OPERATIONAL PLAN FOR INTENSIVE MANAGEMENT OF MOOSE IN GAME MANAGEMENT UNIT 16 DURING REGULATORY YEARS 2015–2017

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 Game Management Unit (Unit) 16 during regulatory years (RY) 2015–2017 (RY = 1 July–30 June, e.g., RY2012 = July 1, 2012–June 30, 2013). The IM plan for moose in Game Management Unit 16 is found in Title 5, Alaska Administrative Code, Section 92, Part 122 (abbreviated as 5 AAC 92.122)[1]. 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 moose in Unit16 has been developed based on the recommendation of Matanuska Valley Fish & Game Advisory Committee and at the request of the Alaska Board of Game (board).

BACKGROUND

The moose population in Unit 16B began to decline after the severe winter of 1989–1990. A series of deep snow winters in the 1990's and an increase in predator populations at the same time exacerbated the population decline and impeded subsequent recruitment of calves into the population. Further decreases in the population were seen after the severe winters of 2000–2001 and 2001–2002.

Moose hunting in the Unit 16B was curtailed in response to the lower moose population with a structured hunting strategy that allowed for at the least a Tier II harvest of moose in the unit when the number of surplus bulls became 199 or less. As a result hunting was limited to Tier II in RY2001 and RY2002 and RY2006 through RY2008.

A wolf control IM plan was first adopted by the board in March 2003 for all non-federal land in Unit 16B excluding a 3 mile buffer around the airports at Beluga, Tyonek, and Skwentna (6,972 mi^2). The commissioner issued public aerial shooting permits or land and shoot permits pursuant to AS 16.05.783. In January 2006, as the result of court actions against the board and the department, the board adopted a revised IM plan as an emergency regulation. The emergency regulation clarified and updated 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, time frame for updates and evaluations, and miscellaneous specifications. In May 2006, the board further modified the emergency regulations and adopted it as a final regulation. In addition the Board increased the size of the control area to include the western portion of Unit 16A for a total of 7,792 mi^2 (Figure 1). Authorization to issue public aerial shooting permits or public land and shoot permits was reaffirmed, and the following Unit 16B predator and prey population estimates and objectives were specified.

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

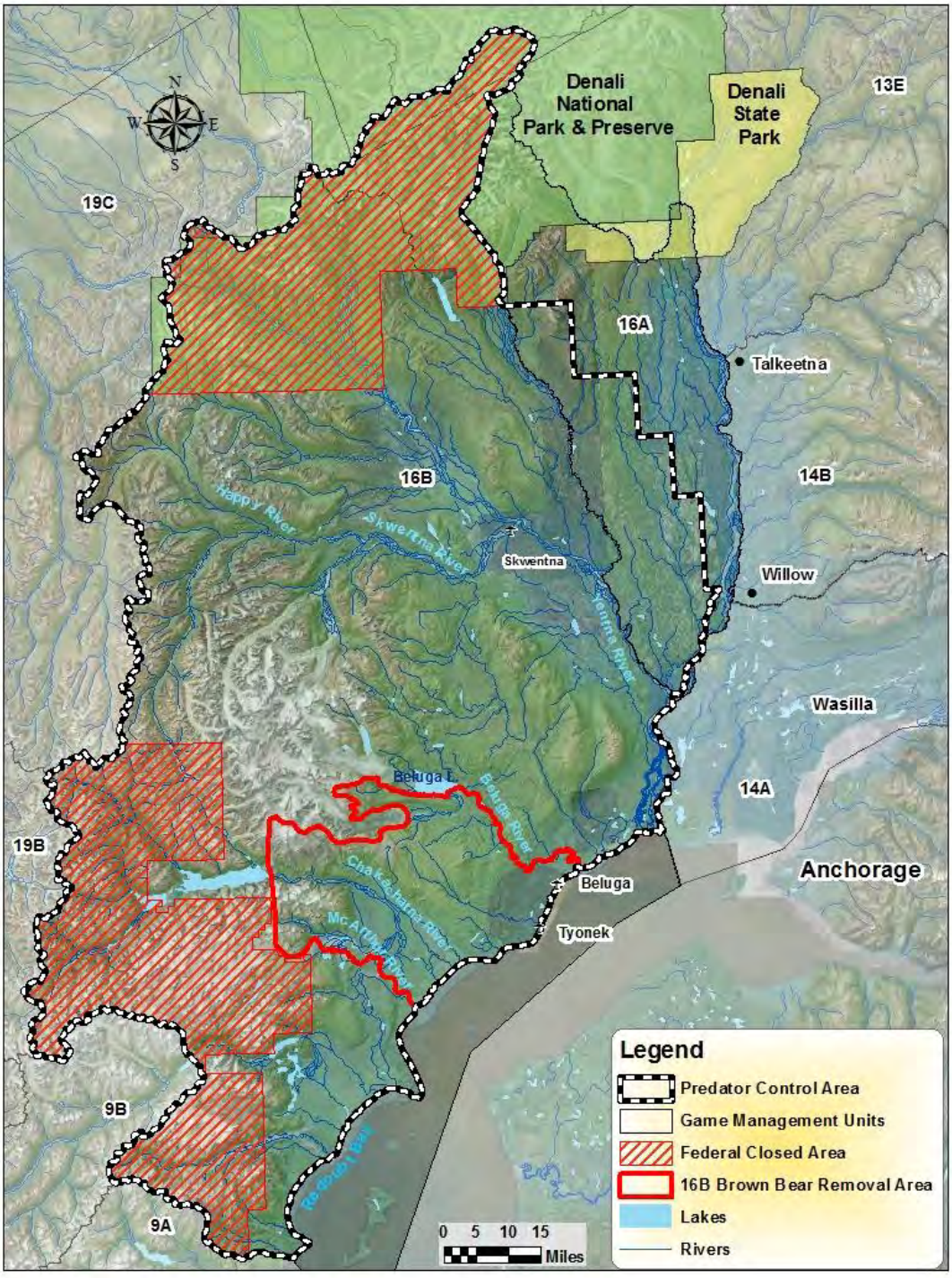

Figure 1. Intensive management area on all non-federal lands for moose in Game Management Unit 16 in Region IV, Alaska. Beginning in RY2006, the eastern boundary was expanded in Unit 16A to target wolf packs that were crossing between Subunits.

