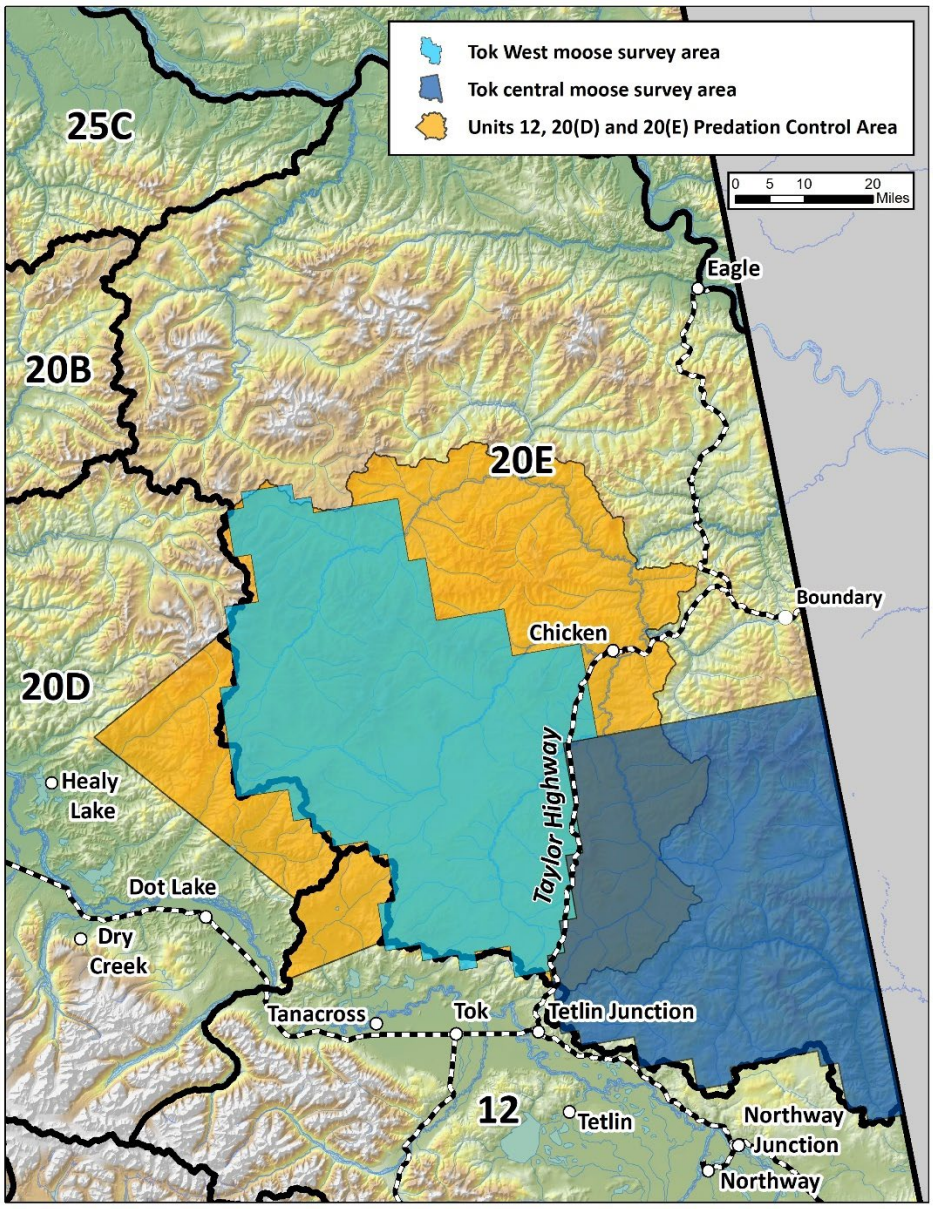


Figure 3. Tok West (2,452 mi^2) and Tok Central moose survey areas, (2,180 mi^2).

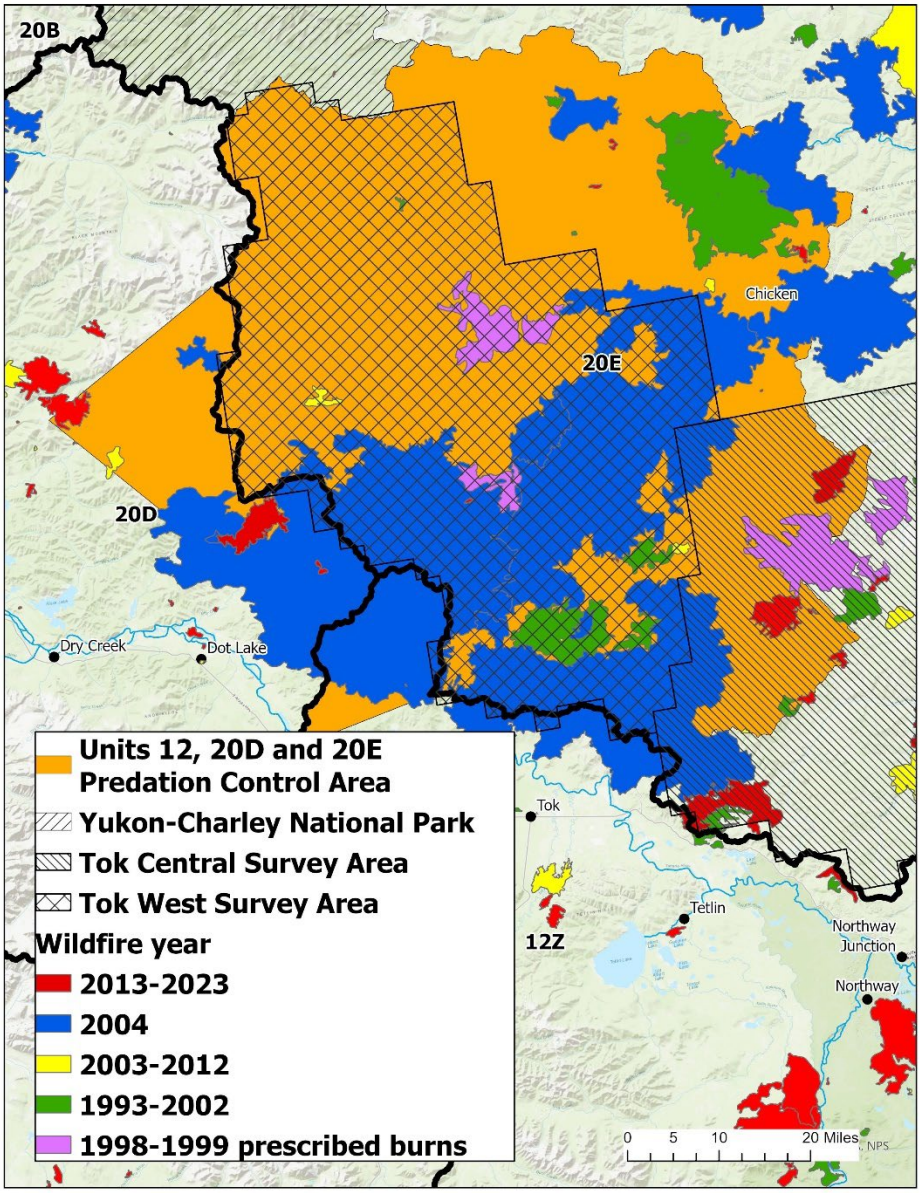


Figure 4. Fire history in southern Unit 20E.

The most recent (2023) unit-wide moose population estimate in Unit 20E was below the IM population objective (8,000–10,000) and reported harvest was below the IM harvest objective (250–500). The 2023 Unit 20E observable moose population estimate, which incorporated post-harvest survey data from 2013–2023, was 4,724 (likely range 4,035–5,413) moose (Gross 2024, unpublished data). This estimate increases to 5,102 (likely range 4,357–5,846) moose when a sightability correction factor (SCF) of 1.08 is applied (Gross 2024, ADF&G unpublished data). The SCF of 1.08 was the average SCF measured during sightability trials in southern Unit 20E moose surveys during 2017–2019. The Unit 20E estimate includes an extrapolation to 36% of the unit that has not been surveyed.

Total reported moose harvest during RY20–RY24 averaged 170 (range 152–192) in Unit 20E, which is below the IM harvest objective for the unit. Achieving the IM harvest objectives is limited to some degree by factors including land ownership (e.g. federal and private lands) and associated access restrictions, limited motorized access within the Ladue and Glacier Mountain Controlled Use Areas, and difficult access to the remote portions of the unit. All areas included within the

proposed wolf control area currently have an Alaska resident any-bull bag limit for moose.

