OPERATIONAL PLAN FOR INTENSIVE MANAGEMENT OF MOOSE IN UNIT 19D EAST DURING REGULATORY YEARS 2014–2019

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 moose in Unit 19D East during regulatory years (RY) 2014–2019 (RY = 1 July–30 June, e.g., RY14 = 1 July 2014–30 June 2015). The IM plan for moose in Unit 19D East is found in Title 5, Alaska Administrative Code, Section 92, Part 123 (abbreviated as 5 AAC 92.123). 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 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 systems to produce and sustain elevated harvests of caribou, deer, or moose in selected areas of Alaska. The IM plan for moose in GMU 19(D) East has been developed based on the recommendation of the McGrath Fish and Game Advisory Committee (McGrath AC) and at the request of the Alaska Board of Game (BOG).

BACKGROUND

To remedy low moose numbers and harvests, the Alaska Board of Game (Board), adopted a wolf predation control plan in Unit 19D East (8,513 mi^2) beginning in the fall of 1995. Public wolf predation control began in RY03. The Board updated and/or reauthorized the plan in January 2000, March 2001, March 2003, January 2006, May 2006, and March 2009.

Board action in May 2006 included adding black and brown bear predation control in a 528 mi^2 area surrounding the village of McGrath that was designated as the Experimental Micromanagement Area (EMMA) to authorize bear control and recognize the experimental nature of the program.

Board action in March 2009 included several notable actions. The plan was reauthorized for July 1 2009–June 30 2014. The EMMA was renamed the Black and Brown Bear Control Area, and the area where wolf control was conducted was identified as a Wolf Control Focus Area (WCFA, 4,484 mi^2). The goal was to identify that bear and wolf control activities were focused into a geographic area smaller than Unit 19D East. An Upper Kuskokwim Villages Moose Management Area (MMA, 1,118 mi^2) was established surrounding McGrath and adjacent to Takotna and Medfra. It designated an area where moose numbers were closely monitored and objectives for moose and moose harvest were applied (Fig. 1). The department had the authority to change the size and shape of the WCFA, the MMA, and the BCFA (Seavoy 2012).

Current IM objectives for all of Unit 19D East are for a moose population of 6,000–8,000 and an annual harvest of 400–600. These objectives have not been achieved.

Two changes in area designations are made in this operational plan. The Black and Brown Bear Control Area is renamed the Bear Control Focus Area (BCFA) to standardize nomenclature in Region III. Designation of the MMA is deleted in this operational plan and regulation because it added unnecessary complication and moose harvest proved difficult to quantify within it. However, we will retain the boundaries as a 1,118 mi^2 subset of our survey area for moose and for research purposes.

Moose numbers were estimated within the MMA and BCFA using GSPE techniques (Kellie and Delong, 2006). They roughly doubled in the MMA between 2001 and 2009, and bull:cow and calf:cow ratios generally improved in response to the application of predator control (Keech, et. al. 2011) (Table 1A). They peaked in the BCFA in 2007 (Table 1B) and have been lower since.

Predation control included aerial wolf removal by public permittees using airplanes and was conducted annually during November 1 – April 30, except during January 2006, when a lawsuit prompted a brief closure. Wolf control areas varied in size including: 3,210 mi^2 (RY03–RY05); 6,245 mi^2 (RY06–RY08); and 4,484 mi^2 (RY09–RY13) (Fig. 2). The department conducted nonlethal black and brown bear control within the BCFA during May 2003 and 2004 using ADF&G commissioner's authority. We reduced black bear numbers by 96% and brown bear numbers by 50% by translocating them to other locations in Interior Alaska (Keech, et. al. 2011). Lethal bear control conducted by public permittees under authority of Board passed regulations has been in place within the BCFA since RY09, but has not been effective in reducing bear numbers or preventing recovery from department nonlethal control.

In Unit 19D East, Keech, et. al. (2011) "demonstrated in a 3-predator, 1-large prey system, substantial predator treatments within a small area was an effective way to increase moose survival and population size." Subsequent to predator removals, harvest increased and he stated that "…managers and policymakers may expect similar results from predator treatment programs elsewhere, but use less costly and less thorough study designs" (Keech 2012). Rationale for this IM Operational Plan is based on that research.

Harvest is recorded by the department using a system of uniform coding units (UCUs) that delineate areas based on drainage boundaries and other geographic features. The UCUs in Unit 19D East average about 266 mi^2 and generally provide a useful tool for assigning harvest to smaller areas within game management units. Our moose harvest objective for the MMA was 100 moose, however, the MMA does not follow UCU boundaries so harvest from this area must be interpreted using UCUs, description of harvest location on hunt reports, and personal knowledge. This is a weakness of the MMA and therefore, it is deleted from this operational plan.