- 2005 moose population estimate for mainland Unit 16B: 3,193–3,951 moose
- IM moose population objective: 6,500–7,500 moose
- Moose harvest objective: 310–600 moose
- Fall 2004 pre-control wolf estimate in Unit 16B: 120–140 wolves
- Wolf control objective: 22–45 wolves remaining in spring

In March 2007, the board reauthorized the predation control IM plan for a period of 5 years, from July 1, 2007 through June 30, 2012. Using the extended boundaries of Unit 16B and western Unit 16A, the Board added a black bear control program to the existing plan. Under black bear control the public could get a permit to take an unlimited number of black bears, cubs and sows with cubs, and allowed for the baiting of black bears in the fall (August 10–October 15 At this time, approximately 1,500 black bears were estimated in Unit 16B with an objective to reduce the population by 60%. This created a management objective of 600 black bears; however, more accurate population data became available later in 2007 and the population was refined to 3,200–3,800 black bears and 625–1,250 brown bears. An 80% reduction at the midpoint of the range at those population levels would result in 700 black bears remaining (removing 2,800) while a 60% reduction in brown bears would result in 375 remaining (removing 560).

In March of 2009, the board added the snaring of black bears, made baiting and snaring available for the entire summer, allowed young hunters (10–15 years of age) to take bears under the adults permit, and allowed the use of helicopters to access black bear bait and foot-snaring camps. The board also updated the predator and prey population estimates as follows:

- 2008 moose population estimate for mainland Unit 16B: 4,063–4,323 moose
- 2007 brown bear population estimate for mainland Unit 16B: 625–1,250 brown bears
- 2007 black bear estimate for mainland Unit 16B: 3,200–3,800 black bears

In spring of 2010 the department conducted a calf mortality study in the southern portion of Unit 16B near the village of Tyonek. A total of 54 moose calves were collared within 48 hours of birth as identified by telemetry flights. Approximately 80% of the calves were killed within the first 6 months of life. Of those killed, 23 (54%) were taken by brown bears, 9 (21%) of the calves were taken by black bears, 6 (15%) of the calves were taken by an unknown predator, and 4 (10%) were capture related.

In March 2011, the board reauthorized the IM plan for Unit 16B for a period of 6 years from July 1, 2011 to June 30, 2017, and added a brown bear control area to a portion of Unit 16B. Under this program permittees would be allowed to take brown bears over bait or with bucket snares in a 960 mi^2 area between the MacArthur and Beluga Rivers termed the Brown Bear Control Area (BBCA) (Figure 2). The board also updated predator and prey numbers to reflect surveys conducted in 2010 and corrections to the bear survey conducted in 2007.

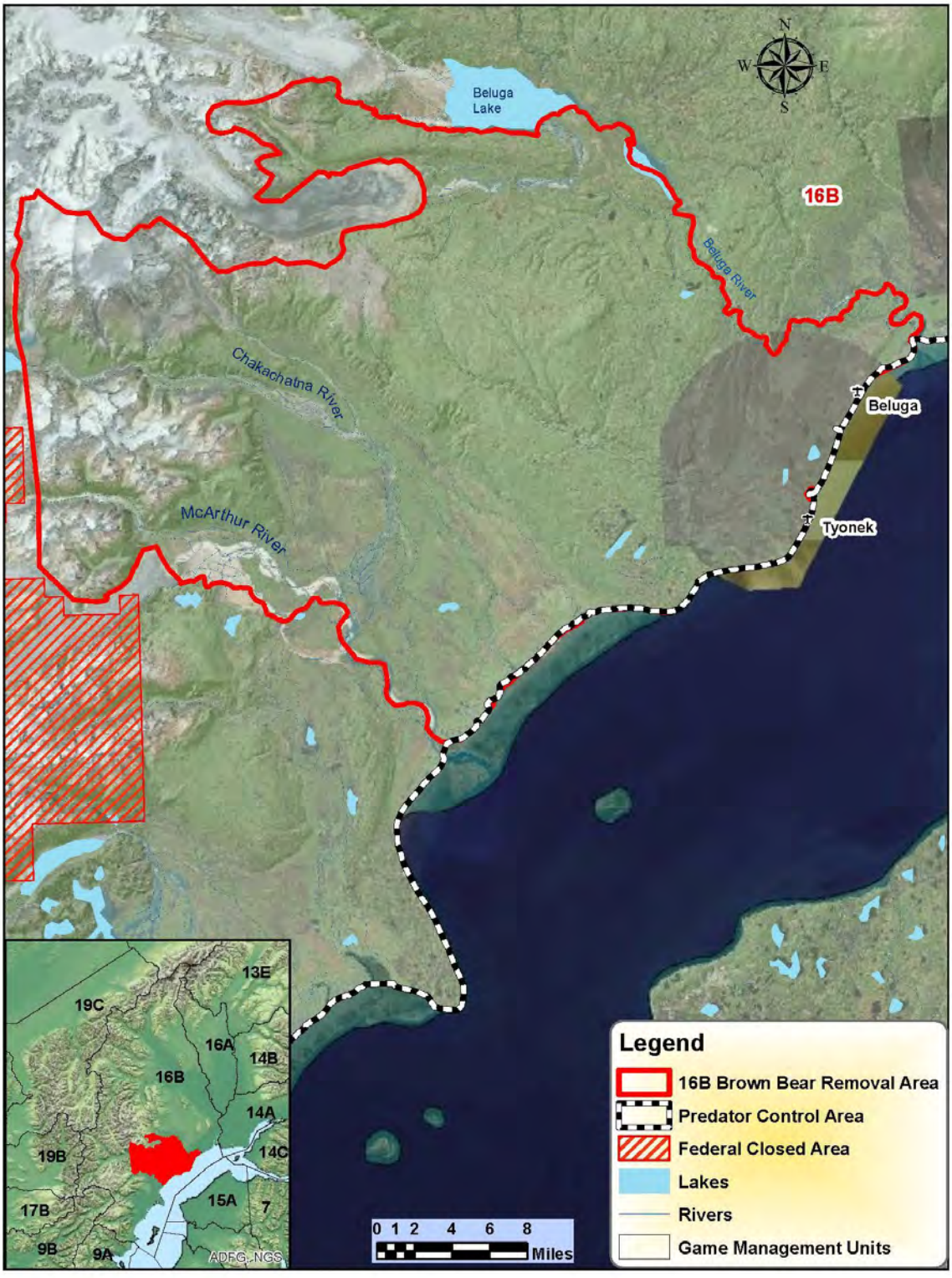

Figure 2. Brown Bear Control Area (BBCA) boundaries within Unit 16B established in RY2010 to allow permittees to take brown bears over bait and by snare within this 960 mi^2 area.

