INTENSIVE MANAGEMENT PROTOCOL

DIVISION OF WILDLIFE CONSERVATION

December 2011

CONTENTS

INTRODUCTION

HISTORY

Numerous wildlife species serve as vital food or economic resources for many Alaskans. The economic and cultural values of hunting, wildlife viewing, and wild lands in Alaska are recognized globally. Intensive management (IM) is a term used to describe the 1994 statute[1] and associated regulations and policies. This IM law is intended to achieve or maintain wild ungulate harvests in defined areas at elevated[2] but sustainable levels through some combination of management practices. The IM law describes some means to achieve objectives, including predation control and habitat enhancement. In addition to these practices specified in the IM law, managers may recommend increasing hunter access and facilitating harvest of adult females and young (fawns or calves at least 3 months old) to achieve IM harvest objectives.[3]

In the late 1990s, Alaska Department of Fish and Game (Department) leadership worked with key legislators and hunting interests to identify areas and species for IM using standardized criteria[4] and subsequently established population and harvest objectives through the Alaska Board of Game (Board).[5] Board actions related to IM and Department resources devoted to IM programs expanded steadily through the 2000s. Predation control involving lethal means under permit (i.e., not allowed under hunting and trapping regulations) began to be implemented under IM starting in winter 2003–2004.[6] The increasing volume, complexity, and diversity of IM programs strained Board and Department resources and further complicated the public's ability to understand and participate in the IM process. It became apparent that structure and standardization beyond that provided by statute and regulation was needed to provide greater clarity and transparency for the IM process. An effort to develop a comprehensive IM protocol began within the Department in the late 2000s. This document reflects Department experience with IM and is intended to be a standardized protocol for compiling, presenting, and archiving information that decision-makers, the public, and Department staff can use to evaluate proposed and existing IM programs.

---

[1] AS 16.05.255(e)-(g) and (j). Other legal and policy directives for IM are found in Appendix A. A history of predator management prior to the IM law was provided by Regelin et al. (2005). See Appendix L for all literature references in this document.

[2] For descriptions of underlined terms, see Appendix B (Concepts and Definitions).

[3] More information about IM programs and scientific literature related to IM can be found at website http://www.adfg.alaska.gov/index.cfm?adfg=intensivemanagement.main.

[4] 5 AAC 92.106.

[5] 5 AAC 92.108.

[6] A nonlethal experimental program to reduce caribou calf mortality by sterilizing breeding pairs of wolves and translocating other pack members primarily from the calving grounds of the Fortymile caribou herd was conducted during 1997—2001 (Boertje and Gardner 2003).

THE REGULATORY AND DECISION PROCESS

Game management policy can be evaluated on the basis of *outcomes* and *outputs*. The governor, legislature, and the appointed members of the Board[7] have various responsibilities in providing legal directives and are the policymakers and decision authorities for wildlife, which is held in public trust (i.e. "trustees", Smith 2011). These decision authorities evaluate *outcomes* of IM policy. They seek to discern whether public or constituent satisfaction is being met for a particular set of values (e.g., Table 1 in Boertje et al. 2010). With respect to IM, this may include high levels of consumptive use, fewer days required to harvest an animal (important with increasing fuel prices for mechanized transportation), measures of hunter satisfaction other than harvest (intangible values, such as time spent in the field with family or friends), or non-hunter acceptance. Outcomes might be judged from Department or other agency reports, commissioned studies, public testimony to the legislature, or other means. One policy evaluation might be whether the benefits perceived or derived from IM programs are commensurate with the public (general) funds or agency workload spent on the programs.

The Division of Wildlife Conservation (DWC) within the Department is the "trust manager" (Smith 2011) for wildlife in the state. The DWC measures *outputs* of IM programs, and provides this information to the Board. This requires scientific investigation of wildlife populations and habitat, characterization of harvest among user groups, and reporting of program monetary costs. The Department has limited authority to make harvest management decisions, reserved primarily to emergency closure of hunting seasons based on short-term biological information.

The IM law directs the Board to make a "positive determination" for IM when certain levels of historic harvest of Sitka black-tailed deer, caribou, and moose, and other criteria are met. Determinations for deer and moose are specific to a game management unit (Unit) or subunit for identified ungulate populations that may span multiple or partial Units, whereas for caribou are by herd range. Where a positive determination is made, the Board sets population and harvest objectives in regulation. If a population or harvest is below its respective objective, the Board must consider various factors and adopt regulations to provide for IM programs to achieve population or harvest objectives prior to further reducing harvest, except where deemed infeasible or incompatible with other purposes. The implementation of IM in the Board of Game process is presented in Appendix C.