Annual moose surveys have been conducted within various moose survey areas in southern Unit 20E since 2004 (except during 2013 and 2016). Although survey area size and location varied during these years, an 1,821 mi^2 area (Taylor Corridor Analysis Area (TCAA), Figure 5) was within the areas surveyed during all years that surveys were conducted since 2004. The PCA overlaps 91% (1,660 mi^2) of the TCAA (Figure 5).

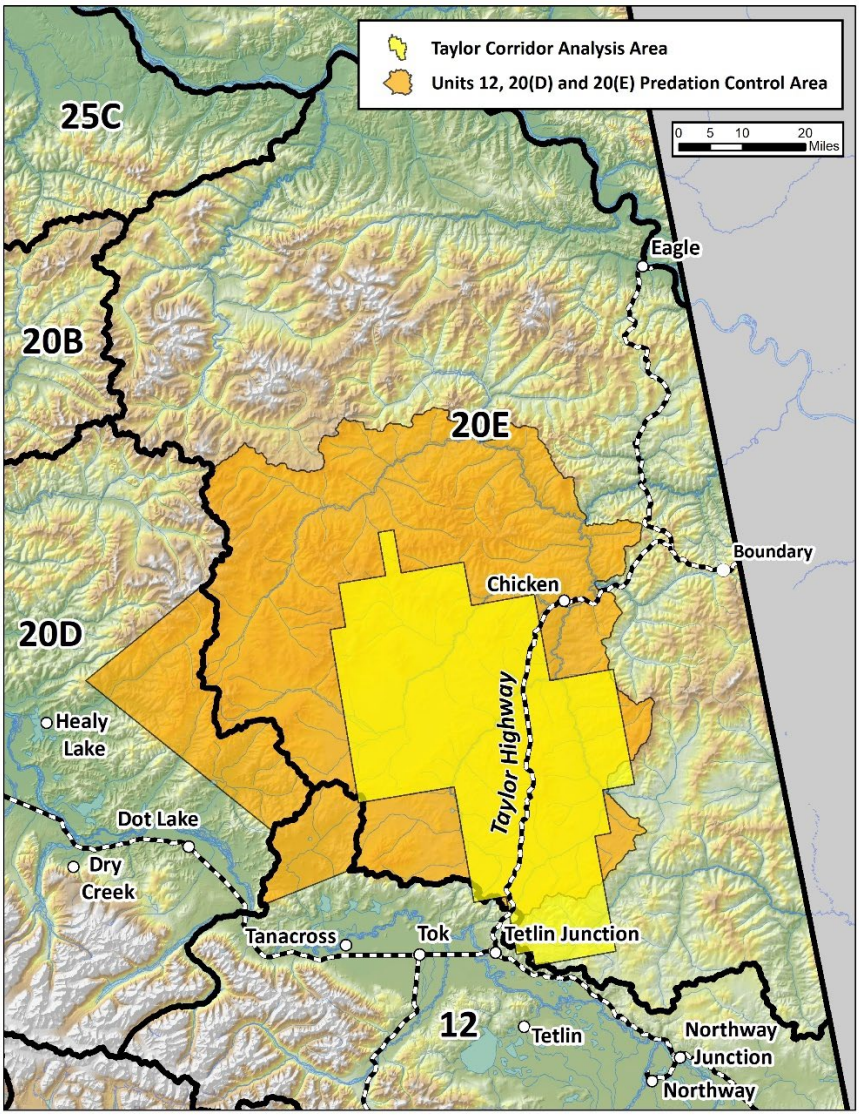


Figure 5. Taylor Corridor Analysis Area, 1,821 mi^2.

Observable moose densities within the TCAA increased from 0.68 moose/mi^2 (90% confidence interval [CI] ± 0.10 moose/mi^2) in 2005 to 1.41 moose/mi^2 (90% CI ± 0.27 moose/mi^2) in 2018, with an estimated annual growth rate of 5% (95% CI ± 1.6%). This increase was likely due to a combination of large wildfires during 2004 and 2005 and wolf control during 2005–2018. Since 2018, the moose density within the TCAA has declined, with density estimates of 0.94 moose/mi^2 (90% confidence interval [CI] ± 0.11 moose/mi^2) in 2023 and 0.74 moose/mi^2 (90% CI ± 0.18 moose/mi^2) in 2024. This decline occurred during a period with 2 consecutive severe winters (2021-2022 and 2022-2023) and increased wolf numbers following suspension of wolf control under the UYTPCP in RY18.

The Taylor Corridor Moose Survey Area (TCSA, 2,241 mi^2) was established in 2014 and overlaps the entire TCAA (82% of TCSA, Figure 6). The TCSA was surveyed annually during 2014–2024 (except 2016). Observable moose densities within the TCSA have been similar to those observed in the TCAA since 2014, with recent estimates of 0.91 moose/mi^2 (90% confidence interval [CI] ± 0.12 moose/mi^2) in 2023 and 0.71 moose/mi^2 (90% CI ± 0.18 moose/mi^2) in 2024.

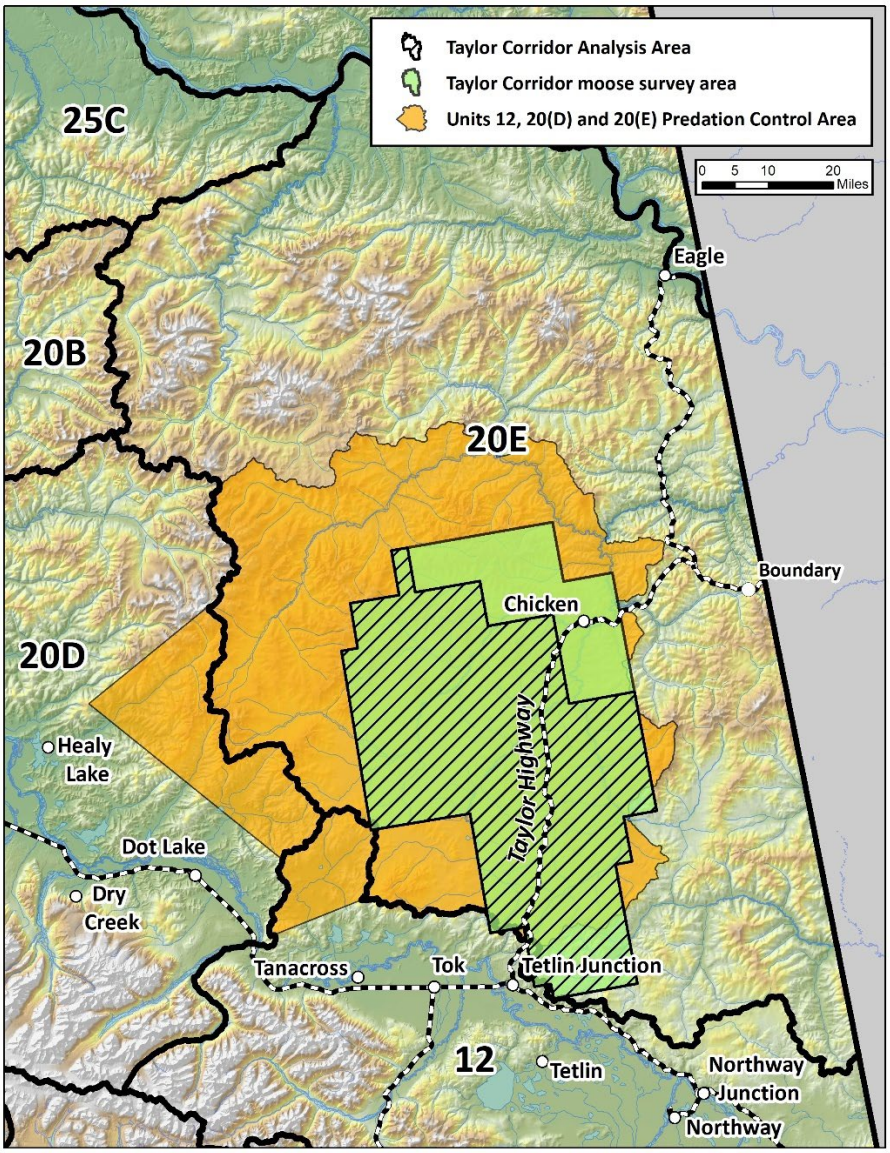


Figure 6. Taylor Corridor Survey Area, 2,241 mi^2.