The revised estimates were:

- 2010 moose population estimate for mainland Unit 16B: 4,788–6,932 moose
- 2007 brown bear population estimate for mainland Unit 16B: 625–1,250 brown bears
- 2007 black bear population estimate for mainland Unit 16B: 3,200–3,800 black bears
- Fall 2010 wolf population estimate for mainland Unit 16B: 40–79 wolves in 8–9 packs
- The IM population objective for mainland Unit 16B is 375 brown bears and 700 black bears.

In the spring of 2012, department staff repeated the calf mortality study in the Tyonek study area. This study was designed to replicate the 2010 study and evaluate the effectiveness of the combined black and brown bear reduction efforts. The study found that calf survival remained low and 86% of known calf mortalities were attributed to bears with 53% killed by brown bears and 33% by black bears. A spatial analysis was also conducted that showed no relationship between bear harvest locations and calf survival within the Tyonek study area.

During the 2013 Board of Game meeting, the board reviewed the Unit 16 IM plan and approved new department recommendations for the plan.

- The Unit 16 IM objectives for moose were divided into 3 moose assessment areas (Unit 16B-North, Unit-16B Middle, and Unit-16B South; Table 1) to evaluate the moose population and the IM program (Figure 3).
- Predator control activities would be suspended when the point estimate of the moose population reaches the mid-point of the IM population objective and the lower end of the range of the IM harvest objectives are met.
- No cow hunts would be implemented until the moose population reaches the upper range of the IM population objective or a decline in moose nutritional status is observed. If the population reaches the upper range of the population objective and the mid-point of harvest objective is not met, cow hunts should be implemented, but the population should be allowed to grow.
- If a declining trend in nutritional condition of moose (e.g. twinning rates) is observed, cow hunts will be implemented to stabilize the population until the nutritional status stabilizes.

Table 1. Unit 16B moose population IM objectives for the 3 moose assessment areas (mainland Unit 16B IM objective subdivided proportionately by size of assessment area).

Survey Unit	Moose Population Objective Per Area (Midpoint)
16B-North	1,820–2,100 (1,960)
16B-Middle	3,120–3,600 (3,360)
16B-South	1,560–1,800 (1,680)
Unit 16B	6,500–7,500 (7,000)

Because the moose population in 16B-Middle and 16B-South was above the midpoint of the moose population objectives for the assessment area, wolf control activities were limited to 16B-North (1,838 mi^2) in RY2013.

A reanalysis of wolf population and harvest data since pre-control was conducted during the drafting of this document. The results suggest that the initial numbers of wolves was likely closer to 175–180 wolves (1.7 wolves/100 mi^2). This is a 34 percent higher than the original population estimate of 120–140. The department is currently monitoring radiocollared cow moose in the 16B-Middle and 16B-North to determine parturition, twinning, and calf recruitment in the unit. Additionally the department conducts Geospatial Population Estimator (GSPE) moose density surveys in Unit 16B. Due to the large size of the unit and the variable weather in the unit, the Unit is subdivided into 3 smaller areas for survey purposes: 16B-North, 16B-Middle, and 16B-South. (Figure 3). A survey was completed in December 2014 in 16B-North (Appendix A) which updated estimates for mainland Unit 16B (all 3 sub-areas) as follows:

- 2014 moose population estimate for mainland Unit 16B: 5,893–8,944 moose
- 2007 brown bear population estimate for mainland Unit 16B: 625–1,250 brown bears
- 2007 black bear population estimate for mainland Unit 16B: 3,200–3,800 black bears
- 2007 wolf population estimate for mainland 16B: 175–180 wolves
- Wolf control objective: 35–55 wolves remaining in the spring
- Spring 2013 wolf population estimate for mainland Unit 16B: 28–41 wolves

As of December 2014, the midpoint estimate of moose abundance in mainland Unit 16B (7,419) is near the upper end of the IM population objective for moose in the same area. Moose harvest in RY 2013 was 274, which was the highest estimated harvest since the program began in 2005 but remains below the lower end of the IM harvest objective.