GEOGRAPHIC AND SPECIES SCOPE

The total of all Units that have a "positive determination" for IM by the Board for caribou, deer, and moose compose 97.5% of the land area of Alaska. The primary predators of ungulates considered in IM are black bears, brown (grizzly) bears, and wolves. Where predation control occurs, it may be approved for only a portion of a Unit. The proportion of Alaska land area with active predator control since the IM law passed in 1994 has ranged from 7% (Boertje et al. 2010) to 11% (Titus 2007). This proportion may change over time through regulatory action that implements, modifies, suspends, reinstates, or terminates IM programs.

---

[7] Members of the Board are appointed by the Governor but must be confirmed by the Legislature.

The situation for coastal deer populations differs substantially from conditions for moose and caribou populations throughout most of their range in Alaska. Presently harvest is the primary tool used for deer management in coastal areas. Deer populations can experience mass die-offs during deep snow winters, particularly in areas where logging has removed critical winter habitat (Kirchhoff and Schoen 1987, Schoen and Kirchhoff 1990). Predation control may have limited potential for increasing deer populations for long periods in these areas because of habitat conditions resulting from past timber harvest. However, information may be forthcoming on the effectiveness of management techniques to reallocate predation mortality to sustainable harvest without substantial growth in deer populations.

PREDATOR POPULATION MANAGEMENT AS AN INTENSIVE MANAGEMENT TOOL

Managing the level of predation is a key tool used by managers to achieve IM objectives in areas where predation limits ungulate population size.[8] To ensure sustained yield of predators, intensive management plans should clearly identify 1) the area, duration, methods, and intent of predator management (regulation or control) by predator species; 2) the level of intended reduction in predator abundance and response by managers if the intended level of reduction is achieved; 3) the scale and frequency at which abundance of the affected predator population will be assessed; and 4) a description of the predator and prey populations and past management practices of adjacent areas. All intensive management programs will be designed to ensure the potential for predator populations to recover in a comparatively short period of time in the control area when a control program is suspended or terminated.

THE ROLE OF SCIENCE IN MANAGEMENT

The act of management is not science. Management is a value judgment by decision-making authorities who allocate resources or uses among competing interests, within legal directives, for a perceived optimal benefit to society. Management decisions are informed by science, which is a process to gather objective information for describing the results of management actions or to forecast the potential outcome of proposed management actions. Management decisions typically incorporate subjective information provided by competing interests within the broad constituency of the decision-making authorities. For IM, the Department's role as trust manager is to provide scientific information on biological sustainability. The public's role in IM is to review the science and provide input on acceptable uses that include social and economic factors and allocation of resources. Finally, the role of the decision-makers is to incorporate information from the trust manager and the public. Public use allocation for IM might include methods and means of harvest or predation control, or more broadly in the regulatory process include defining areas closed to harvest in favor of non-consumptive practices.

PURPOSE OF THIS DOCUMENT

This document is intended as a Department protocol for practical implementation of IM in Alaska. The aim is to improve the overall transparency of the IM process, as well as the efficiency of procedures for implementing IM projects by Department staff. This IM protocol consists of 2 primary components: 1) principles and guidelines and 2) implementations tools.

---

[8] A review of biological case studies involving predator management in Alaska is in Appendix D.

The principles and guidelines (P&G) aim to clarify the framework and process used to evaluate outputs from IM programs in the context of associated legal and policy directives. The implementation tools consist of a feasibility assessment, operational plan, and department report. These are meant as aids for agency staff responsible for planning, implementing and evaluating IM programs.

PRINCIPLES AND GUIDELINES

The P&G for intensive management are a compilation of agency knowledge and experience. The principles are the basis for managing wildlife populations and their habitat for diverse uses by present and future generations and informed public involvement in the state regulatory process. This basis is consistent with the mission of DWC "to conserve and enhance Alaska's wildlife and habitats and provide for a wide range of public uses and benefits."

The P&G are intended to meet the needs of 2 audiences: 1) provide an operational framework for the Department to implement IM programs mandated by law within constraints of regulation and policy; and 2) provide information and context to the public for participation in the IM regulatory process, primarily through advisory committees and the Board. To meet these needs, the P&G aim to 1) clarify the scope and implementation of IM, including the role of the public and various elements of state government; and 2) define factors considered and strategies used by wildlife managers to achieve elevated levels of sustainable harvests of ungulates (caribou, Sitka black-tailed deer, and moose) while simultaneously ensuring long-term viability of predator populations (black bear, brown bear, and wolf).

The principles describe implementation of IM under the broad concepts of sustainability and adaptive management. Within each principle, the associated guidelines describe operational considerations generally the responsibility of wildlife managers (biologists). However, the role of the public is expressly noted for some of the guidelines. Background information for each principle is provided in Appendix B.