Since 2005, Unit 20E moose harvest increased from an average of 160 (range 130–187) annually during 2005–2013, to 217 annually (range 191–246) during 2014–2021, but has returned to 2005–2013 levels since, with an average of 156 annually (range 152–162) during 2022–2024 following the deep snow winters of 2021-2022 and 2022-2023. Unit 20E moose hunter success rate averaged 22% (range 16%–26%) annually during 2005–2021, but also decreased during 2022–2024, to an average of 17% (17% in all years).

Estimated bull-to-cow and calf-to-cow ratios have decreased in recent years. Early winter bull-to-cow ratio estimates decreased from an average of 46 bulls per 100 cows (range 38–67) during 2005–2015 to an average of 31 bulls per 100 cows (range 26–38) during 2017–2024. No moose

surveys were conducted in 2013 and 2016. The midpoint bull-to-cow ratio estimate was below the minimum bull-to-cow ratio management objective of 30 bulls per 100 cows during 2018 (26 bulls per 100 cows). The bull-to-cow management objective was reduced to 25 in 2020 to allow for the increased rate of harvest in recent years and the bull-to-cow ratio has remained above the new management objective since 2020. Early winter calf-to-cow ratios averaged 26 calves per 100 cows during 2005–2012, 2014, 2015 and 2017–2019 surveys, but declined to an average of 15 calves per 100 cows (range 12–17.5) during 2020–2024 surveys. This decline is likely in part due to a combined effect of predation as well as the reduced fitness of individuals due to the extreme winter conditions in the region during two severe winters (2021-2023), which brought record-setting snow depths, long durations of snow cover, and very late springs (Coady 1974).

Habitat presently does not appear to be a limiting factor for the southern Unit 20E moose population. Twinning rates in southern Unit 20E and northern Unit 12 during 2004–2024 averaged 32%, while the 2022–2024 3-year weighted average twinning rate was 38% (90% CI ± 6%). Twinning rates greater than 20% are believed to indicate that the habitat can support a larger population (Franzmann and Schwartz 1985, Seaton et al. 2011).

During 1989–2024, fire occurred in 1,865 mi^2 (39%) of the proposed wolf control area, with most of the area burned during 2004 (1,592 mi^2). The burns in 2004 were likely an important factor, along with wolf reductions, in creating and maintaining a modest increase in moose density that has allowed higher yields during the last 2 decades. The department is currently developing several prescribed fire burn plans for portions of southern Unit 20E with the goal of maintaining early seral stage forests particularly as the large area that burned in 2004 matures. Mechanical crushing of willows and maturing hardwood trees in portions of these burns near the Taylor Highway and forest roads can also maintain early seral conditions beneficial to moose in areas accessible to hunters. A 2022 survey of browse utilization in the TCSA found moderate rates of removal 29% (95% CI 25–32%).

Past research suggests that grizzly bears and wolves are the primary predators of moose in Unit 20E. Research in Unit 20E in the 1980s estimated that grizzly bears killed 22% and wolves killed 8% of the total post-calving moose population annually (Gasaway et al. 1992). This study also found that grizzly bears were the primary predator of moose calves (killed 52% of radio-collared calves) followed by wolves (12–15%) and black bears (3%). However, this study was conducted when wolf numbers were estimated to be at reduced levels due to 1 year of wolf control. Nevertheless, research conducted in southwestern Yukon Territory during the same period found similar results and concluded that grizzly bears and wolves killed an estimated 26% and 14%, respectively, of the post-calving moose population annually. Although brown bears have been identified as the primary predator of moose calves (Boertje et al. 1988), attempts to reduce brown bears in 20E have proven unsuccessful. Other IM bear control options are expensive, controversial, and likely unnecessary (e.g., Boertje et al. 1995), particularly for moose populations already near or above LDDE (Gasaway et al. 1992:49).

To evaluate recovery of the wolf population within the UYTPCP area, following the suspension of the program in the spring of 2018, the department conducted a wolf survey in a ~17,150 mi^2 portion of the 18,750 mi^2 Upper Yukon Tanana Predator Control Area (UYTPCA) in spring of 2020. Results indicated the wolf population had recovered to pre-control levels.

In spring of 2023, the department conducted a wolf survey within a 5,125 mi^2 (Figure 7) portion of the UYTPCA surveyed in 2020. The focus was on southern Unit 20E because of concerns raised by the public of the potential negative effects of increased wolf numbers on the moose population.

The estimated number of wolves in packs within the 5,125 mi^2 survey area in southern Unit 20E, with 4,282 mi^2 (84%) within the PCA, was 109–110 wolves (excluding singles), which equates to an estimated density of 21.3–21.5 wolves/1,000 mi^2. In 2020, the estimated number of wolves (99–102 wolves (excluding singles) and a density of 19.3–19.9 wolves/1,000 mi^2) was similar to the estimate within the same 5,125 mi^2 area surveyed in 2023.

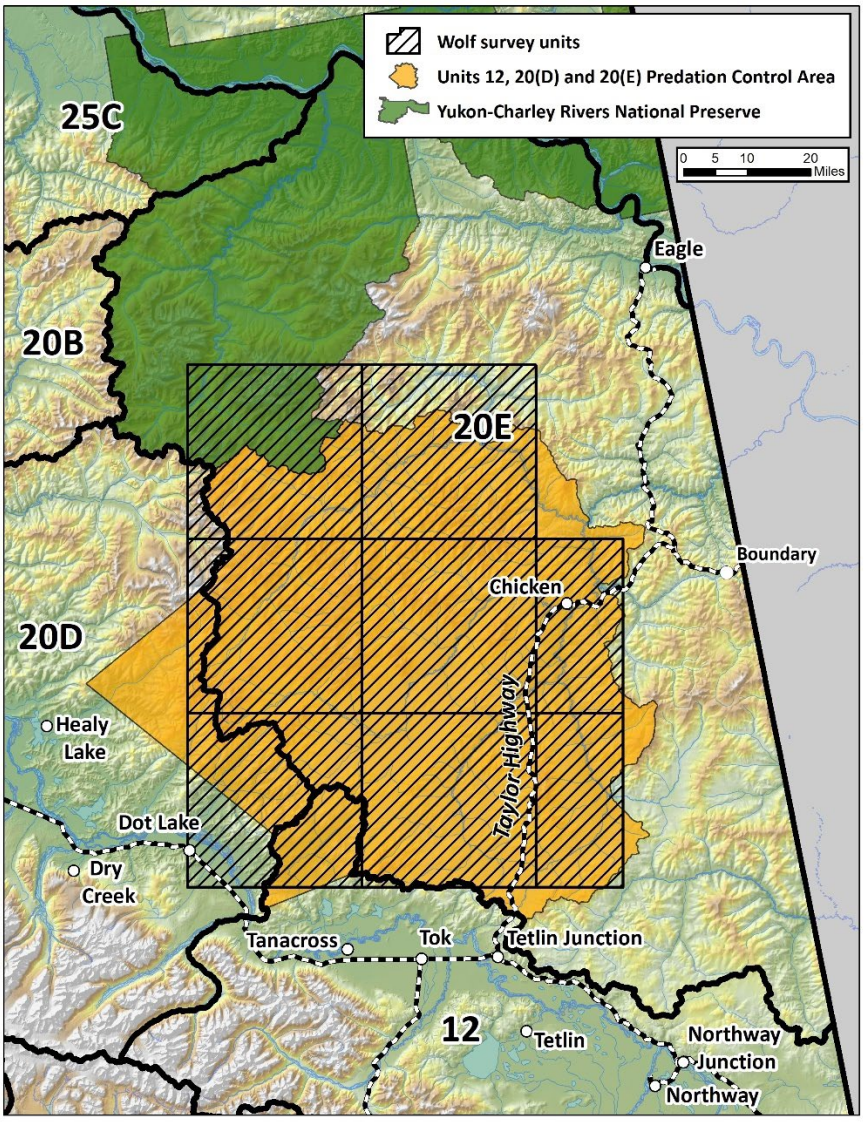


Figure 7. Southern Unit 20E Wolf Survey Area, 5,125 mi^2.

In response to two consecutive years (Fall 2023 and Fall 2024) of estimated moose populations under the IM objective of 1.0-1.4 moose mi^2, the Department began developing the Units 12, 20(D), and 20(E) Predation Control Focus Area Program (PCFAP) operational plan, to benefit moose, which the board authorized during their March 2024 meeting in Fairbanks, AK. Under this program, wolf control is authorized within the 4,704 mi^2, Units 12, 20(D) and 20(E) Predation Control Area (PCA) (Figure 8). Moose population objectives for the PCFAP are based on the moose density within the TCSA. In addition, annual moose and wolf surveys as well as other metrics conducted in the TCSA will be used to evaluate the program to determine if it will be activated or suspended based on codified language (5AAC 92.113(c)) and this operational plan.