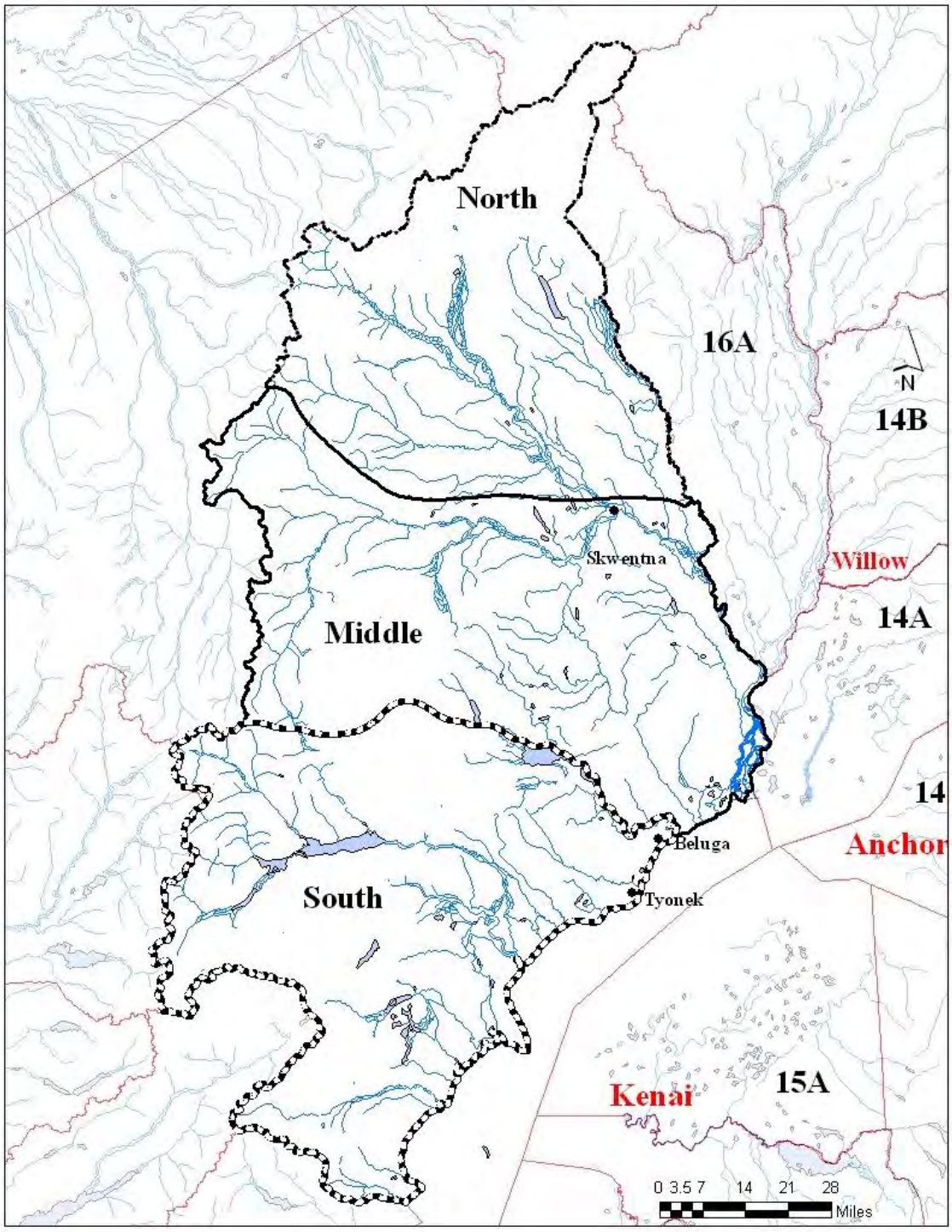

Figure 3. Map of Unit 16B identifying the three survey areas which comprise the moose assessment area: 16B-North, 16B-Middle, and 16B-South.

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 16B defines the population of wolves and includes Denali and Lake Clark National Park and Preserve lands but excludes Cook Inlet below mean high tide (10,298 mi^2 total). During RY1998 department biologists attempted to treat a louse infestation in the wolf population in Unit 16. Wolves were captured and treated with the antiparasitic drug ivermectin (Merck & Co) or received ivermectin through baits laced with the ivermectin paste (Masteller 2000). As a result of that work the department was able to arrive at an initial wolf population estimate which was refined in RY2014. The pre-control population estimate was 175 to 180 (1.7 wolves/100 mi^2), which was compiled from sealing records; trapper and pilot observations; and previous surveys.

The objective of the wolf reduction plan is to reduce the pre-control population of wolves by 70–80% resulting in a management objective of 35–55 wolves (0.34–0.54 wolves/100 mi^2) for mainland Unit 16B. Federal land closed to aerial control in the north and west is expected to provide refugia for wolves in Unit 16B.

Wolf take as a result of trapping, hunting, and control activities has been highly variable. Control activities are dependent upon on fresh snow 24 to 48 hours before pilot gunner teams can operate effectively. From RY2004 through RY2013 a total of 216 ($\overline{x} = 21.6, \text{high} = 91, \text{low} = 0$) wolves were taken in the control program (Table 2). In March 2013 the department conducted a minimum count wolf survey (McNay 1993) and estimated 28–41 wolves based on tracks seen during the survey. Tracking and weather conditions were marginal for this survey and the department anticipates conducting another minimum count in RY2014 to obtain a more accurate estimate.

The BBCA (960 mi^2) defines where members of the public who have obtained predator control permits can harvest brown bears over bait or with bucket snares. Outside this area both brown and black bears can be taken over bait through SDA and liberal seasons/bag limits. In spring 2007 the bear population was estimated at 625–1,250 brown bears (Table 3) and 3,200–3,800 black bears (Table 4) for mainland 16B.

Table 2. Wolf abundance estimates and removal in wolf assessment area of the Unit 16 Predation Control Area.

Unit 16A

Period	RY	Harvest removal		Dept. control removal	Public control removal	Total removal[a]	Spring abundance (variation)
		Trap	Hunt				
Year 0	2003	11	9	0	0	20	27 ± 5
Year 1	2004	10	2	0	0	12	
Year 2	2005	15	4	0	0	19	
Year 3	2006	6	0	0	10	16	
Year 4	2007	6	1	0	1	8	
Year 5	2008	7	1	0	1	9	
Year 6	2009	2	0	0	1	3	
Year 7	2010	0	0	0	0	0	
Year 8	2011	0	2	0	0	2	
Year 9	2012	0	0	0	0	0	
Year 10[b]	2013	0	0	0	0	0	

[a] Additional removal may be Defense of Life and Property, vehicle kill, etc.
[b] Wolf control area limited to 16B-North.

Unit 16B

Period	RY	Harvest removal		Dept. control removal	Public control removal	Total removal[a]	Spring abundance (variation)
		Trap	Hunt				
Year 0	2003	35	9	0	0	44	138 ± 27
Year 1	2004	13	12	0	91	116	
Year 2	2005	18	2	0	23	43	
Year 3	2006	8	5	0	22	35	
Year 4	2007	1	3	0	20	24	
Year 5	2008	12	3	0	20	35	
Year 6	2009	0	3	0	2	5	
Year 7	2010	7	1	0	9	17	
Year 8	2011	2	0	0	15	17	
Year 9	2012	0	0	0	2	2	28–41
Year 10[b]	2013	1	2	0	0	3	

[a] Additional removal may be Defense of Life and Property, vehicle kill, etc.
[b] Wolf control area limited to 16B-North.