PRINCIPLE 1: Intensive management programs should be ecologically sustainable

Rationale: Management of natural systems requires guarding against unintended consequences. For example, reducing predator populations to very low levels for extended periods could result in unchecked growth of ungulate populations if harvests are ineffective in regulating these. Overabundant ungulate populations might then damage their forage base and dramatically decline due to a lack of food. Delayed recovery of predators could reduce hunting, trapping, or viewing opportunity for these species.

Guideline 1.1: Managers should ensure ungulate and predator populations and their habitats will be managed for their long-term sustainability.

> a) Elevated ungulate populations should not degrade forage, nutritional condition, or population productivity to unsustainable levels.
>
> b) Habitat management practices intended to maintain or enhance forage health and availability should be implemented where and when they are feasible, acceptable, and cost-effective.

c) Predator populations will be managed for sustainability even when reduced to lower levels with the intent to elevate harvestable surplus of ungulates; predators must be able to increase after treatments are reduced or suspended.

PRINCIPLE 2: Intensive management programs should be based on scientific information

Rationale: Objective information is required for scientific understanding of the effects of IM programs. Reliable knowledge gained from management treatments potentially allows effective application elsewhere with lower risk of unintended outcomes and more efficient use of public and private funds.

Guideline 2.1: Managers should design and conduct IM programs in a systematic and scientific manner to ensure learning from treatments and responses.

a) The size and location of treatment areas should adequately influence the intended species while using natural boundaries easily recognized by hunters; managers should clarify rationale if smaller than area defined in regulation.

b) Populations of ungulates and their predators, ungulate habitat, and wildlife harvest should be monitored using scientific methods.

c) IM programs should include monitoring of treatment response or additional research where appropriate, using comparable and adjacent untreated areas where possible to evaluate effects of treatments.

PRINCIPLE 3: Intensive management programs should be socially sustainable

Rationale: Intensive management programs are closely scrutinized by the public because they involve practices invoking personal values on wildlife or land use. Broad, long-term public support for IM programs is essential to achieve and maintain elevated ungulate populations and harvest. Public understanding of all facets of IM programs is critical to informed engagement in the regulatory and political processes.

Guideline 3.1: Managers should work with public stakeholders to identify desired outcomes and mitigate potential or actual conflicts that may ensue as a result of elevated ungulate harvests; these steps should occur in the planning phase.

a) Intensive management programs should define clear objectives, including population size, desired harvest levels by sex and age class of ungulates, and other measurable parameters that can define success in terms of public satisfaction within biological constraints.

b) Public access problems that may impede harvest of ungulates or predators, create unacceptable crowding conditions, or lead to conflict among users should be identified and mitigated, where feasible.

c) Harvest of adult female and juvenile ungulates may be critical for achieving the harvest objective and other purposes in an IM program (see Principle 1, Guideline 1.1a), so public stakeholder concerns should be addressed and mitigated.

Guideline 3.2: Managers should enhance involvement of an informed public to evaluate intensive management programs.

a) Hunters and other public stakeholders should be engaged in setting IM objectives, determining acceptable practices, prioritizing among proposed IM programs, and prioritizing between IM and other wildlife conservation programs within the Department.

b) The range of values, results, and context of IM programs should be effectively communicated to Alaskans and the broader public.

c) The public should understand uncertainties in potential responses to treatments and possible consequences of proposed IM programs.

d) Feasibility assessments for proposed IM programs should be provided to the Board in a matrix that compares key factors and potential for achieving objectives or other public satisfaction metrics among proposed and existing programs.

e) Progress of IM programs toward ungulate population and harvest objectives should be regularly assessed along with harvest allocation among user groups and overall public satisfaction with the IM program.

f) Managers and public stakeholders should periodically reevaluate IM objectives on the basis of feedback from associated monitoring or research programs.

Guideline 3.3: Before recommending predation control programs for IM, managers should engage the public on opportunities to participate in predator population management through harvest.

PRINCIPLE 4: Intensive management programs should have a transparent and explicit decision framework

Rationale: Planning, implementing, and evaluating IM programs is a multi-step process of data collection and analysis, public planning, regulatory decision-making, program development, evaluation of progress, and administration. This process should be accessible and understandable to the public, and provide clear expectations with regard to how decisions are made to implement, modify, suspend, or terminate IM practices or an IM program.

Guideline 4.1: Managers should discuss decision frameworks and data quality with hunters and other public stakeholders for proposed IM programs to clarify public expectations and verify acceptable tradeoffs.

PRINCIPLE 5: Intensive management programs should be economically sustainable

Rationale: Intensive management programs are more expensive than basic wildlife and harvest monitoring programs. Policymakers and the public need actual or projected cost information to evaluate the value of existing and proposed IM programs.

Guideline 5.1: Managers should account for the monetary costs and harvest results of IM programs on a regular basis.