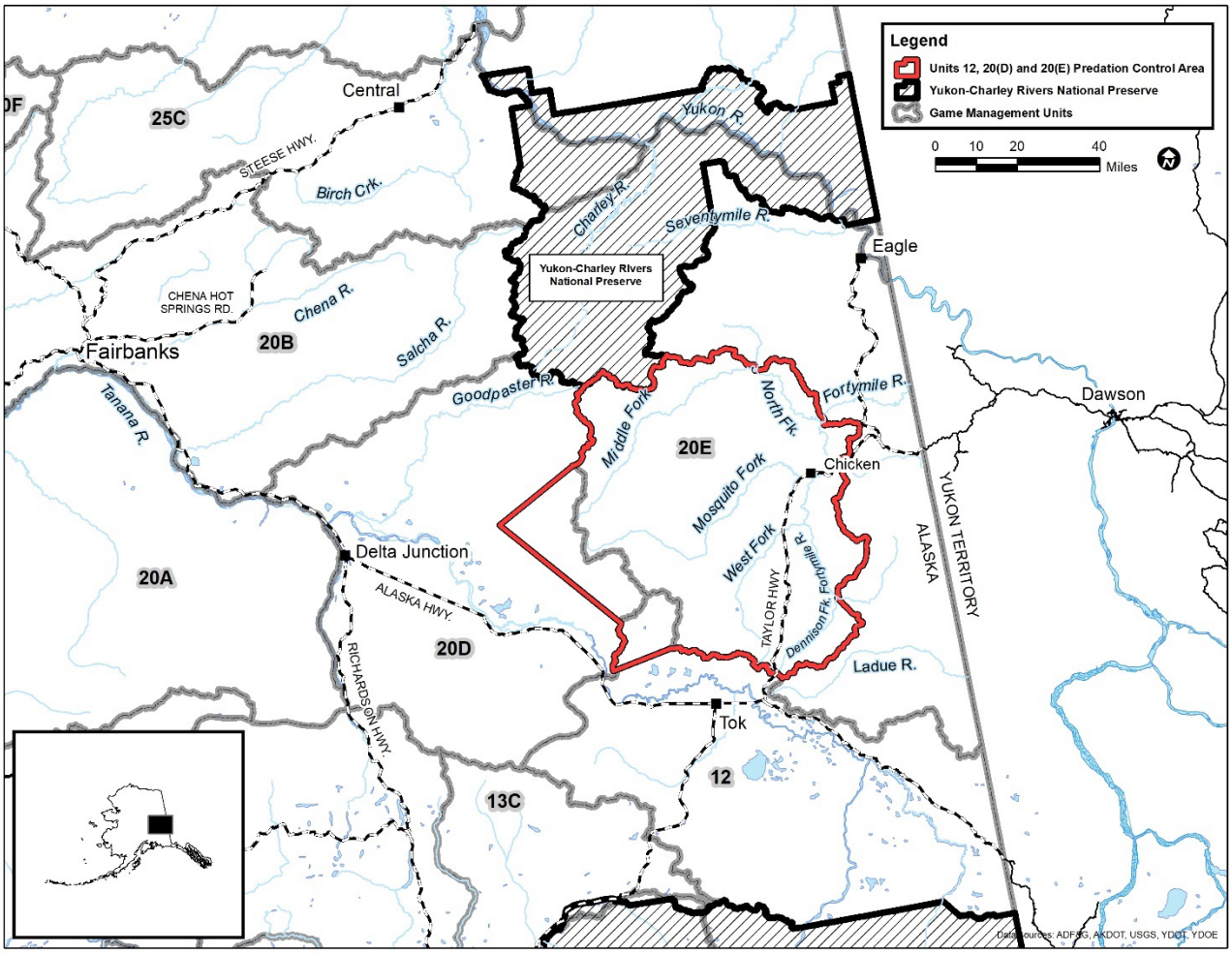


Figure 8. Units 12, 20(D), and 20(E) Predation Control Focus Area, 4,704 mi^2.

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:*

The wolf control objective in the PCA is to reduce wolf numbers to the extent possible, with a minimum objective to reduce numbers by at least 60–80 percent of the pre-control estimate. Removing wolves only from the PCA will ensure that wolves persist in Units 12, 20D and 20E.

Units 12 (9,975 mi^2), 20D (5,637 mi^2) and 20E (10,680 mi^2) define the population of wolves. Based on the most recent population estimates for these Units, the estimated pre-control wolf population was 179–192 (RY19) in Unit 12, 144 (RY17) in Unit 20D and 213–230 (RY19) in Unit 20E (Gross 2024, Schmidt and Cooper, 2024).

The PCA (4,704 mi^2) defines where aerial wolf control may be conducted. Based on the results of the 2023 wolf survey within a 5,125 mi^2 area (Figure 7) that overlaps the proposed IM area, the pre-control estimate is approximately 110 wolves in the PCA.

Wolf control may be conducted annually by issuing pilot and gunner permits to the public using aerial or land and shoot methods during November through April. Department control using aerial, land and shoot, or ground-based methods may also be conducted if public permittees are unable to achieve the control objective. If, after three years, removal rates continue to fall below 60%, the department will review, modify, or suspend the program.

Presently known alternatives to predator control for reducing the number of predators are ineffective, impractical, or uneconomical in the Units 12, 20D and 20E situation. Hunting and trapping conducted under authority of ordinary hunting and trapping seasons and bag limits is not an effective reduction technique in sparsely populated areas such as this. Relocation of wolves is impractical because it is expensive, and it is very difficult to find publicly acceptable places for the relocated animals.

B. *Habitat Enhancement:*

Based on recent results of twinning (RY23) and browse surveys (RY21) conducted in PCA, moose do not appear to be nutritionally limited at recently observed population densities (1.0–1.4 moose/mi^2 in TCSA) in southern Unit 20E.

The most recent 3-year weighted average twinning rate (2022–2024) in southern Unit 20E and northern Unit 12 was 38% (90% CI ± 6%).

A 2022 survey of browse utilization in the TCSA found moderate rates of removal 29% (95% CI 25–32%).

Although habitat does not appear to be limiting at this time, ongoing habitat enhancement efforts will continue. The department is currently developing several prescribed fire burn plans for portions of southern Unit 20E with the goal of maintaining early seral stage forests particularly as the large area that burned in 2004 matures. In addition, mechanical crushing of willows and maturing hardwood trees in portions of these burns near the Taylor Highway and forest roads are currently being planned to help maintain early seral conditions beneficial to moose in areas accessible to hunters.

C. *Prey Harvest:*

If the moose population is increasing and the moose density in the TCSA exceeds 1.4 moose/sq mile for 2 consecutive surveys, antlerless moose permits will be issued to maintain the moose population between 1.0–1.4 moose/sq. mile and keep the bull:cow ratio within objectives, within the TCSA. Issuing larger numbers of antlerless permits in a single year to achieve desired population reductions is undesirable to the public. Therefore, the number of antlerless permits will be limited to the number needed to achieve desired reductions over multiple years. Antlerless moose permits can be issued under Unit 20E antlerless moose regulations adopted by the BOG in spring of 2022.

Twinning rates are a sensitive indicator of moose nutritional status (Boertje et al. 2009) and will be carefully monitored within the TCSA. If the 3-year average twinning rate is >20% the department will manage the population to continue to promote growth. At a rate of 15–20% the population will be stabilized through harvest. If the 3-year average twinning rate is <15% the population will be reduced through harvest.

In addition, if results of future browse surveys in the TCSA indicate browse removal rates are exceeding 35%, but twinning rates are above 20% and the moose density within the TCSA is below 1.4 moose/sq. mile, antlerless harvest or overall population reduction should be considered if high removal rates persist.

II. Anticipated Responses to Treatments

Based on observed increases in moose density in the combined TWSA and TCSA (3,519 mi^2 in southern Unit 20E, Figure 9) during 2004–2018, concurrent with wolf control activities under the Upper Yukon Tanana Predator Control Program and large-scale fires in this area, it is assessed that the combination of wolf control and ongoing habitat enhancement efforts, within the proposed IM area, has a high likelihood of resulting in a moderate increase in the moose population within the combined TWSA and TCSA, that will be adequate to meet the population objectives under the proposed IM program and help make progress towards achieving the Unit 20E IM harvest objective.