Table 3. Brown bear abundance estimates and removal in brown bear assessment area of the Unit 16 Predation Control Area.

Period	RY	Spring abundance (variation)	Harvest removal		Dept. control removal		Public control removal		Total removal[a]
			FA	SP	FA	SP	FA	SP	
Year 4	2007	937 ± 313	64	36	---	---	---	---	100
Year 5	2008		84	28	3	---	---	---	115
Year 6	2009		34	35	---	---	---	---	69
Year 7	2010		93	26	---	2	---	27	148
Year 8[b]	2011		63	36	0	2	3	5	109
Year 9	2012		36	42	0	0	0	3	81
Year 10	2013		47	37	0	0	0	7	91

[a] Additional removal may be Defense of Life and Property, vehicle kill, etc.
[b] Year 8 (RY 2011) was the first full year of the brown bear control program.

Table 4. Black bear abundance estimates and removal in black bear assessment area of the Unit 16 Predation Control Area.

Unit 16A

Period	RY	Spring abundance (variation)	Harvest removal		Dept. control removal		Public control removal		Total removal[a]
			FA	SP	FA	SP	FA	SP	
Year 3	2006		21	73	0	0	0	0	94
Year 4[b]	2007		18	81	0	0	0	10	109
Year 5	2008		24	77	0	0	0	15	116
Year 6	2009		20	61	0	0	0	19	100
Year 7	2010		67	50	0	0	6	0	123
Year 8	2011		17	48	0	0	0	3	68
Year 9	2012		13	30	0	0	2	1	46
Year 10	2013		54	42	0	0	8	8	112

[a] Additional removal may be Defense of Life and Property, vehicle kill, etc.
[b] Year 4 (RY2007) was the first year of the black bear control program.

Unit 16B

Period	RY	Spring abundance (variation)	Harvest removal		Dept. control removal		Public control removal		Total removal[a]
			FA	SP	FA	SP	FA	SP	
Year 3	2006		75	251	0	0	0	0	326
Year 4[b]	2007	3500±300	73	210	0	0	1	106	390
Year 5	2008		69	188	0	0	32	108	397
Year 6	2009		43	106	0	0	58	131	338
Year 7	2010		83	104	1	0	136	107	431
Year 8	2011		26	93	0	0	40	74	233
Year 9	2012		32	53	0	0	18	60	163
Year 10	2013		58	76	0	0	13	40	187

[a] Additional removal may be Defense of Life and Property, vehicle kill, etc.
[b] Year 4 (RY 2007) was the first year of the black bear control program

Based on research in Alaska and Canada, a 60 percent or greater reduction the bear population (relative to pre-treatment) is expected to reduce predation on moose resulting in an increase in moose survival while being consistent with the management goal of reaching a desirable predator-to-prey ratio (National Research Council 1997). Therefore the IM objective for bear reduction in mainland Unit 16B is 375 brown bears. For black bears the IM objective was for an 80% reduction which leaves 700 black bears.

Presently known alternatives to predation control for reducing the number of predators are ineffective, impractical, or uneconomical in the Unit 16B 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 or bears is impractical because it is expensive and it is very difficult to find publicly acceptable places for relocated predators. Stocking of moose is impractical because of capturing and moving expenses, risk of disease transmission, and likely higher level of natural mortality for moose moved to an unfamiliar area.

B. *Habitat Enhancement:*

Habitat manipulation is expected to be ineffective given the factors limiting the moose population in Unit 16. While habitat can affect pregnancy and birth rates for moose, the moose population does not appear to be limited by either of these factors. Poor calf survival and recruitment limits the moose population growth in Unit 16B. Moose have been radio collared and monitored each spring since 2004. Productivity appears to be high within the unit and the most recent twinning survey conducted by the department in spring of 2014 identified a pregnancy rate of 91% and a twinning rate of 44%.

Although habitat currently does not appear to be limiting the moose population, the department submitted a formal request to Department of Natural Resources - Division of Forestry (DNR-DOF) in August 2014 to consider reducing fire suppression levels from full or modified to limited in Unit 16 wherever prudent. A change in fire suppression levels will allow natural wildfires to create a mosaic of seral stages and habitat types that

mimic natural wildfire regimes and forest succession which is the best long-term strategy to maintain productive habitat for moose.

C. *Prey Harvest:*

Current moose harvest regulations were designed to keep the harvest within sustainable yield, limited to bulls only when the objective is population growth (Table 5). Antlerless harvest may be warranted to slow, stop, or reverse population growth as well as to help adjust bull:cow ratios but not until the population reaches the upper objective or a decline in moose nutritional status is observed. If the population reaches the upper objective and the mid-point of harvest objectives is not met, conservative cow hunts can be considered while promoting continued population growth.

Twinning rates are a sensitive indicator of nutritional status (Boertje et al. 2009) and have been (will be) monitored within the mainland portion of Unit 16B. If the 2-year average twinning rate is >20% we will continue to promote growth. At a rate of 15–20% the population will be stabilized through harvest. If the 2–year average twinning rate is <15% the number of moose will be reduced through harvest. Predation control will be suspended if harvest alone is insufficient to stabilize or reduce moose numbers.

Table 5. Moose harvests in assessment area Unit 16B, regulatory years 2002 through 2013.