The best current approximation for harvest from within the MMA comes from the registration permit hunt RM650. The hunt area for this permit has changed through time (Seavoy 2012) but most of the harvest from this hunt was from within the MMA. General hunts (non-permit) are also held in Unit 19D and hunt boundaries overlap. During RY01–RY05, the average RM650 harvest was 75 moose and, during RY08–RY12, it had risen to 103 (Table 2).
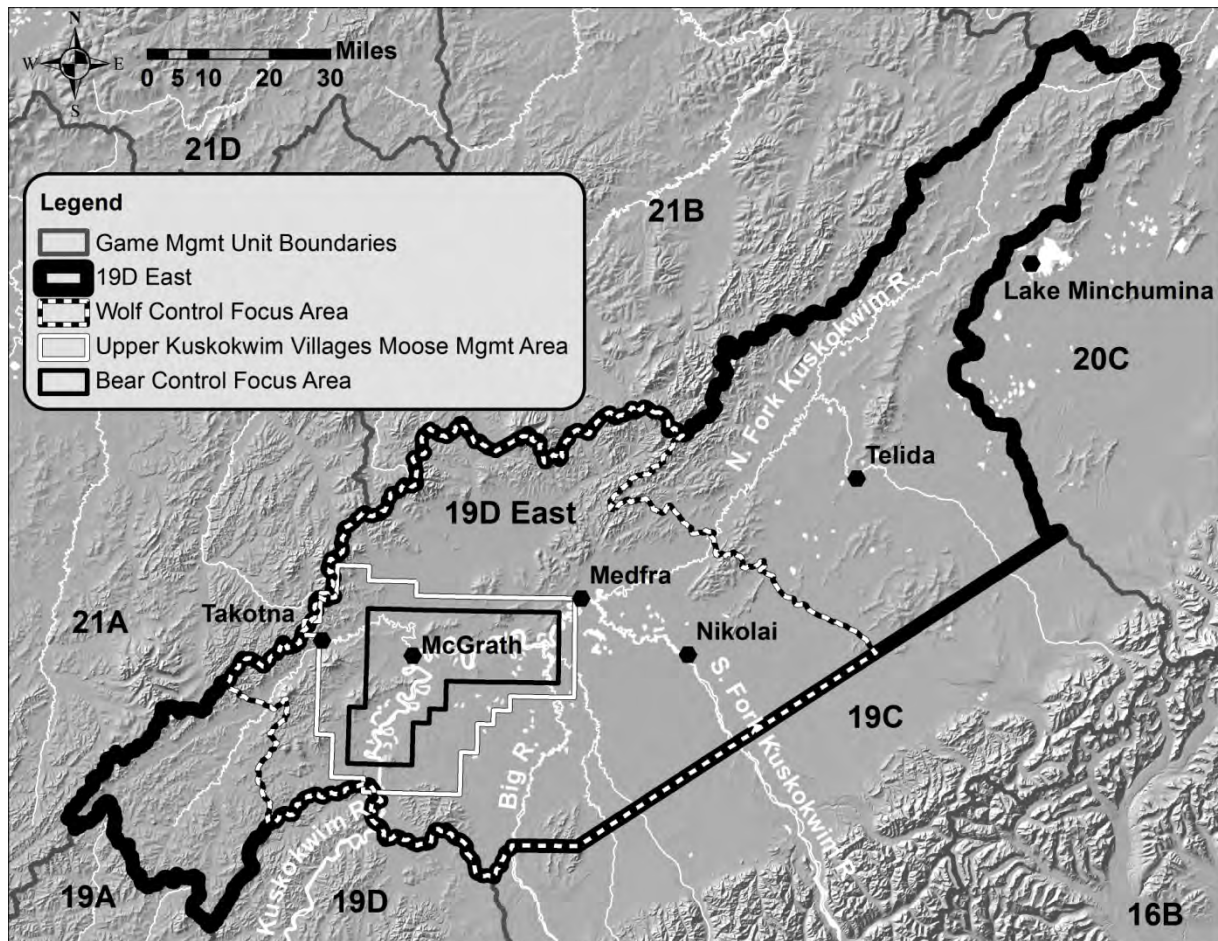
FIGURE 1. RY13 predation control area management boundaries including Unit 19D East (since RY95; 8,513 mi^2), Wolf Control Focus Area (WCFA; since RY09; 4,484 mi^2), Upper Kuskokwim Villages Moose Management Area (MMA; RY10–RY13; 1,118 mi^2), and the Bear Control Focus Area (BCFA; RY01–RY08 as EMMA, RY09–RY13 as Black and Brown Bear Predation Control Area; 528 mi^2).
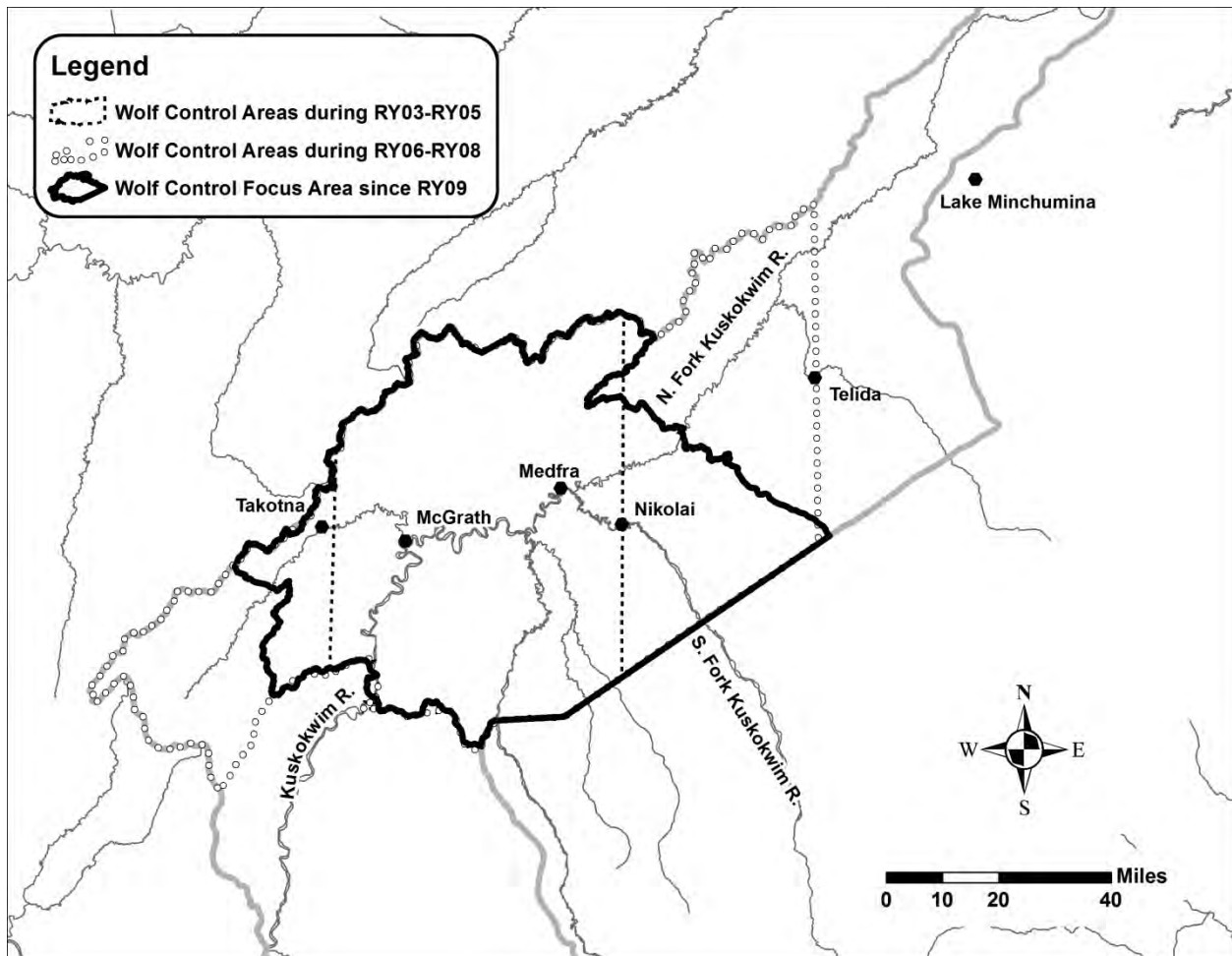
FIGURE 2. Unit 19D East wolf control areas in effect during RY03–RY05 (3,210 mi^2), RY06–RY08 (6,245 mi^2), and Wolf Control Focus Area since RY09 (WCFA 4,484 mi^2).