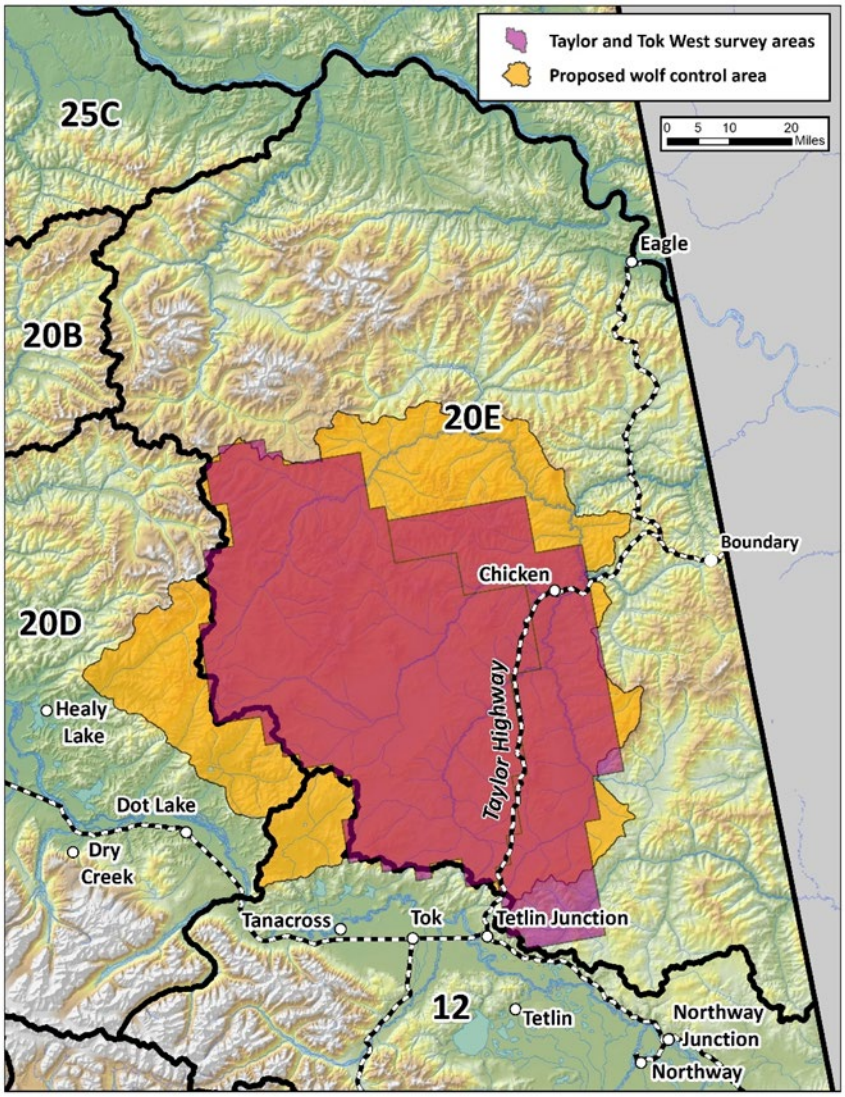


Figure 9. Combined Tok West and Taylor Corridor moose survey area, 3,519 mi^2.

A. *Predator Abundance:*

Units 12 (9,975 mi^2), 20D (5,637 mi^2) and 20E (10,680 mi^2) define the pre-control population of wolves. The estimated pre-control wolf population in these 3 units is 536–566 based on the most recent population estimates for these Units (Gross 2024, Schmidt and Cooper, 2024). Based on the results of the 2023 wolf survey within a 5,125 mi^2 area (Figure 7) that overlaps the proposed IM area, there are an estimated 109–110 wolves in the proposed IM area.

If the wolf control objective to reduce wolves in the PCA by at least 60–80 percent of the pre-control estimate is achieved, wolf numbers will be reduced by approximately 65–88 wolves within the PCA by wolf control activities. However, this only represents a 10 – 15% of the pre-control wolf population in Units 12, 20D and 20E combined. Removing wolves only from the PCA will ensure that wolves persist in Units 12, 20D and 20E.

Based on the rapid recovery time of the wolf population, within the nearby UYTPCA, following the suspension of that program at the end of RY18, it is anticipated wolf numbers in the PCA will recover to pre-control levels in 2–4 years if control is (ADF&G 2024. Unit 20E Moose Intensive Management Feasibility Assessment).This is consistent with the expectation

that wolves would recover to pre- control levels in 3–5 years in the PCA if wolf control were suspended (National Research Council 1997:52–53).

B. *Predation Rate:*

Calf survival of calves associated with collared cows in the PCA was monitored during 2014–2015 and 2015–2016, coincident with years of reduced wolf numbers from wolf control activities under the UYTPCP, and averaged 40% (range 26–53%). During 2020–2021 through 2022–2023, following recovery of the wolf population to pre-control levels starting in 2020, calf survival rates of calves associated with collared cows in the PCA averaged 14% (range 5–27%). Although these results appear to show a difference in calf survival between these two periods, deep snow conditions during winters 2021–2022 and 2022–2023 likely contributed to increased calf mortality during these winters. Therefore, it's difficult to determine to what degree the change in calf survival may have been attributed to increased wolf predation verse deep snow conditions.

Composition data from moose surveys in the TCSA from 2014–2019 (no survey in 2016), coincident with years of reduced wolf numbers from wolf control activities under the UYTPCP, averaged 24 calves:100 cows using the mid-point estimate during those years. During 2020–2024, following recovery of the wolf population to pre-control levels starting in 2020, the average ratio was 15 calves:100 cows using the mid-point estimate during those years. Although fall calf:cow ratios are not a direct measure of predation rates (e.g. NRC 1997), calf:cow ratios will be used as an index to help evaluate the relative change in recruitment, without direct attribution to changes in predation rate.

Annual spring twinning and fall composition surveys will be attempted annually, in the PCA. During annual twinning surveys, a sample of radio collared cow moose (n=40–50) will be located to determine birthrates for this sample of cows. These cows will be monitored throughout the year to assess survival rates of these cows and their dependent calves to help evaluate changes in wolf predation rates and the overall effectiveness of the IM program.

If a 60–80% reduction in wolf abundance is achieved in the PCA (relative to pre-treatment abundance), it is anticipated that a higher numbers of calves relative to cows in fall composition surveys will be observed. In addition, a larger proportion of collared cows and calves associated with these cows are expected to survive annually, similar to levels observed during 2014–2019. These changes would be consistent with a reduction in wolf predation on moose in the PCA.

C. *Prey Abundance:*

The observable moose densities within the TCSA were estimated at 0.91 moose/mi^2 (90% confidence interval [CI] ± 0.12 moose/mi^2) in 2023 and 0.71 moose/mi^2 (90% CI ± 0.18 moose/mi^2) in 2024.

If a 60–80% reduction in wolf abundance is achieved in the PCA (relative to pre-treatment abundance), it is anticipated that an increasing trend in moose density in the PCA during these years and progress being made toward moose density objectives will be observed. The expected increases in abundance will be utilized and regulated in accordance with principles in part E and F.

D. *Prey Recruitment:*

Recruitment of moose calves is measured with the same information outlined in Section II. B. Additional monitoring efforts, such as collaring fall calves (~5 mo. old) or short yearlings (9-10 mo. old) to have a sample of known age cows to evaluate age specific survival rates, may be initiated if current efforts are determined to be inadequate to evaluate program effects.

E. *Prey Productivity or Nutritional Condition:*

Twinning rates will be monitored within the PCA. If the 3-year average twinning rate is >20% and the moose density is below 1.4 moose/mi^2 the population will be managed to promote growth. When 3-year average twinning rate is 15–20% moose density will be stabilized through harvest. If the 3-year average twinning rate is <15%, the density in the PCA will be reduced through harvest.

F. *Harvest:*

This program is intended to help make progress towards achieving the Unit 20E IM objectives for moose. The Unit 20E IM harvest objective is 250–500. Harvest in Unit 20E is accomplished primarily by using registration and general harvest hunts for residents and non-residents. Wolf reduction in the PCA should result in an increase in harvestable surplus of moose in a portion of southern Unit 20E. In the Unit 20E, Amount Necessary for Subsistence (ANS) is 50–75 moose.