Guideline 5.2: In areas where it is appropriate, managers should evaluate issuance of permits to the public to engage in wolf or bear control as a means to reduce direct costs of IM to the state.

TOOLS FOR PROGRAM IMPLEMENTATION AND ASSESSMENT

Three document templates based on P&G have been created for use in the Board process (see Appendix E). These 3 templates provide "checklists" based on P&G to ensure consistency in addressing key biological and management factors in IM programs. All factors are not pertinent in all programs, but a standard template ensures that all factors are considered and provides transparent documentation for comparing differences among IM species and areas. For example, managing moose and caribou populations for high levels of harvest requires substantially different strategies. These templates are not intended to be "go/no-go" decision frameworks from the Department. Instead, they use objective information to characterize the level of uncertainty and potential for increasing ungulate harvest in a defined area and time period. This provides decision-makers and the public with the information needed to understand the consequences of management choices and their costs. Once the biological and management factors are presented by the Department, implementation is a policy decision by elected and appointed officials with public trust authority for wildlife that incorporates biological, social, and economic factors (Smith 2011). The initial version of the templates will be updated as warranted by changes in scientific knowledge and managerial experience.

The 3 document templates are, in intended procedural order:[9]

FEASIBILITY ASSESSMENT

The document template summarizes available information and gauges the potential for a proposed IM program to meet ungulate population and harvest objectives within a defined time frame after applying one or more treatments. This template is a checklist[10] of biological and management factors and challenges to be addressed, preferably before undertaking IM programs, to improve the potential for achieving objectives while attempting to minimize possible hunting-related conflicts. Evaluation of factors includes some level of professional judgment, which is collective management intuition gained by Department staff through experience with a species, technique, or area. The area wildlife biologist will have a lead role in preparing a feasibility assessment. The assessment also provides guidance to the Board for its feasibility determination as outlined in the IM law.[11]

The Department will review elements of a proposed management program and then make a recommendation on the most feasible strategy to maintain or increase the ungulate population and to increase harvest. In providing recommendations, the Department will convey limitations of biological data or modeling forecasts so the Board and public understand the potential of not

---

[9] This intended order is for new (proposed) programs. The Department began using the annual report template for existing IM programs with predation control in February 2011. The Department will produce operational plans for existing programs at the time of each IM Plan renewal (typically a 5- or 6-year authorization period).

[10] An abbreviated outline of the feasibility assessment template is provided in Appendix F.

[11] AS 16.05.255(f)(1).

achieving an objective or having unanticipated results from management decisions. Uncertainty in outcome is caused by limited precision of estimated factors (e.g., population size or predation rate) and limitations on forecasting (e.g., imperfect ecological models of harvesting from prey-predator systems).

Assessing feasibility of new programs should recognize that existing IM programs require ongoing commitment from the Board, the Department, and the public. The Department will continue to monitor biological indicators in all IM programs, even when predation control is inactive. Adding new IM programs requires new resources or tradeoffs with existing IM programs or other programs in the Division of Wildlife Conservation if the budget remains static. When a new IM program is proposed in a region, the Department may present a matrix to the Board comparing feasibility elements and an overall assessment of potential to achieve IM harvest objectives for each new program and for all existing IM programs in the region. This will likely be presented by a regional supervisor at a regional Board meeting. The Department may present a similar comparison matrix for IM programs statewide for broader context.

If the Board requests the Department to proceed with a proposed IM program after it has considered the tradeoffs with other regional and statewide IM programs, the Department will prepare an operational plan. In preparing an operational plan the Department should engage the public to receive input on 1) measures of progress toward objectives and criteria of program success; 2) acceptable methods for enhancing ungulate abundance and harvest, including a discussion of expected harvest levels and "hunter carrying capacity;" and 3) other topics unique to a proposed management program.

OPERATIONAL PLAN

This is a template document that serves as a checklist[12] of components necessary to implement, administer, and evaluate an IM project. Each project-specific operational plan becomes a standalone document that in conjunction with the associated regulation[13] reflects the unique circumstances of a specific IM project approved by the Board. Operational plans describe scientific criteria of treatment strategies and the decision framework for IM programs.

No 2 operational plans are the same, but each follows the format and sequence of items in the operational plan template. Each plan is a decision framework that describes the current biological situation and what actions will be taken to reach population, harvest, and other management objectives. Each plan follows the tenets of adaptive management that promotes ongoing objective evaluation of information, assumptions, and expectations on which specific management actions in the plan are based. This effectively creates an automatic feedback loop

---

[12] An abbreviated outline of the operational plan template is provided in Appendix G.