TABLE 1A. Results of the 2001, 2004, and 2006–2012 GSPE moose surveys in the MMA (1,118 mi^2).

Year	Number of moose observed	Estimates of observable moose (90% CI)	SCF ($n_{observed}$, $n_{available}$)	Estimate with SCF applied (90% CI)	Calves: 100 cows (90% CI)	Bulls:100 cows (90% CI)	Yearling bulls:100 cows (90% CI)	Total moose/mi^2
2001	455	727 (±89)	1.19 (32, 38)	868 (±147)	36 (±10)	21 (±6)	8 (±3)	0.8
2004	578	940 (±107)	1.27	1192 (±228)	66 (±18)	18 (±6)	8 (±4)	1.1
2006	762	1117 (±102)	1.17 (42, 49)	1308 (±174)	55 (±10)	30 (±8)	12 (±3)	1.2
2007	844	1290 (±131)	1.33 (31, 41)	1720 (±306)	53 (±14)	36 (±10)	15 (±4)	1.5
2008	678	1356 (±116)	1.27 (16, 20)	1718 (±352)	44 (±12)	40 (±11)	14 (±5)	1.5
2009	711	1435 (±127)	1.27	1820 (±323)	38 (±10)	40 (±11)	11 (±4)	1.6
2010	712	1416 (±114)	1.27	1796 (±312)	43 (±11)	49 (±13)	16 (±5)	1.6
2011	639	1298 (±121)	1.27	1647 (±296)	42 (±11)	33 (±10)	10 (±3)	1.5
2012	650	1036 (±91)	1.29 (23, 30)	1337 (±199)	35 (±11)	38 (±5)	7 (±2)	1.2

TABLE 1B. Results of the 2001, 2003–2012 GSPE moose surveys in the Bear Control Focus Area (BCFA) (528 mi^2).

Year	Number of moose observed	Estimates of observable moose (90% CI)	SCF ($n_{observed}$, $n_{available}$)	Estimate with SCF applied (90% CI)	Calves: 100 cows (90% CI)	Bulls:100 cows (90% CI)	Yearling bulls:100 cows (90% CI)	Total moose/mi^2
2001	440	440 (±0)	1.19 (32,38)	525 (±61)	34 (±6)	18 (±3)	8 (±1)	1.0
2003	237	424 (±79)	1.35 (21,28)	573[a](±138)	56 (±20)	18 (±8)	5 (±3)	1.1
2004	531	531 (±0)	1.27	674 (±104)	63 (±14)	13 (±3)	6 (±1)	1.3
2005	479	479 (±0)	1.30 (38,49)	621 (±79)	51 (±9)	18 (±3)	9 (±2)	1.2
2006	591	591 (±0)	1.17 (42,49)	692 (±67)	58 (±8)	25 (±3)	14 (±2)	1.3
2007	662	662 (±0)	1.33 (31,41)	883 (±129)	56 (±12)	39 (±8)	16 (±3)	1.7
2008	296	599 (±103)	1.27 (16,20)	758 (±191)	43 (±14)	33 (±12)	14 (±7)	1.4
2009	331	654 (±93)	1.27	830 (±174)	44 (±14)	31 (±11)	7 (±3)	1.6
2010	311	625 (±74)	1.27	793 (±154)	43 (±13)	38 (±13)	15 (±5)	1.5
2011	335	658 (±90)	1.27	835 (±172)	49 (±14)	31 (±14)	12 (±5)	1.6
2012	308	474 (±48)	1.29 (23,30)	612 (±117)	47 (±7)	28 (±7)	6 12 (±3)	1.2

[a] All SUs were sampled during 2001 and 2004-2007, thus counts of observable moose have no variance or CIs.