Regulatory Year	# of Hunters	Resident General Season Harvest	Tier II Harvest	Nonresident General Season Harvest	Estimated		Total Harvest
					Unreported	Illegal	
2002[a]	275	0	67	0	5	25	97
2003[b]	593	98	79	1	12	25	215
2004[b]	563	85	79	0	11	25	200
2005[b]	546	62	77	0	10	25	174
2006[a]	303	4	104	0	7	25	140
2007[a]	274	6	102	0	7	25	140
2008[a]	299	5	115	1	8	25	154
2009[b]	625	100	85	0	13	25	223
2010[b]	579	97	103	0	14	25	239
2011[c]	651	100	90	9	14	25	238
2012[c]	599	68	91	17	12	25	213
2013[c]	700	113	91	26	16	25	271

[a] Tier II hunting only
[b] Tier II and Resident hunting only
[c] Tier II, Resident, and Nonresident hunting allowed

II. ANTICIPATED RESPONSES TO TREATMENTS

A. *Predator Abundance:*

In 2004, the pre-control population estimate of 175–180 for wolves in Unit 16B was compiled from sealing records; trapper and pilot observations; and previous surveys. This is approximately 1.7 wolves/100 mi^2. In March 2013 an attempt to obtain a minimum count of wolves and tracks in Unit16B detected a minimum of 28–41 wolves. If this minimum number is accurate then the objective to reduce the population to 70–80% of the pre-control population has likely been achieved. Further evaluation of the effectiveness of wolf control program and assessment of wolf abundance will be derived from minimum count reconnaissance surveys or a Sample Unit Probability Estimator (SUPE) (Becker et al. 2004) when survey conditions are appropriate.

Through immigration and productivity, it is anticipated that wolf numbers would recover to pre-control levels in 3–5 years after control efforts cease (National Research Council 1997:52–53). The fluid nature of undefended wolf territories and the potential increase in moose abundance also could increase the rate of wolf immigration into the control area.

Bear harvest data collected during the last eight years of predation control indicates that current harvest rates are not sufficient to reduce the black or brown bear populations, and it is unrealistic to expect that the bear population objectives will be achieved with the reduction methods used to date.

B. Predation Rate:

We will continue to monitor summer survival as well as overwinter survival of moose calves. Annual spring twinning, fall composition, and population surveys will be attempted annually to further determine the efficacy of the IM program. If an 80% reduction in black bear abundance and 60% reduction in brown bear abundance could be achieved (both relative to pre-treatment abundance), we anticipate calf survival during the first six weeks of life would improve. Thus, if we observe no other increases in other calf mortality sources, we expect to see higher numbers of calves relative to cows in fall composition surveys.

C. *Prey Abundance:*

Moose abundance in the mainland Unit 16B under 3,500 ft. was estimated at 0.95 moose/mi^2 in 2005 based on a compilation of historic data. The 2011 moose population estimate in 16B-Middle was statistically greater ($P = 0.008$) than the 2005 estimate, and suggested an increase of approximately 8% per year. Much of this increase was in the bull segment of the population, as indicated by both bull numbers and bull:cow ratios. The increase in the bull:cow ratio was likely primarily due to restricted harvests that began in RY2006. The cow segment of the population increased at < 5% per year, but the increase was not attributable to predator treatments because neither calf:cow ratio ($r = 0.40$; $P = 0.370$), calf survival ($r = 0.45$; $P = 0.491$), nor adult cow survival ($r = - 0.18$; $P = 0.737$) changed during the RY2005 through RY2011 period. A GSPE of Unit 16B–North in December 2014 estimated 1,587 moose which adjusts the Unit 16B combined

estimate to within population objective (Table 6). The survey unit still remains at 81% of the objective midpoint.

Table 6. Unit 16B moose population estimates and composition.

Survey Unit	Year	Bull:100 Cows Ratio	Calf:100 Cows Ratio	Population Estimate	80% Confidence Interval
16B-North	1993	50	16	2,006	1,574–2,438
	2003	33	16	982	798–1,167
	2008	58	12	834	678–990
	2014	60	34	1,587	1,361–1,747
16B-Middle	1993	21	25	3,694	
	2008	54	21	2,446	1,722–3,171
	2011	46	24	3,458	2,918–4,000
16B-South	1996	25	25	1,081	936–1,226
	2004	23[a]	23[a]		
	2010	52	18	2,372	1,594–3,151
Unit 16B Combined	1996			6,739	
	2010			5,642	4,788–6,932
	2012			6,664	5,190–8,141
	2014			7,418	5,893–8,943

[a] Composition Survey only

We anticipate the moose population to increase the most in areas where the proportion of predator removal is greatest. The anticipated increases in abundance will be utilized and regulated commensurate with increases in moose calf survival and recruitment.

D. *Prey Recruitment:*

If the bear population is significantly reduced, we would anticipate a reduction in bear predation on moose calves and an increase in moose calf survival. The reduction would lead to increased recruitment of calves into the yearling age class and an increase in moose abundance. Maintaining the wolf population at lower levels could also aid in the overwinter survival of calves. To monitor these potential effects, we will continue to conduct productivity and survival flights using telemetry in May through the first few weeks of life, at 6 months of age, and in late winter to determine survival of known animals.

E. *Prey Productivity or Nutritional Condition:*

Moose productivity, twinning rates as well as over-winter and summer calf survival will be monitored as part of this plan. With collared females and an increase in moose densities we should be able to obtain sufficient sample sizes to monitor twining rates within 16B. If the 2–year average twinning rate is >20% we will continue to promote growth. At a rate of 15–20% the population will be stabilized through harvest. If the 2–

year average twinning rate is <15% the number of moose will be reduced through harvest. Any declining trend in twinning rate or other index of nutritional status will also trigger the department to re-evaluate population and harvest objectives. Predation control will be suspended if harvest alone is insufficient to stabilize or reduce abundance.

In addition we will be conducting a habitat evaluation and browse utilization surveys (Seaton et al. 2011) across Unit 16A and as part of the pre and post-burn evaluation of a habitat enhancement project beginning in the summer of 2015. Any declining trend in browse availability will trigger a department proposal to re-evaluate the moose population and harvest objectives.

F. *Harvest:*

If bear and wolf reduction is consistent and at a high enough level, an increase in the harvestable surplus of moose could result. Moose harvest is currently regulated under general harvest for bulls with spike-fork antlers or 50-inch antlers or antlers with three or more brow tines in Unit 16. In Unit 16B, there are additional opportunities to harvest any bull through drawing and Tier II hunts. As the harvestable surplus increases additional opportunities will be provided.

G. *Other Mortality Factors:*

Evidence suggests that snow approaching chest height (Coady 1974) and deep snow years in excess of 31 in. (Keech 2012) severely limit movement and can be a factor that may lower recruitment and survival. Severe winters have been reported in Unit 16 during the 1990's, 2000, 2001, and 2012.