[13] 5 AAC 92.125. Under an IM Plan authorized with this regulation, predation control may be turned on and off multiple times during the authorization period based on specified conditions. For example, implementation could be delayed until certain conditions are met (e.g., decline of prey to below an abundance threshold; see "proactive" in Appendix C), and implementation may be temporarily suspended if other conditions are achieved (e.g., prey response reaches objective in treatment area).

that helps to signal if and when management actions should be modified, suspended, reinstated, or terminated. Documentation throughout this process is essentially a learning experience, the knowledge from which can be used not only to enhance the ongoing project but also to gain reliable knowledge for more effectively forecasting responses or implementing IM in other areas.

DEPARTMENT REPORT

This is a legally-mandated annual report to the Board for an IM program that includes predation control[14], supplemented with an annual interim report which is offset by about 6 months.[15] These dates account for lag time in entering reported predator removal and ungulate harvest into an electronic database for archive and analysis. The February annual report will include most of the ungulate harvest from the prior fall and bear removal from the prior regulatory and calendar years, whereas the August interim report will have the ungulate harvest and wolf removal from the previous regulatory year.

These reports include a brief update on key information[16] that is used to determine if satisfactory progress of an IM project is being realized. Report information will be used for Department recommendations and Board decisions on continuing, modifying, suspending, or terminating IM treatments or IM programs. Report information is for a single program, but the Department may also present it in a table showing multiple IM programs in a region or all IM programs statewide.

---

[14] AS 16.050(b).

[15] Department reports are archived at http://www.adfg.alaska.gov/index.cfm?adfg=intensivemanagement.programs.

[16] An abbreviated outline of the department report template is provided in Appendix H.

APPENDIX A. Legal and policy directives for intensive management.

1. State of Alaska

a) Legal Directives[17]

i) Alaska Constitution, Article VIII (Natural Resources)

- Section 1 “It is the policy of the State to encourage the settlement of its land and the development of its resources by making them available for maximum use consistent with the public interest.”

- Section 2 “The legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State, including land and waters, for the maximum benefit of its people.

- Section 3 “Wherever occurring in their natural state, fish, wildlife, and waters are reserved to the people for common use.”

- Section 4 “Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.”

ii) Alaska Statutes (AS), Title 16, Section 5 (AS 16.05)

- AS 16.05.020 (2) defines the functions of the Commissioner (of the Department) to “manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state.”

- AS 16.050(b) defines the duties of the Commissioner to “annually submit a report to the Board of Game regarding the department’s implementation during the preceding 3 years of intensive management programs.”

- AS 16.05.255(a)(6) defines Board authority to adopt regulations on “methods, means, and harvest levels necessary to control predation and competition among game in the state.

- AS 16.05.255(e)-(g) and (j) describes the process for the Board of Game to adopt IM regulations, including criteria for assessing feasibility prior to adopting regulations, unless a finding of biological emergency occurs. If a population or its harvest is below the IM objective, the Board cannot further reduce harvest unless it begins a regulatory process to restore the abundance or productivity of the ungulate population through habitat enhancement, predation control, or other means.

[17] Full text available at http://www.legis.state.ak.us/basis/folio.asp

- AS 16.05.258 describes customary and traditional harvest for subsistence, distinguishes nonsubsistence areas, and creates an allocation priority for subsistence in times of resource shortage.

- AS 16.05.780 clarifies that taking of antlerless moose remains closed in an area unless recommended by the Department and approved by a majority vote of active local Fish and Game advisory committees.

- AS 16.05.783 permits shooting a wolf the same day airborne on nonscheduled (noncommercial) flights, or shooting a wolf from an aircraft, only if the action is part of a predator control program approved by the Board.

<u>iii) Alaska Administrative Code (AAC; regulations), Title 5, Chapter 92</u>

- 5 AAC 92.039 clarifies the need for a permit and lists associated stipulations (practices, participant qualifications, reporting requirements) for people using aircraft (including helicopters) to take wolves as part of an approved predation control program.

- 5 AAC 92.080(4)(B) defines use of motorized boats and land vehicles for hunting caribou in some areas, or for taking wolves or bears in areas defined for a predation control program (see 5 AAC 92.125).

- 5 AAC 92.106 defines criteria for making a positive determination of IM of game species "important for providing high levels of harvest for human consumptive use" by game management unit or subunit (deer, moose) or by herd (caribou); criteria include level of historic harvest, habitat capability, predator populations, weather, access, effects on subsistence, cost, and other factors.

- 5 AAC 92.108 lists IM population and harvest objectives by species and area.

- 5 AAC 92.110 defines the authority of the Commissioner to conduct wolf control for programs approved by the Board (see 5 AAC 92.125), including approved methods, restrictions, and annual suspension of activities if predator control objectives have been met prior to a specified date.

- 5 AAC 92.115 defines the authority of the Commissioner to conduct bear control for programs approved by the Board (see 5 AAC 92.125), including approved methods, restrictions, and annual suspension of activities if predator control objectives have been met prior to a specified date.