TABLE 2. RM650 and Unit 19D moose harvest regulatory years 2001–2002 through 2012–2013.

Regulatory Year	RM650	Unit 19D
2001	73	94
2002	98	115
2003	75	91
2004	60	77
2005	71	95
2006	62	83
2007	86	114
2008	103	122
2009	92	119
2010	107	126
2011	128	148
2012	103	119

Data collection and analyses detailed in this IM plan will be coordinated with ongoing (July 1, 2012–June 30, 2017) ADF&G predator-prey research in Unit 19D East (Federal Aid Research Project Statement, No. 1.73). Research objectives include:

- Monitor moose population dynamics in the MMA

- Determine annual survival rates and primary causes of mortality of moose calves

- Determine condition, survival rates, and causes of mortality of yearling moose

- Determine twinning rates of moose in the MMA

- Characterize winter moose browse in the MMA

- Estimate wolf numbers in the MMA

- Estimate black bear numbers and harvest rates in the BCFA

- Analyze suspected predator hair and tissue samples for species and sex identification

ADAPTIVE MANAGEMENT FRAMEWORK

Adaptive management is designing programs to maximize what can be learned from field experiments 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:*

Unit 19D East (8,513 mi^2) defines the population of wolves. The precontrol population was estimated in February 2001 through a minimum count wolf survey (Gardner and Pamperin, in press) at 198 wolves. Our control objective is to temporarily reduce wolves to no fewer than 40 in Unit 19D East to assure the long term persistence of the population. Wolf control will be conducted by annually issuing pilot and gunner permits to the public using airplanes as shooting platforms during November through April. Department control will also be conducted if public permittees are unable to achieve the control objective.

The WCFA (4,484 mi^2) defines where aerial wolf control will be conducted. This area was selected because it follows UCU boundaries, and a 2006 wolf survey identified at least 40 wolves beyond the WCFA and within Unit 19D East. By not conducting wolf control outside the WCFA, we can reduce wolves within this area, and still be reasonably sure that at least 40 will persist in Unit 19D East as a whole. Our objective for wolf control within the WCFA is to temporarily reduce wolf numbers to the lowest level possible with a minimum successful reduction to fewer than 27 from the precontrol estimate of 68 (at least 60% reduction).

The BCFA (528 mi^2) defines where bear control will be conducted. It will be done by department staff using airplanes to locate bears and a helicopter as a shooting platform. Bear control objectives will be to temporarily reduce black and brown bear numbers to the lowest level possible. Because the area is small relative to Unit 19D East, the effect on the overall bear populations in the unit is insignificant. Meat and hides will be salvaged. Meat and small hides ($\leq$ 5 ft squared) will be distributed in Unit 19 communities. Large hides were taken to Fairbanks for sale at a state auction.

Presently known alternatives to predator control for reducing the number of predators are ineffective, impractical, or uneconomical in the Unit 19D East 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 and bears is impractical because it is expensive, and it is very difficult to find publicly acceptable places for the relocated animals. Habitat manipulation is ineffective because low density means competition for food is low and nutritional condition is likely high; it is poor survival, not poor birth rate that keeps moose populations low in Unit 19D. Also, stocking of moose is impractical because of capturing and moving expenses and risk of disease transmission.

B. *Habitat Enhancement:*

No habitat enhancement projects will be conducted. We expect flooding and natural fires to occur frequently enough that active habitat enhancement is not necessary. We will work with wildland fire managers to encourage them to allow wildfire where there are few conflicts with other land uses.

Based on available data, habitat does not appear to be a factor limiting abundance of moose in the WCFA. Although a 2008–09 survey of browse utilization found a relatively high browse removal rate of 40.5% in Unit 19(D), (Paragi, T.F., and K.A.K. Seaton. in prep.), the most recent twinning surveys (Seavoy 2010) conducted in 2012 and 2013 found a 2-year average twinning rate of 28% within the BCFA.

C. *Prey Harvest:*

Moose harvest will be designed to remain within sustainable yield, limited to bulls only when the objective is population growth. Antlerless harvest may be warranted to slow, stop, or reverse population growth.

Twinning rates are a sensitive indicator of moose nutritional status (Boertje et al 2009) and will be carefully monitored within the BCFA. If the 2-year average twinning rate is >20% we will continue to promote growth. At a rate of 15–20% the number will be stabilized through harvest. If the 2-year average twinning rate is <15% number of moose will be reduced through harvest. Predator control will be suspended if harvest alone is insufficient to reduce moose numbers.

The moose season most in demand is a fall season for bull moose, generally accessed by boat. The area most in demand for this season includes the major rivers near McGrath, Takotna, and Nikolai within the Upper Kuskokwim Controlled Use Area (UKCUA; 739 mi^2; Fig. 3). This area is prone to harvest sufficient to depress bull:cow ratios as seen in 2001–2004 (Tables 1a and 1b). Also, complaints of crowding suggest that success rates could be depressed as overcrowding disturbs moose sufficiently that they move beyond reach of boat-borne hunters. A registration permit hunt with permits distributed prior to the season within the hunt area is currently in place. About 300 permits are issued annually. Additional hunting pressure within this area may require a higher density of moose and perhaps a different season structure to distribute hunters in space and time, depending on hunter preferences and user conflicts.