G. *Use of Nontreatment Comparisons:*

The department will attempt to survey the combined TWSA, TCSA and Tok Central Survey Area (5,050 mi^2, Figure 10), once every 3-years, coinciding with the 3-year board of game cycle, to periodically evaluate changes in the entire southern Unit 20E moose population and evaluate effects of the IM program. The portion of the Tok Central moose survey area to the east of the control area (Tok central survey area remainder – 2,180 mi^2, Figure 10), will be used as a control to monitor trends in moose population and composition outside, but adjacent to the PCA, in an area without wolf control.

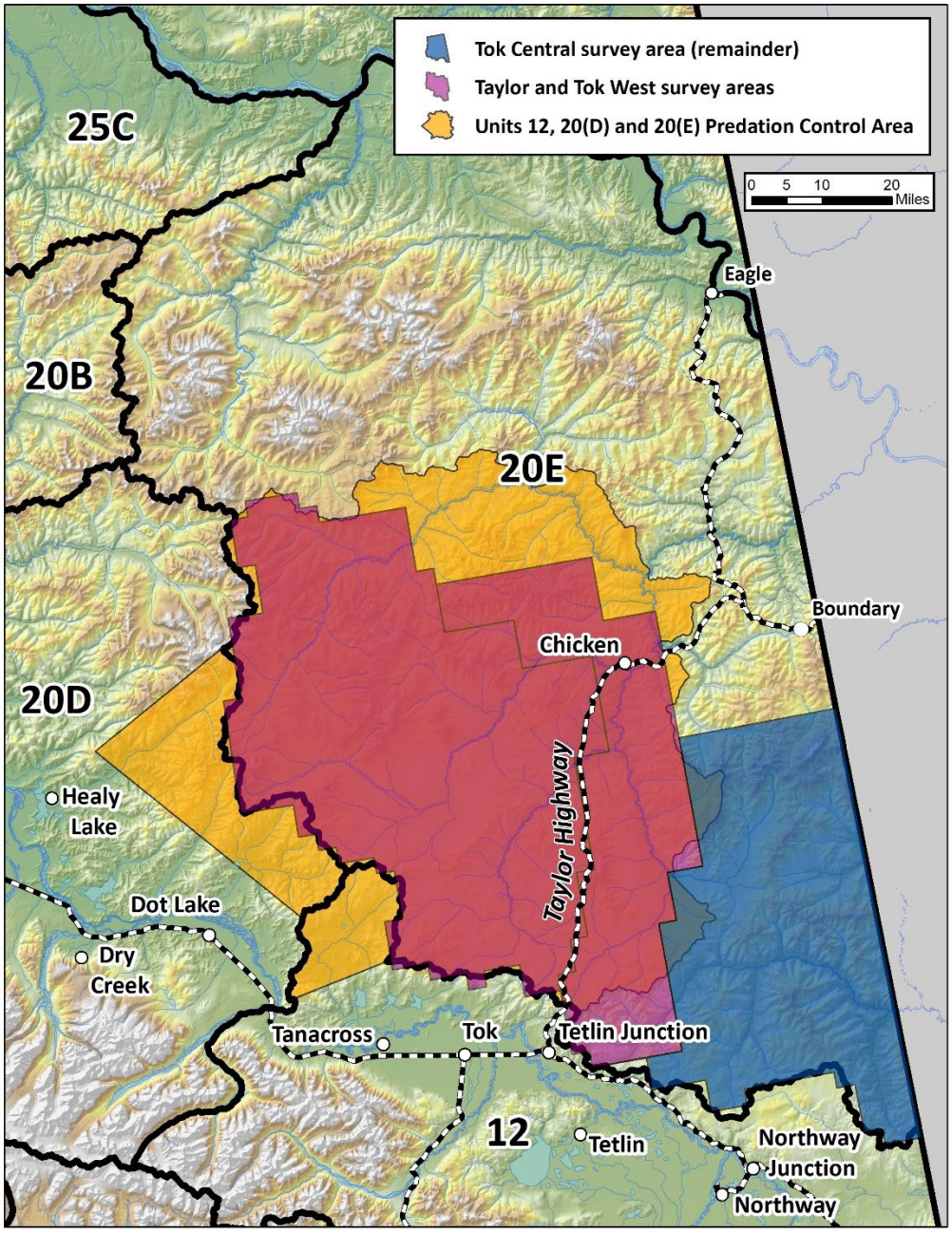


Figure 10. Combined Tok West, Taylor Corridor and Tok Central moose survey area, 5,050 mi^2.

H. *Other Mortality Factors:*

Deep snow years in excess of 31 inches (Coady 1974 and Keech 2012) have been shown to be a factor that may reduce annual moose survival and lower recruitment in moose populations.

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:*

The estimated pre-control wolf population was 179–192 (RY19) in Unit 12, 144 (RY17) in Unit 20D and 213–230 (RY19) in Unit 20E based on the most recent population estimates for these Units (Gross 2024, Schmidt and Cooper, 2024). Based on the results of the 2023 wolf survey within a 5,125 mi^2 area (Figure 7) that overlaps the proposed IM area, there are approximately 110 wolves in the proposed IM area.

Viable predator populations can easily be maintained outside the 4,704 mi^2 PCA, which includes 2%, 10% and 38% of Units 12, 20D and 20E, respectively. The control area is adjacent to a federal conservation unit, which will serve as additional refugia. The wolf objective for Unit 12 is to maintain a population of at least 100 wolves (Gross 2024), for Unit 20D is to manage harvest to maintain a fall population of 15–125 wolves (Schmidt and White 2024), and for Unit 20E is to reduce the fall population to no less than 60 wolves (Gross 2024). These objectives can be confirmed outside the wolf control area using a minimum count or intensive aerial survey (Gardner and Pamperin 2014).

Based on the rapid recovery time of the wolf population, within the nearby UYTPCA, following the suspension of that program at the end of RY18, it is anticipated wolf numbers in the PCA will recover to pre-control levels in 2–4 years if control is suspended (ADF&G 2024. Unit 20E Moose Intensive Management Feasibility Assessment).

B. *Habitat and Forage Condition:*

A baseline browse survey was conducted in the PCA during late-winter 2022. While no forage assessment studies are currently scheduled for this program, studies may be conducted if declines in twinning rates below 20% are detected. Browse removal is a measure of competition for food by moose that is inversely correlated to nutritional condition (Seaton et al. 2011).

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

The moose population objective for this program is to maintain between 2,240–3,140 observable moose (1.0–1.4 moose mi^2), within the Taylor Corridor Survey Area (TCSA). Geospatial Population Estimator (GSPE) surveys will be attempted in the TCSA annually. Achieving this objective will contribute to achieving the IM population objective of 8,000–10,000 moose in all of Unit 20E.

Moose age and sex composition will be assessed using data collected during late autumn GSPE surveys in the TCSA.

The nutritional condition of moose will be primarily monitored through twinning rates using

radiocollared (2–3 radio tracking flights during May 20–30) and non-collared females observed annually during late May twinning surveys in the PCA. Radio collared cows will be radio tracked every 2–3 days during May 20–30. The twinning rate will be calculated as the proportion of cows with twins or triplets from the sample of all cows with calves observed during these spring twinning surveys.

D. *Prey Harvest:*

The IM harvest objective for Unit 20E is 250–500 moose. Hunter access is limited over much of the unit, which may make achieving the Unit-wide IM harvest objective difficult. However, an increase in moose harvest within the PCA, which is more accessible by hunters compared to the remainder of the unit, would contribute to the overall Unit 20E IM harvest objective.

Harvest reported in Universal Coding Units (UCU) – 20EY000501, 20EY000601, 20EY000701, 20EY000801, 20EY000901, 20EY000902, 20EY000903, 20RY000904 will be monitored to assess changes in moose harvest in the PCA (Figure 11).