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 on February 1, each year, with an interim update of selected criteria on August 1, each year.

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

The pre-control wolf population of 175 to 180 wolves (1.3 wolves/100 mi^2) estimated in the fall of 2004 was compiled from sealing records, trapper and pilot observations and previous surveys. This estimate forms the basis for the requirement that 35–55 wolves (0.34–0.54 wolves/100 mi^2) remain in the assessment area.

The department anticipates conducting a SUPE (Becker et al. 2004) in RY2014 to obtain an estimate of wolf abundance with precision. We will evaluate whether continued aerial wolf control by the public each winter can achieve wolf and moose population objectives.

Neither brown bear nor black bear numbers are expected to be reduced sufficiently to increase moose survival to attain IM objectives for moose abundance by using the methods and means employed to date. Concerted efforts from the public and organizations and liberalized methods and means resulted in substantial increases in take

of bears initially, but effort and take have declined in recent years (Table 3 and 4). At no point have staff been able to detect measurable increases in moose calf survival attributable to the efforts employed in this program. Tables 7 and 8 (below) present the breakdown of bears harvested through the snaring component of the program. We anticipate conducting a bear abundance assessment as early as 2016 across mainland Unit 16B using an aerial distance sampling approach (Becker and Christ, *in press*).

Table 7. Harvest of black bears through snaring in the assessment area of the Unit 16 Predation Control Area.

	Spring		Fall		
RY	Male	Female	Male	Female	Total
2008	7	7	-	-	14
2009	22	12	9	9	30
2010	23	21	18	11	55
2011	6	5	9	5	25
2012	1	3	4	2	10
2013	2	1	3	2	8
2014	-	-	2	2	4

Table 8. Harvest of brown bears through snaring in the assessment area of the Unit 16 Predation Control Area.

	Spring		Fall		
RY	Male	Female	Male	Female	Total
2008	-	-	-	-	-
2009	-	-	-	-	-
2010	12	10	-	-	22
2011	2	2	1	2	7
2012	1	0	0	0	1
2013	2	1	0	0	3
2014	-	-	0	0	0

B. *Habitat and Forage Condition:*

Habitat was not identified as a factor limiting moose productivity and recruitment, therefore baseline habitat or browse utilization assessments were not conducted at the plan's inception. As a component to the South Trapper Lake Burn Plan in Unit 16A, which overlaps the predation control area, we will be assessing current annual growth and browse removal which is identified as a measure of competition for food by moose that is inversely correlated to nutritional condition (Seaton et al. 2011). If significant declines in twinning rates are detected, we will expand browse assessment studies into mainland Unit 16B.

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

The abundance objective in Unit 16B assessment area is >1.0 moose/mi^2 (approximately 6,500–7,500 moose). Age-sex composition will be assessed annually through GSPE surveys or composition surveys as funding and weather permit.

The nutritional condition of moose will be monitored through twining rates using radio-collared females in the spring and from composition data derived from annual surveys. Currently 80 cow moose are collared in Unit 16B and we will continue to maintain collars as funding allows.

D. *Prey Harvest:*

The moose harvest objective in Unit 16B is 310–600 with an Amount necessary for Subsistence (ANS) of 199–227 moose. Moose harvest is monitored through moose harvest reports. Average reported harvest in the assessment area between 2009 and 2013 was 237 moose. It is anticipated that additional any bull opportunities offered in RY2014 in 16B-Middle and 16B-South, and DM541 across mainland Unit 16B, will increase harvest.

IV. Decision Framework to Implement or Suspend a Treatment

A. *Predation Control:*

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

- When the mid-point of intensive management objectives for the moose population are reliably achieved;
- When wolf population surveys or accumulated information from permittees indicate the need to avoid reducing numbers below the midpoint of the intensive management objective of 35–55 wolves;
- When black bear population inventories or accumulated information from permittees indicate the need to avoid reducing numbers below the management objective of 700 black bears;
- When brown bear population inventories or accumulated information from permittees indicate the need to avoid reducing numbers below the management objective of 375 brown bears;
- If after 3 years the harvest of predators is not sufficient to make progress towards the intensive management objectives for wolves, black bears, or brown bears; the program may be suspended for one or more of the predator species.

Predation control activities will be suspended or modified:

- When the moose population can be reasonably maintained at the midpoint of the IM population objectives, and moose harvest can be reasonably maintained within the IM moose harvest objectives;

- If after 3 years, there is no indication of an increase in the total number of moose in the assessment area;

- When wolf reduction and population objectives have been met or after 3 years if progress towards that objective indicates that objectives cannot be achieved;

- When bear reduction and population objectives have been met or after 3 years if progress towards that objective indicates that objectives cannot be achieved.

- When declining trends in twinning rate or other index of nutritional status are observed and indicate objectives may be too high.

B. *Habitat Enhancement:*

No habitat enhancement projects are planned as a component of this operational plan other than review and recommendations for fire management strategies that are consistent with population and harvest objectives. In addition, the department will conduct periodic forage assessments studies to evaluate the IM moose population objectives. If significant declines in forage availability and moose twinning rates are detected, habitat enhancement projects will be considered, and re-evaluation of population and harvest objectives will occur through department generated proposals.

C. *Prey Harvest Strategy:*

1. Prey Harvest.

The harvest rate management objective for moose in Unit 16B is 5–8% (310-600) of the population objective. Season and bag limit restrictions over the course of IM have maintained a high bull:cow ratios. Currently there is a general hunt for bulls August 20–September 25 (spike-fork antlers or 50-inch or antlers with three or more brow tines on at least one side), two "any bull" draw hunts (DM540: August 20–September 25; DM541: August 20–September 25 and November 15–December 15), and three Tier II permit hunts (TM565/567/569) December15–March 31.

As abundance and sex ratios increase, additional harvest opportunities will be proposed to the Board of Game by the department. Given access limitations, much of the additional harvest is anticipated to come from winter hunting opportunities. Winter hunts are expected to be necessary to achieve harvest objectives given access during autumn hunts.

If harvest of female moose is needed to achieve population objectives, but not acceptable to users, IM treatments will be discontinued.