- 5 AAC 92.116 lists special provisions in predator control areas, including conditions of program activities when the sale of untanned bear hides with claws attached and of skulls is approved for black bears and for brown bears.

- 5 AAC 92.125 describes biological and management criteria of predation control implementation plans, reporting requirements, and means to ensure sustainability of predator populations in a defined area (described as an "IM Plan").

- 5 AAC 99.025 describes the amounts necessary for subsistence under customary and traditional uses of a game population.

iv) Recent State Case Law on IM Programs

- Koyukuk River Basin Moose Co-Management Team v. Board of Game (8/22/2003) (http://touchngo.com/sp/html/sp-5728.htm); the Alaska Supreme Court confirmed:
  - The relevant area for a moose population under intensive management is the area determined by the Department to be relevant as currently set forth in 5 AAC 92.108.
  - "Game population" is defined in AS 16.05.940(20) as a "group of game animals of a single species or subgroup manageable as a unit."
  - While not addressed by the court, it is implied that managers should also consider whether a population defined for 5 AAC 99.025 (amounts necessary for subsistence) should match or differ from one defined for 5 AAC 92.108.
- Friends of Animals v. State of Alaska (January 2006); Alaska Superior Court confirmed:
  - Department interpretation that IM law is a mandate to conduct IM activities under certain conditions, as opposed to a limitation of when it may be conducted.
  - Sustained yield and harvestable surplus references in IM law were relevant to prey populations, not directed at predator populations.
- Ronald T. West v. State of Alaska (August 2010); ruling on an appeal to the Alaska Supreme Court confirmed:
  - Both the constitution and intensive management laws require management for sustained yield of predators and prey.
  - Predation control implementation plans (5 AAC 92.125) approved by the Board of Game apply sustained yield principles to managing predator populations for higher yields of ungulates.

b) Policy

i) Alaska Board of Game (http://www.adfg.alaska.gov/index.cfm?adfg=gameboard.findings)

- Wolf management policy (Findings 2011-185-BOG, expires June 30, 2016).
- Bear conservation, harvest, and management policy (Findings 2011-186-BOG; expires June 30, 2016).

ii) Alaska Department of Fish and Game

- Fire management policy 2009.
- Guidance on wolf pups 2009.

- Orphaned game animal policy 2010.

2. Federal Government

a) Legal Framework

i) Congressional Acts[18]

- Federal Airborne Hunting Act 1971, PL 92-159
    - Prohibits shooting from aircraft with exceptions, including protection of wildlife, livestock, and human life.
    - Requires federal or state issued license or permit.
    - Requires states authorized to issue permits to file reports with the Secretary of the Interior containing information on any permits issued.
- Alaska National Interest Lands Conservation Act 1980, PL 96-487 (ANILCA)
    - Title II (National Park Service) and Title III (National Wildlife Refuge System) include wildlife species as an establishing purpose of conservation units.
    - Title VIII requires opportunity for continued subsistence uses by rural residents and requires the evaluation (an 810 Evaluation) of the effects on subsistence uses.
    - Section 1314(a) provides that "Nothing in this Act is intended to enlarge or diminish the responsibility and authority of the State of Alaska for management of fish and wildlife on the public lands except as may be provided in Title VIII of this Act, or to amend the Alaska constitution."
- National Environmental Policy Act 1969 PL 91-190 and 42 U.S.C. 4321-4347 (as amended)
    - Requires a written assessment regarding the environmental effects of significant federal actions.
- National Wildlife Refuge System Improvement Act 1997, PL 105-57 (and the Refuge Administration Act 1966)
    - Maintain the biological integrity, diversity, and environmental health of the system.
    - Wildlife-dependent recreational uses are compatible if they do not have a tangible adverse impact on refuge system resources.

---

[18] http://www.fws.gov/laws/Lawsdigest.html and http://www.nps.gov/aboutus/lawsandpolicies.htm

  - Conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats.
  - Nothing in this Act shall be construed as affecting the authority, jurisdiction, or responsibility of the several states to manage, control, or regulate fish and resident wildlife under State law or regulations in any area within the system.
  - Notwithstanding any other provision of this Act, the Secretary [of the Department of the Interior] may temporarily suspend, allow, or initiate any activity in a refuge in the system if the Secretary determines it is necessary to protect the health and safety of the public or any fish and wildlife population.
  - Coordinate, interact, and cooperate with adjacent landowners and state fish and wildlife agencies.