Meanwhile, an underutilized harvestable surplus beyond the UKCUA may develop and additional hunts or longer seasons may be desired in this area. Currently, a general hunt exists within about 94% of Unit 19D outside the UKCUA, but few moose are taken from the more difficult to access areas. Utilizing moose in these areas may require winter hunts and attempts to utilize these additional animals should be a primary focus of harvest strategies as moose numbers increase.
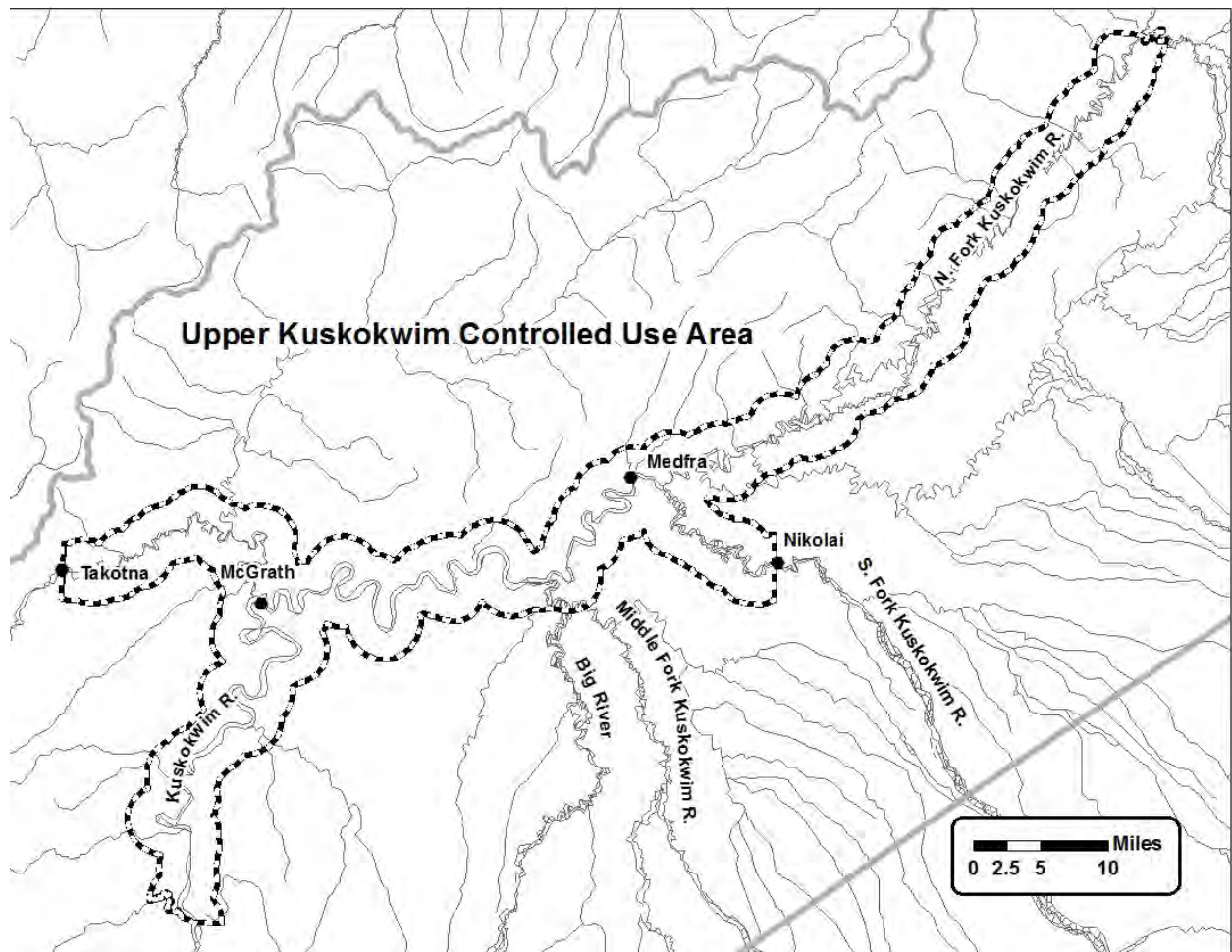
FIGURE 3. Upper Kuskokwim Controlled Use Area (UKCUA; 739 mi^2).

II. ANTICIPATED RESPONSES TO TREATMENTS

In Unit 19D East, Keech, et. al. (2011) "demonstrated in a 3-predator, 1-large prey system, substantial predator treatments within a small area was an effective way to increase moose survival and population size." We anticipate similar results as we continue wolf and bear control in the same area.

A. *Predator Abundance:*

In March 2006, a minimum count wolf survey provided the basis for a Fall 2005 estimate of 91 wolves in 20 packs in Unit 19D East, including 48–52 wolves outside the WCFA. Subsequent surveys did not include all of Unit 19D East.

In April 2013, we estimated 20 wolves within the WCFA using interviews with wolf control permittees, and 48–52 wolves outside the WCFA (based on the March 2006 survey) for a

total of 68–72 within Unit 19(D) East. This is approximately 0.82 wolves/ 100 mi^2. With 48–52 wolves outside the WCFA we are assured the minimum 40 wolves remain in Unit 19D East even after reducing wolves to the lowest level possible in the WCFA. Based on wolf behavior and reproductive success, it is anticipated wolf numbers would recover to pre-control levels in 3–5 years in the WCFA if wolf control were suspended (National Research Council 1997:52-53).

Based on the nonlethal bear removal program conducted in spring 2003 and 2004, the extrapolated estimate of the black bear population within Unit 19D East before the bear removal program was approximately 1,700 bears, including approximately 130 (96 independent bears; i.e. not including cubs) within the BCFA. Based upon the same removal program and extrapolations, the brown bear population within Unit 19D East before the bear removal program, was approximately 128 bears, including approximately 9 within the BCFA.