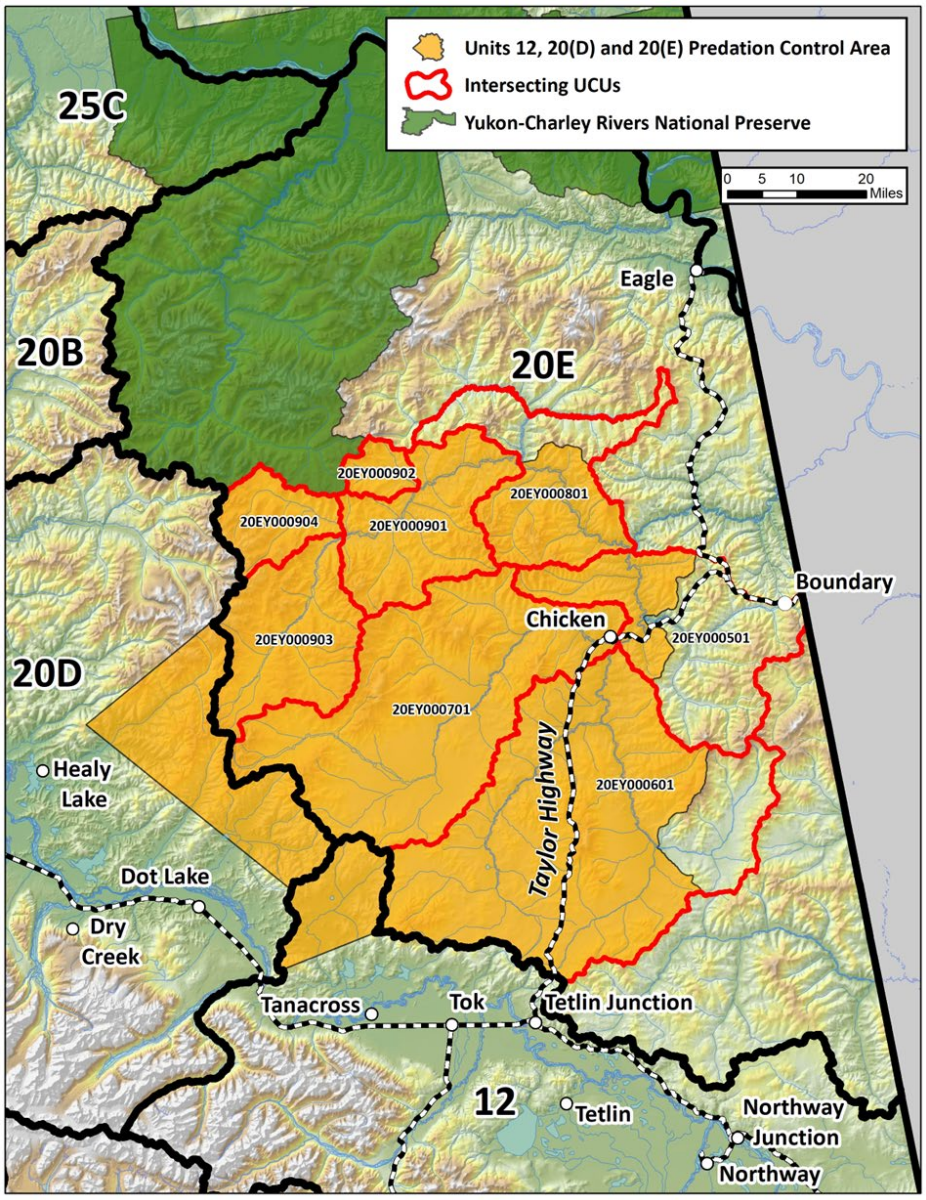


Figure 11. UCUs overlapping the portion (4,839 mi^2) of the PCA, in Unit 20E, used to assess changes in moose harvest within the PCA.

IV. Decision Framework to Implement or Suspend a Treatment

A. *Predation Control:*

1. Prey Abundance.

Decision-making framework to initiate or suspend predator control will be based upon estimates of moose density from GSPE moose surveys conducted in the TCSA, encompassing 2,241 square miles in southern Unit 20E along the Taylor Highway, the 3-year average moose twinning rate in the TWSA and TCSA in southern Unit 20E and the level of wolf removal within the PCA, in relation to the wolf reduction objective.

The management strategies for this IM program are intended to maintain the moose population in southern unit 20E within recently observed densities to continue to meet hunter demand, while maintaining a nutritionally robust population. Specifically, the population objective for this IM program will be to maintain a moose density of 1.0 – 1.4 moose/mi^2, within the TCSA. All GSPE surveys should be designed to achieve precision of at least +20% at the 90% confidence interval, but actual precision will vary with survey conditions and funding.

Predation control activities will be initiated:

- If a GSPE point estimate of observable moose in the TCSA is below the lower end of the population objective of 1.0 moose/mi^2 (approximately 2,241 moose) for 2 consecutive surveys, and the 3-year average twinning rate is ≥20%.

- Department control using aerial, land and shoot, or ground-based methods may also be conducted if public permittees alone are unable to achieve wolf control objectives, defined as a 60% reduction of the fall, pre-control estimate of wolf abundance for two consecutive years. Department control will not occur prior to a re-evaluation of the program which may include a revision of this operational plan.

- If after 1–3 years, wolf inventories or accumulated information from permittees indicate the wolf reduction objective in the PCA of 60–80% is not being met by public control permittees only, department control using aerial, land and shoot, or ground-based methods may be initiated to supplement public permittee efforts to help achieve the wolf reduction objective.

Predation control activities will be suspended:

- If a GSPE point estimate of observable moose in the TCSA exceeds 1.2 moose/sq mile for 2 consecutive surveys. As long as the GSPE point estimate of observable moose in the TCSA is ≥1.0 moose/ mi^2, following suspension of the program, wolf control will remain suspended.

- If the 3-year average twinning rate within the TCSA is at or below 20%.

- When wolf inventories or accumulated information from permittees indicate the need to avoid reducing wolf numbers below the minimum management objectives of 179–192 wolves in Unit 12, 200–250 in Unit 20D and 213–230 in Unit 20E.

Predation control will be suspended, pending reevaluation of program treatments and objectives:

- If after 9 years or 6 moose abundance estimates, in the absence of severe winter conditions, removal of wolves in combination with ongoing habitat enhancement efforts are not sufficient to result in an increasing trend likely to meet the upper moose density objective in the TCSA within 3 years.

- If after 12 years, in the absence of severe winter conditions, the density in the TCSA remains below 1.2 moose per sq. mi for 2 consecutive abundance surveys.

- If after 3 years, any measure (twinning rates, browse removal, parturition rate, survival rates) consistent with significant levels of nutritional stress in the moose population are identified.

Twinning rates are an important indicator of moose nutritional status. If the 3-year average twinning rate is >20% the department will continue to promote growth. When the 3-year average twinning rate is 15–20%, wolf control will be suspended, and moose density will be stabilized through harvest. If the 3-year average twinning rate is <15% moose density will be reduced through harvest. Utilizing twinning rates will ensure that the moose density is appropriate for the amount of forage available on the landscape regardless of population density.

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 moose. These include, but are not limited to regulatory change, weather, water levels, fuel cost, the day of the week the season opens, reporting habits, as well as moose numbers and their distribution.

B. *Habitat Enhancement:*

Habitat indices will not be used to initiate enhancement activities during this program period. However, the department is currently developing several prescribed fire burn plans for portions of southern Unit 20E with the goal of maintaining early seral stage forests particularly as the large area that burned in 2004 matures. In addition, mechanical crushing of willows and maturing hardwood trees in portions of these burns near the Taylor Highway and forest roads are currently being planned to help maintain early seral conditions beneficial to moose in areas accessible to hunters.

C. *Prey Harvest Strategy:*

1. Prey Harvest.

There is currently a registration and a general harvest hunt, open to residents and non-residents, and a winter draw hunt (10 permits) open to residents only, in Unit 20E.

In addition, if the moose population continues to increase and exceeds 1.4 moose/sq mile in the TCSA for 2 consecutive surveys, antlerless moose permits will be issued to maintain the moose population between 1.0–1.4 moose/ mi^2 and maintain the bull:cow ratio within objectives, within the TCSA. Issuing larger numbers of antlerless permits in a single year to achieve desired population reductions is undesirable to the public. Therefore, the number of antlerless permits will be limited to the number needed to achieve desired reductions over multiple years. Antlerless moose permits can be issued under Unit 20E antlerless moose regulations adopted by the BOG in spring of 2022.

2. Prey Nutritional Index.

Twinning rates are an important indicator of nutritional status in moose. Twinning (rates?) will be monitored within the PCA and 3-year average twinning rates will be used in the decision-making framework. Additional information available on nutrition such as calf weights, age of first reproduction, and age-specific pregnancy will also be considered if this data is collected in the future.

V. PUBLIC INVOLVEMENT

A. *Continued Outreach by Department:*

The department will accomplish outreach through the state fish and game advisory committee and board processes. Local advisory committees have been actively involved in moose management in Unit 20E and serve as good platforms for public education. Input from all committees will be encouraged.

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

The department will continue to engage the advisory committees, board and ADF&G staff to evaluate the success of this program.