ii) Federal Regulations

- National Park Service Organic Act 1916, 16 U.S.C. l, 2, 3, and 4
  - Conserve wild life unimpaired for the enjoyment of future generations.
- Wilderness Act 1964, PL 88-577 and 16 U.S.C. 1131–1136, 78 Stat. 890
  - Minimum requirements analysis for all proposed research and administrative (management) activities to determine if activities are necessary to administer the area as designated wilderness and accomplish purposes of the conservation unit.

b) Policy

- Master Memorandum of Understanding between State and (individually) Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service (all Department of Interior) and U.S. Forest Service (Department of Agriculture)
- National Park Service policy on natural resource management (http://www.nps.gov/policy/MP2006.pdf)
- National Wildlife Refuge system (Fish and Wildlife Service)
  - Policy on biological integrity, diversity, and environmental health (http://www.fws.gov/policy/601fw3.html).
  - Stepped down management plans for species, habitat, fire, and public use within Comprehensive Conservation Plans for individual system units.

APPENDIX B. Important concepts and definitions.

Adaptive management – This is a system of "learning by doing" that incorporates experimental design with feedback from the learning stage (science) back into the doing stage (management). It involves scientists, managers, and policymakers who seek to understand the uncertainties in resource management by experimentally testing alternative management strategies based on theories of cause and effect. Adaptive management can be implemented at various levels, including a simple approach of trial and error. However, this simple approach reduces the chance to obtain reliable information that can be applied with confidence of a similar outcome in new situations. Implementing a single nonreplicated strategy assumed to be suitable may work, but if it does not, it may provide little or no learning that would be useful in designing a new strategy with a better chance for achieving objectives.

Adaptive management of renewable resources recognizes the uncertainty in resource responses to treatments in complex systems of human-environmental interactions (Walters 1986). It uses a systematic learning process to improve understanding of the system and management decisions over time. Adaptive management was recommended as a constructive approach for designing treatments of predator-prey systems to increase prey harvest in Alaska (National Research Council 1997). However, practical limitations on replicate treatment and control sites occur in field experiments at the scale of large mammal systems (Hayes et al. 2003:26–27). Operational plans (see section above, Tools for Program Implementation and Assessment) will describe the level of survey and inventory data and study design constraints for IM programs. Research may be considered for new or unique situations for which few or no case studies exist to inform strategies for IM, but budget and staff constraints involve tradeoffs with other programs and research needs. The level of information for decisions to implement IM will vary among members of the public and scientific community based on a perceived requirement to adequately balance uncertainty (a tolerance for risk of potential consequences of a management action) against specified outcomes (Appendix I). The general framework of adaptive management for IM involves evaluating responses to treatments (Appendix J). If a program fails to achieve objectives defined prior to implementation, decisions are required to collect more information (budgetary tradeoff) and revise strategies (potentially a policy tradeoff) or to terminate the program (policy tradeoff).

Adaptive management for IM should be a recurring process of 1) applying one or more (possibly sequential) practices in an attempt to achieve an elevated sustainable harvest of wild ungulates; 2) monitoring results and feedback; 3) continuing or suspending practices using predetermined decision criteria that incorporate an understanding of scientific uncertainty and the potential consequences of incorrect decisions; and 4) modifying the management approach when appropriate due to changing conditions. The evaluation design or associated research may also change based on interim findings. Implementing adaptive management is difficult: 1) if public stakeholders fail to agree on the policies to test and decision criteria before undertaking treatments, 2) if experiments are expensive or difficult to design and monitor, or 3) if short-term responses are adopted as "solutions" before the full extent of learning is obtained (potentially refuting initial responses).

Biological emergency – Referenced but not defined in AS 16.05.255(f)(2) as a determination by the Alaska Board of Game. A determination of biological emergency under (f)(2), based on recommendation from the Department, allows significant harvest reduction and expedited implementation of IM practices. The intent is to begin ungulate recovery without the formal feasibility assessment required under (e)(3) and (f)(1), but the Department should evaluate the biological and management situation for continuing the IM program at the next regional Board meeting. It implies in the context of the statutory language the need for immediate action to 1) improve the status of a depleted population or 2) risk the reduction and even cessation of sustainable harvest. It includes considering predator control where there is the risk of temporary extinction for an ungulate population (National Research Council 1997:128), which may be coincident with sustainable harvest being nonexistent or regulated to an extremely low level or an geographically isolated situation (low potential of immigration from surrounding populations). The risk of waiting until a biological emergency exists for an ungulate prey species is prolonged scarcity of predators and prey (Gasaway et al. 1983:38), requiring a large reduction or even elimination of ungulate harvest and potentially more extreme or prolonged measures to recover the ungulate population.