After nonlethal black bear removal within the BCFA, the number of independent bears was reduced to 4 in 2004, and had recovered to 70 by 2007 and 123 by 2010 (Keech 2012). This recovery occurred partially during years when public bear control using bucket mounted foot snares was active (RY09–RY13) in the BCFA. This indicates that removing a large percentage of black bears from a small area results is a temporary reduction in bear numbers. Subsequent removals by the department are expected to provide similar results. In addition, because the BCFA is a relatively small geographic area, removing black bears from within it will have only a minor effect on the overall population in Unit 19D East.

Six of the estimated 9 brown bears in the BCFA were removed during the nonlethal program. Recovery was not monitored because of the few brown bears present. However, because the BCFA is a small geographic area, removal will have only a minor effect on the overall population in Unit 19D East.

B. *Predation Rate:*

The predation rate on moose in Unit 19D East was substantially reduced after combined bear and wolf control (Keech et al 2011). During 2001 and 2002 black bears, brown bears and wolves killed 87 of 132 (66%) radiocollared moose calves. After predator control, during 2003 through 2010, these predators killed 112 of 309 (36%) radiocollared moose calves (Keech 2012). We anticipate a similar rate reduction with continued wolf and bear control. We will monitor summer calf survival in the area by annual spring twinning and fall composition surveys well as less frequent density estimates in the BCFA and WCFA.

C. *Prey Abundance:*

Moose abundance within the WCFA was estimated at 0.7 moose/mi^2 (3,025 Moose) in 2012, based upon GeoSpatial Population Estimator (GSPE) surveys (Kellie and DeLong 2006) in the MMA (1.2 moose/mi^2; 2012) and in a 4,195 mi^2 outside the MMA (0.5 moose/mi^2; 2008). Based on the case history of bear and wolf control in the plan area (Keech et al. 2011), we expect moose abundance to increase in the WCFA, but predominantly within and

adjacent to the BCFA. The expected increases in abundance will be utilized and regulated in accordance with principles in part E and F.

D. *Prey Recruitment:*

Moose annual survival was substantially increased after combined bear and wolf control (Keech et al 2011). Moose calf annual survival increased from an average of 30% in the two years prior to predator removals to 45% during 2003–2010 following predator treatments (Keech, 2012). However, deep snow ($\geq$ 31 in), as happened during winter 2004–05 (snow depth measured in April 2005), may lower recruitment (Fig. 4).

FIGURE 4 Snow depth April 1, 1980–2013, McGrath, Alaska. Line at 31in (80 cm) indicates snow depth that may reduce moose calf survival (Coady 1974) regardless of predator control (Keech et al. 2011).
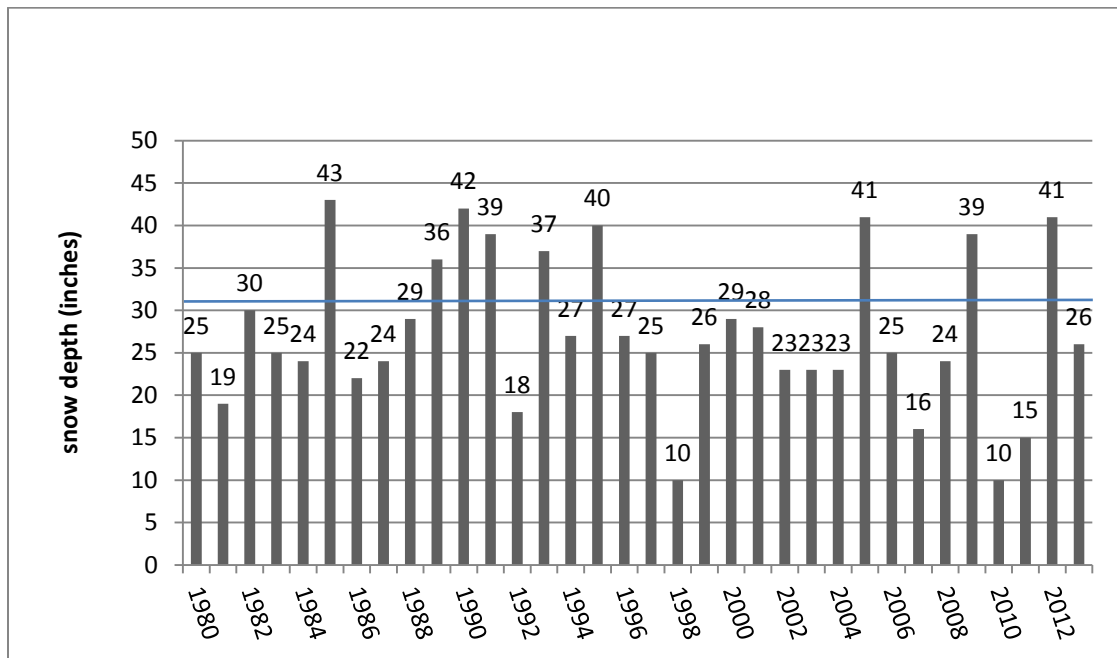
E. *Prey Productivity or Nutritional Condition:*

Twinning rates will be monitored within the BCFA. If the 2-year average twinning rate is >20% we will continue to promote growth. When 2-year average twinning rate is 15–20% moose density will be stabilized through harvest. If 2-year average twinning rate is <15% moose density will be reduced through harvest. Predator control will be suspended if harvest alone is insufficient to reduce abundance.

F. *Harvest:*

Harvest is accomplished using a combination of general hunts and a registration permit hunt (described above in section I.C). Continuation of predation control will likely allow continuation of the current seasons and bag limits. It might also prompt an increase in moose numbers that would allow additional harvest. This scenario is most likely in the more lightly hunted portions of Unit 19D East outside the UKCUA. Additional hunt opportunity will most likely occur through cow hunts by registration permit, longer seasons under the general hunt, and/or winter seasons.