2. Prey Nutritional Index.

   Calf productivity and survival will be monitored with particular attention to twinning rates as an important indicator of nutritional status. Declining trends in nutritional indices will trigger department proposals to re-evaluate population and harvest objectives relative to IM treatments. Declining trends in nutritional status will also trigger suspension of predator control if hunters are unable to surplus animals.

V. PUBLIC INVOLVEMENT

A. *Continued Outreach by Department:*

Outreach is accomplished through state fish and game advisory committees (AC), the board, and the Matanuska Fish and Wildlife Commission (MFWC). The two local advisory committees within Unit 16, Tyonek and Mt. Yenlo, are currently inactive, but the department will continue to encourage involvement by these ACs. Adjacent ACs in Unit14 are active, and the Department will continue to encourage involvement from all committees with particular emphasis from communities in Unit 16.

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

We will continue to engage the advisory committees, the board, MFWC, and department staff to evaluate the success of this program. The main objective of this operational plan is to increase moose harvest in the Unit 16B.

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 have been effective. Ground-based bear removal efforts waned in recent years and were not effective at reducing bear predation in this remote area. Local hunters and trappers will be encouraged to continue harvesting wolves and bears through the liberalized 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 such as the MFWC will be encouraged. Harvest reporting by all hunters will provide the Department with critical information on resource demand and harvest success.

VI. OTHER CONSIDERATIONS

This IM program and the predation control components have been renewed three times since original authorization in 2004. To date, wolf removal has seemingly reduced the wolf population by an estimated 73–80%. However, bear removal has not approached levels necessary to attain the reduction goals (remove 60% of the brown bear population and 80% of the black bear population) and has had no detectable effect on moose calf survival. Similar to other IM programs, a rise in effort by the public in Unit16 lead to an initial spike in predator removal only to relax in subsequent years. Further, the vast size and remoteness of this control area tends to dilute the level of effort while also concentrating effort to areas of high accessibility (i.e., lakes, rivers, communities, roaded areas). The department

recommends that bear control efforts be suspended because the program has not been effective.

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APPENDIX A. Summary of supporting information.

<table>
<tr><td colspan="5">Geographic Area and Land Status</td></tr>
<tr><td>Management area(s)</td><td colspan="4">Prey abundance assessment (6,358 mi^2), prey harvest assessment (6,358 mi^2), predator abundance assessment (10,298 mi^2), predation control (7,792 mi^2), Brown Bear Control Area (960 mi^2); see Figure 1.</td></tr>
<tr><td>Land status</td><td colspan="4">Unit 16 and the Predation Control areas include state, private, and Native corporation lands. National Park Service lands are not included in the predation control areas.</td></tr>
<tr><td colspan="5">Biological and Management Situation</td></tr>
<tr><td rowspan="3">Prey population</td><td colspan="4"></td></tr>
<tr><td>Survey Unit</td><td>IM Population Objective proportional to area (midpoint)</td><td>2014 Moose Population Estimate</td><td>Percent Recovery to Objective Midpoint</td></tr>
<tr><td colspan="4">16B-North 1,820–2,100 (1,960) 1,587 81%
16B-Middle 3,120–3,600 (3,360) 3,458 103%
16B-South 1,560–1,800 (1,680) 2,372 141%
Unit 16B 6,500–7,500 (7,000) 7,418 106%</td></tr>
<tr><td>Prey harvest (human use)</td><td colspan="4">IM objectives: 310–600; Reported harvest in 2013: 271 moose

Amount necessary for subsistence in Unit 16B: 199–227 moose</td></tr>
<tr><td>Feasibility of access for harvest</td><td colspan="4">Access for harvest exists via the road system by boat, snowmachine, and to a lesser extent by ATV. Airplanes can access the area through a number of water bodies and a few airstrips, but avgas is unavailable for sale within the unit. Access to the western portion of the unit is limited. There are very few restrictions imposed by landowners.</td></tr>
<tr><td>Nutritional condition</td><td colspan="4">Habitat is not limiting based on twinning rates. Estimates of twinning rates from radio-collared moose in 2013 and 2014 were 69% and 47% respectively. Parturition rates for the same time periods were 89% and 91%.

2010 16B-South: 18 calves:100 cows</td></tr>
</table>

	2011 16B-Middle: 24 calves:100 cows
Habitat status and enhancement potential	Habitat does not appear to be limiting. Flooding along rivers helps to reset succession to early seral stages. At the Department's request it is anticipated that the state wildfire protection levels will be relaxed wherever prudent to better mimic natural fire regimes. A 4,943 square acre area designated in the South Trapper Lake Burn Plan (*in prep*) within a portion of the predation control area in Unit 16A is proposed to burn under prescription. Regeneration and browse utilization assessment will occur in areas within the South Trapper Lake Burn and in adjacent areas of Unit 16.
Predator(s) abundance	Wolf estimate in Unit 16B in 2013: 28–41 wolves. Bear estimates in Unit 16B in 2007 (90% CI): 3,500 (±300) black bears or 187.3 black bear per 1,000 km^2 and 937 (± 313) brown bears or 40.6 brown bear per 1,000 km^2.
Predator(s) harvest	Estimated in 2013 (SY rate): Within the assessment area; average wolf harvest = 9 per year over the last 5 years with 3 harvested in 2013 (25–30%), average black bear harvest = 270 over last 3 years (6–12%), average brown bear harvest = 95 over the last 3 years (5–6%).
Evidence of predation effects	2010 Moose Calf Mortality Study: 80% calf mortality at 6 months of which 74% were attributed to bear predation. 2012 Moose Calf Mortality Study: Calf survival remained low with 86% of known calf mortalities attributed to bears.
Feasibility of predation control	Due to the size of this control area and accessibility issues it will be difficult to achieve predation control objectives for black and brown bears. Wolf population objectives have been met during the past nine years, and the moose population has increased towards the objectives. It is anticipated that the moose harvest objective will be achieved with sufficient liberalizations of winter moose hunting opportunity.
Other mortality	Snow depths can commonly approach the chest height of moose which will reduce movements. Severe winters have been documented as recent as 2001 and 2012.