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

The public will be allowed to participate in aerial wolf control through permits issued by the department.

Local hunters and trappers will be encouraged to continue harvesting wolves through the current seasons and bag limits.

D. *Monitoring and Mitigation of Hunting Conflict:*

Advisory committee and board processes will be used to monitor and mitigate user conflict. Communication between committees and other stakeholders will be encouraged.

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APPENDIX A. Summary of supporting information for Unit 20E.

Geographic Area and Land Status	
Management area(s)	Prey abundance assessment – annual surveys in Taylor Corridor Moose Survey Area (2,241 mi^2, Figure 5), every 3-years in combined Tok West, Taylor Corridor and Tok Central moose survey area (5,050 mi^2, Figure 10) Prey harvest assessment (4,839 mi^2), reported harvest in UCUs – 20EY000501, 20EY000601, 20EY000701, 20EY000801, 20EY000901, 20EY000902, 20EY000903, 20RY000904 – see Figure 11 Predator abundance – population of wolves (26,292 mi^2 - including Units 12 (9,975 mi^2), 20D (5,637 mi^2) and 20E (10,680 mi^2)), southern Unit 20E wolf survey area to estimate wolf removal rate within the PCA (5,125 mi^2) Predator control area (4,704 mi^2) – see Figure 1
Land status	The majority (52%) of proposed IM area is state land, 32% is federal (BLM) lands and 16% is private lands (Doyon Limited) – see Figure 12
Biological and Management Situation	
Prey population	Unit 20E IM population objective: 8,000–10,000 moose Unit 20E estimate in 2023: 4,724 moose (likely range 4,035–5,413)
Prey harvest (human use)	Unit 20E IM harvest objectives: 250–500 Reported moose harvest in Unit 20E, during RY20–RY24, averaged 170 (range 152–192) Unit 20E amount necessary for subsistence 50–75
Feasibility of access for harvest	Access is good and highly variable via extensive ATV/OHV trails off the Taylor Highway, roads, rivers and creeks, landing strips and float ponds.
Nutritional condition	3-year (2022–2024) weighted average twinning rate was 38% (90% CI ± 6%)
Habitat status and enhancement potential	Browse biomass removal 29% (95% CI 25–32%) in 2022. Twinning rates are high, and the department is currently developing several prescribed fire burn plans for portions of southern Unit 20E with the goal of maintaining early seral stage forests particularly as the large area that burned in 2004 matures. In addition, mechanical crushing of willows and maturing hardwood trees in portions of these burns near the Taylor Highway and

	forest roads are currently being planned to help maintain early seral conditions beneficial to moose in areas accessible to hunters.
Predator(s) abundance	PCA estimated in 2023: Wolves 109 – 110: Black bears 450–650, Grizzly bears 132–165
Predator(s) harvest	Reported harvest in the PCA RY23: Grizzly bear 10, Black bear 30, Wolves 35

Evidence of predation effects	Composition data from moose surveys in the TCSA from 2014–2019 (no survey in 2016), coincident with years of reduced wolf numbers from wolf control activities under the UYTPCP, averaged 24 calves:100 cows using the mid-point estimate during those years. During 2020–2024, following recovery of the wolf population to pre-control levels starting in 2020, the average ratio was 15 calves:100 cows using the mid-point estimate during those years. Although fall calf:cow ratios are not a direct measure of annual recruitment rates, they can be used as an index to help assess predation rates of calves through 5–6 months of age and rate of recruitment in moose populations. Calf survival of calves associated with collared cows in the PCA was monitored during 2014–2015 and 2015–2016, coincident with years of reduced wolf numbers from wolf control activities under the UYTPCP, and averaged 40% (range 26–53%). During 2020–2021 through 2022–2023, following recovery of the wolf population to pre-control levels starting in 2020, calf survival rates of calves associated with collared cows in the PCA averaged 14% (range 5–27%). Although these results appear to show a difference in calf survival between these two period, deep snow conditions during winters 2021–2022 and 2022–2023 likely contributed to increased calf mortality during these winters. Therefore, it's difficult to determine to what degree the change in calf survival may have been attributed to increased wolf predation verse deep snow conditions.
Feasibility of predation control	Based on observed increases in moose density in the combined Taylor Corridor and Tok West Moose Survey Areas (3,519 mi^2 in southern Unit 20E) during 2004 –2018, concurrent with wolf control activities under the Upper Yukon Tanana Predator Control Program and large-scale fires in this area, it is assessed that the combination of wolf control and ongoing habitat enhancement efforts, within the proposed IM area, has a high likelihood of resulting in a moderate increase in the moose population within the combined Taylor Corridor and Tok West Moose Survey Area (3,519 mi^2), that will be adequate to meet the population objectives under the proposed IM program and help make progress towards achieving the Unit 20E IM harvest objective.
Other mortality	Deep snow winters

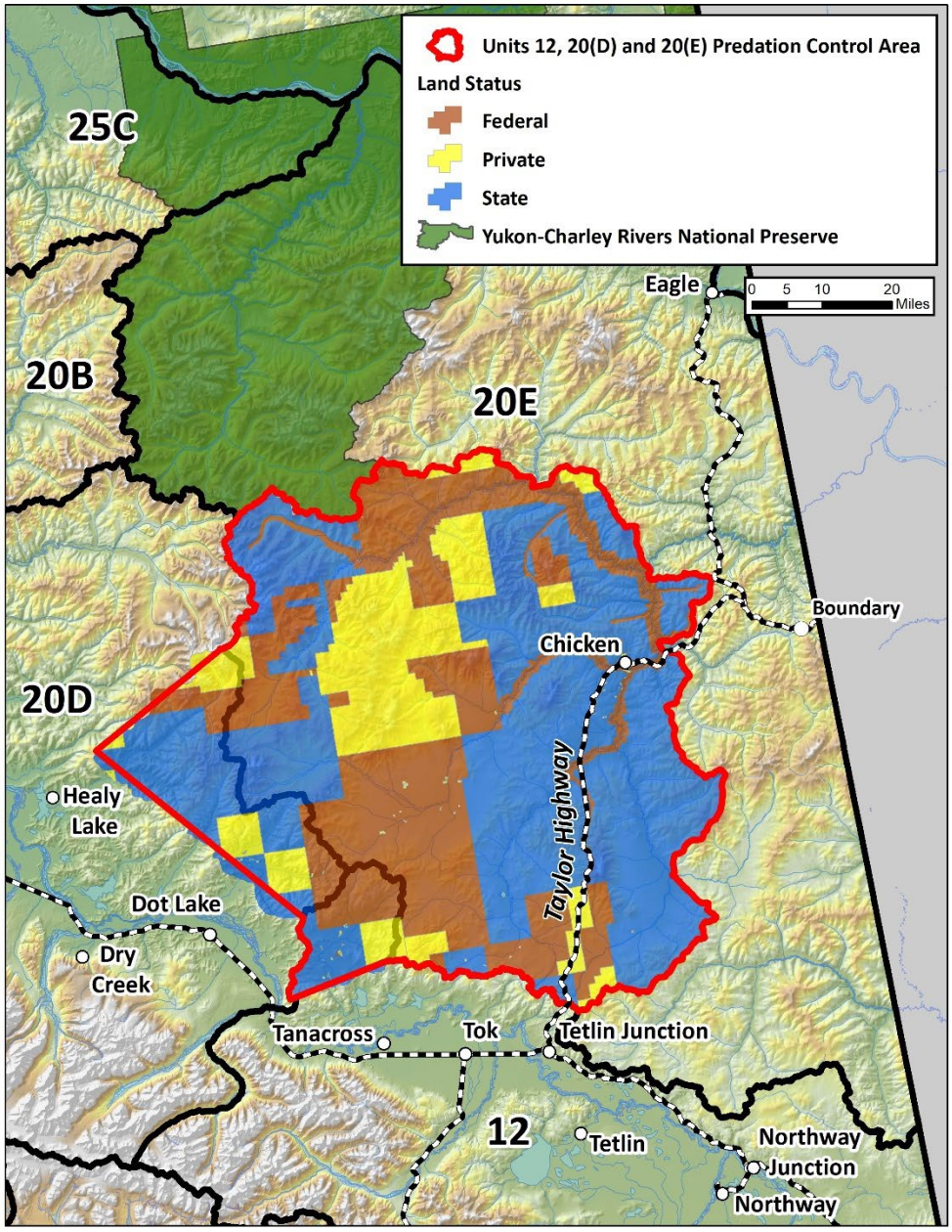


Figure 12. Landownership within PCA.