G. *Use of Nontreatment Comparisons:*

A similar adjacent nontreatment area is not available and no direct comparisons will be made. However, results of routine surveys in the western portion of Unit 19A and research planned in Unit 19 D East will provide useful moose population size, trend, composition and mortality data for comparisons to help evaluate treatment.

H. *Other Mortality Factors:*

Deep snow years in excess of 31" (Keech 2012) were shown to be a significant factor in moose calf survival in the Unit 19D East. Three of these years have occurred since predation control began in RY03 and more are expected (Fig. 4).

III. EVALUATION CRITERIA AND STUDY DESIGN TO DOCUMENT TREATMENT RESPONSE

Adaptive management with the intent to increase harvestable surplus of prey requires evaluating the biological response and achievable harvest after treatments are implemented. Evaluation will be reported to Board annually at their February meetings, with an interim update of selected criteria in August of each year.

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

The pre-control wolf population of 198 wolves or 23 wolves/1000 mi^2 was estimated in February 2001 based on a minimum count reconnaissance style wolf survey within 5,000 mi^2 of Unit 19D East (Stephenson 1978; Gardner and Pamperin, in press); reported harvest; and extrapolation to the unsurveyed portions of Unit 19D East. This estimate forms the basis for the requirement that 40 wolves remain post control (an 80% reduction).

In March 2006, a minimum count wolf survey provided the basis for a fall 2005 estimate of 91 wolves in 20 packs in Unit 19D East, including 48–52 wolves outside the WCFA. With 48–52 wolves outside the WCFA we are assured the minimum 40 wolves remain in Unit 19(D) East even after reducing wolves to the lowest level possible in the WCFA.

Wolf numbers within the WCFA are estimated annually using pilot interviews, harvest, and control data. In spring 2013, the post-control estimate was 20 wolves. Based on immigration and reproductive success, it is anticipated numbers will recover to pre-control levels in 3-5 years in the WCFA if control is suspended.

We will conduct aerial wolf surveys in the WCFA or portions of it in late winter 2014 and 2017. Data from these surveys will be used to estimate wolf numbers/density.

Pre-control black bear numbers were estimated at 96 independent bears using a removal estimator during bear removals in 2003. Immediate post-removal bear numbers were estimated at 4 independent bears in 2004. Subsequent black bear estimates of 70 in 2007 and 123 independent bears in 2010 were conducted using mark-recapture methods. Bears recovered to within 73% of pre-control levels 3 years post bear control and were fully recovered 6 years post bear control (Keech et al 2012). It is anticipated that recovery from future bear reductions would be similar.

We will use mark-recapture techniques to estimate the number of black bears during spring 2014 and 2016 in the BCFA.

B. *Habitat and Forage Condition:*

Baseline browse surveys were conducted in March 2001 and 2003 (Paragi et al 2008) and after the moose population had increased following predator control (2009; Paragi and Seaton, in prep.). Browse removal is a measure of competition for food by moose that is inversely correlated to nutritional condition (Seaton et al. 2011). Additional browse surveys are planned for spring 2015 and 2017.

C. *Prey Abundance, Herd Composition, and Nutritional Condition:*

The abundance objective with the BCFA is 2.0 moose/mi^2 (approximately 1,100 moose). Achieving it will contribute to achieving our IM population objective of 6,000–8,000 moose in all of Unit 19D East.

We will evaluate whether continued aerial wolf control by the public each winter and aerial bear control by the department can achieve the BCFA moose density objective and also promote overall growth in the surrounding WCFA. Density is expected to be unequal across the WCFA because of variations in habitat quality and focused management of bear predation in the BCFA. We will continue to assess moose abundance in the BCFA as the primary response metric and in the WCFA with GSPE surveys conducted in fall. We intend to estimate a sightability correction factor (SCF) with each GSPE using radio-marked moose (Gasaway et al. 1986) or other appropriate techniques. We will design a survey that includes a high proportion of sample units in the BCFA, but also includes sampling of GSPE cells in the WCFA. We will survey the BCFA and WCFA during fall 2014 and 2016. Additional surveys may be conducted depending upon other area priorities and funding.

We will assess composition data annually in November within the BCFA using methods described by Seavoy (2010). We expect an increase in the ratio of calf moose to adult females in the BCFA where there will be bear and wolf control combined. These surveys will also be used to assess bull to cow ratios.

The nutritional condition of moose will be primarily monitored through twinning rates using radio-collared and non-collared females observed annually during late May surveys (Seavoy 2010). The twinning rate will be calculated as the proportion of cows with twins or triplets from the sample of all cows with calves.

D. *Prey Harvest:*

The moose harvest objective within the WCFA is 180. Achieving it will contribute to achieving our IM harvest objective of 400–600 moose in all of Unit 19A. Harvest will be assessed using hunter reports.

IV. DECISION FRAMEWORK TO IMPLEMENT OR SUSPEND A TREATMENT

A. *Predation Control:*

1. Prey Abundance.

The decision making framework to initiate or suspend predator control will be based upon estimates of density and twinning rate within the BCFA.

The density objective for the BCFA is 2.0 moose/mi^2 (1,100 moose). If a moose GSPE point estimate is higher than the objective, wolf control may be suspended after considering other biological factors such as twinning rates. Wolf control may continue, or be initiated if it has been suspended, if the GSPE point estimate is below the density objective and twinning rates are >20%. This ensures that moose density is appropriate for the amount of food available on the range.

To remain proactive and ensure densities do not fall too low, a 1 to 2 year department conducted bear control effort may be conducted if a GSPE point estimate in the BCFA indicates the density is <1.2 moose/mile^2 and the 2-year average twinning rate is >20%. All GSPE surveys will be designed to achieve precision of at least $\pm$ 20% at the 90% confidence interval, but actual precision will vary with survey conditions and funding.

Twinning rates are an important indicator of moose nutritional status. If the 2-year average twinning rate is >20% we will continue to promote growth. When 2-year average twinning rate is 15–20% moose density will be stabilized through harvest. If 2-year average twinning rate is <15% moose density will be reduced through harvest. Predator control will be suspended if harvest alone is insufficient to reduce abundance.

2. 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 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:*

We will not be using any habitat indices to initiate enhancement activities during this program period.

C. *Prey Harvest Strategy:*

1. Prey harvest.

There are currently 2 resident moose hunts and no nonresident hunts within Unit 19D East. Both resident hunts require reporting harvest success. They include a general hunt 1 Sept–20 Sept in Unit 19D, except within the UKCUA, and a registration permit hunt 1 Sept–25 Sept throughout Unit 19D.

2. Prey Nutritional Index.

Twinning rates are an important indicator of nutritional status in moose. We will monitor twinning within the BCFA and use 2-year average twinning rates in our decision making framework as described above. We will also consider any additional information available on nutrition such as calf weights, age of first reproduction, and age-specific pregnancy.

V. PUBLIC INVOLVEMENT

A. *Continued Outreach by Department:*

We will accomplish outreach through the state fish and game advisory committee and BOG processes. The McGrath Advisory Committee is productively engaged with us during meetings, and it includes members who regularly communicate with us through visits, volunteering during field projects, phone calls, and participating in educational programs. There is sufficient participation by members of this committee and community interest in its activities, including participation by other agencies, that this platform for public involvement is appropriate. Input for all other advisory committees will also be encouraged.

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

We will continue to engage the McGrath advisory committee, BOG, and ADF&G staff as we apply criteria chosen for evaluating success including achieving and evaluating moose numbers and harvest in the WCFA.

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

The public has participated in aerial wolf control and bear snaring through permits issued by the department, and wolf reductions by the public have been effective. However, if public aerial wolf control cannot meet removal objectives, then the Department may conduct additional wolf removals using a helicopter. Bear snaring by the public has not been effective.

Local hunters and trappers will be encouraged to continue harvest of wolves and bears to help regulate the numbers post-treatment to prolong the effectiveness of predation control. Predator harvest incentive programs initiated and funded by Alaska Native corporations have been in place and are also encouraged.

D. *Monitoring and Mitigation of Hunting Conflict:*

Hunter conflicts have the most potential to occur within the UKCUA and are currently addressed as described earlier. Most of the demand comes from hunters living along the entire length of the Kuskokwim River and diffusing this conflict is best accomplished by increasing moose numbers along the entire length of the river.

VI. OTHER CONSIDERATIONS

As stated, hunter conflicts are best resolved by increasing moose numbers along the entire length of the Kuskokwim. Within Unit 18, moose numbers are increasing within the Kuskokwim River drainage as well as along the Yukon. Both areas provide opportunity for the large number of hunters living there. As that moose population grows, and hunting opportunity along the Kuskokwim in Unit 18 increases, the demand for moose in Unit 19D East by hunters living downriver is likely to decline. This is the most likely and best scenario for mitigating hunter conflicts in Unit 19D East, however, increasing moose numbers in Unit 18 is beyond this plan.

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APPENDIX A. Summary of supporting information.

Geographic Area and Land Status	
Management area(s)	Prey abundance assessment (BCFA; 528 mi^2), prey harvest assessment (WCFA; 4,484 mi^2), predator abundance assessment (WCFA; 4,484 mi^2), predator control focus areas (WCFA; 4,484 mi^2; BCFA; 528 mi^2) – Figure 1
Land status	WCFA is mostly in state or Native corporation ownership.
Biological and Management Situation	
Prey population	IM objectives: 6,000–8,000 moose Estimate in 2012: 5,035 moose
Prey harvest (human use)	IM objectives: 400–600 104 moose reported in RY12 Amount necessary for subsistence: 205–451 in Units 19C and 19D combined. Determined in 2006.
Feasibility of access for harvest	Access for harvest exists readily by boat and snowmachine, and to a lesser extent, by 4 wheeler and highway vehicle. Landowner restrictions are few. Wolf numbers have been successfully reduced since RY03.
Nutritional condition	2-year average twinning rates in BCFA during 2012–2013 was 28%.
Habitat status and enhancement potential	Wildfires and floods regularly reset succession to early seral stages. No enhancement is anticipated.

Predator(s) abundance	Wolf numbers in WCFA in April 2013: 20 based on permittee interviews Bear numbers within the BCFA in 2010: 123 (96 – 162; 95% CI)
Predator(s) harvest	Reported in Unit 19D East in RY12: Wolf take and reported harvest Unit 19D East: 14 Black bear take and reported harvest: 2 (1 from BCFA) Grizzly bear take and reported harvest: 2
Evidence of predation effects	Keech, et. al. (2011) "demonstrated in a 3-predator, 1-large prey system, substantial predator treatments within a small area was an effective way to increase moose survival and population size."
Feasibility of predation control	Subsequent to predator removals, harvest increased. Keech (2012) stated that "…managers and policymakers may expect similar results from predator treatment programs elsewhere, but use less costly and less thorough study designs".
Other mortality	3 winters with 1 April snow depth greater than 36" have occurred since predation control began in RY03 (Figure 3).