Decision framework – Public stakeholders and regulatory bodies need a clear understanding of how IM areas are defined, alternatives to site-specific harvest objectives (e.g., measures of ungulate or range condition and trend, or harvest per unit effort), the decision framework (data needs and data quality), and the tradeoffs of implementing additional IM programs on existing agency workload. Implementing IM programs presently requires about one-third of the operations and salary budget of the Division of Wildlife Conservation in some regions. Maintaining long-term stable funding for IM is critical to achieve objectives with on-going programs. Intensive management programs that are ill-timed, ill-advised, or otherwise have low potential to achieve elevated harvests in a defined time frame have substantial costs in terms of human and financial resources and hinder the ability to conduct future IM programs.

Decision frameworks for individual practices and for IM programs should be based where feasible on predetermined criteria in a framework that incorporates principles of adaptive management, such as feedback on results of management practices, scientific uncertainty in monitoring data, and an assessment of the consequences of making incorrect decisions. Transparent criteria for implementing, modifying, continuing, or terminating IM programs will help ensure informed decisions that are effective and defensible.

Density dependence – Inverse relationship between population abundance in a defined area (density) and a biological rate or condition (e.g., nutritional status of ungulates as gauged by age of female at first birth or number of young born per reproductive event). For example, the proportion of female moose that give birth to twins tends to decrease as population density increases due to decreased nutritional condition. The effect of higher productivity and higher sustained yield at a density below carrying capacity may be counterintuitive but is a critical concept to understanding the need to adequately harvest an ungulate population released from predation effects so that it does not reach carrying capacity (Appendix K). The time lag between change in density and change in nutritional condition is an uncertainty factor in management and continues to be the subject of research efforts.

Depleted population – One which has had a dramatic decline in a short period or declined over time to an uncharacteristic low abundance compared to historic conditions in the area.

Elevated harvest – Increase in harvest yield (total ungulates or ungulates/unit area) from a population produced by active management of factors limiting population growth in a defined area. “Elevated” is a relative condition unique to each area and its ecological conditions. For example, elevated harvest in a remote area with multiple large predators may be substantially less (even after increase in ungulate abundance following predation control) than elevated harvest near urban centers where large predators are greatly reduced or absent because of human influence and predation on ungulates is already comparatively low. The increase over the abundance level existing prior to active management is sustainable in the long term but may vary over time. For example, managers may recommend an elevated harvest of adult females to reduce population growth rate and cause a temporary decline in abundance to meet a management objective for improved nutritional condition.

Habitat enhancement – Habitat is broadly defined as the environmental factors of food, water, and cover (shelter from elements or predators) and their spatial relationship to one another that allows wildlife to survive and reproduce in a given area. Habitat enhancement in northern forests typically involves stimulation of shrub or young tree growth to increase browse biomass (forage) on winter range of ungulates. This may be accomplished by mechanical disturbance (e.g., logging trees or crushing shrubs), prescribed fire (burns set by humans under specific conditions), or allowing wildland fires to burn where they don’t threaten other human resources. Management of habitat may also take the form of protecting some habitat features from human disturbance, such as maintaining adequate canopy cover of older (large) conifers to intercept snow on deer winter range in coastal forest. It may also include protecting areas of high lichen biomass in boreal forest from human-caused or natural fires to maintain winter range for caribou (high lichen biomass typically takes several decades to regrow after fire).

Predation control and predator regulation – *Predation control* in the biological context is reducing predation effects to a level that increases survival in the intended ungulate population and allows ungulate population growth in a comparatively short period. For wolves this is recognized to be at least 55% below pre-control levels (National Research Council 1997:184). Control is typically done by reducing abundance of predators in a defined area through lethal means but may include nonlethal means (e.g., translocation or sterilization). Control of wolves is rarely effective with typical harvest methods (hunting and trapping) and typically includes aircraft-assisted shooting. *Predator regulation* is reducing the abundance of predators to a level below their theoretical food-based carrying capacity (sometimes described as harvest limited; Gasaway et al. 1992). Regulation for wolves typically requires reductions of at least 30% below pre-treatment levels (e.g., Adams et al. 2008). Regulation to less than control levels may not produce rapid increases in intended prey abundance, but it might maintain increased ungulate survival following control programs or eventually allow ungulate populations to increase slowly if other mortality factors remain constant. There are few evaluations of black bear (Keech et al. 2011) or brown bear (Ballard and Miller 1990, Miller and Ballard 1992, Gardner 1995) reduction levels with concurrent monitoring of prey response from which to derive working definitions of regulation and control levels. Future research to define these parameters is recommended as a component of programs designed to manage bear predation.

This distinction between regulation and control explains why IM programs that address predation mortality can vary widely in participation (public harvest, public control, or Department control), spatial extent, and duration depending on factors unique to each IM area. Both predation control and predator regulation would be unsustainable if predators did not have the ability to increase by reproduction or immigration once proportional removal was reduced to less than the regulation threshold.

Predator control by the Department may also occur for public safety or for instances of biological emergency, where prompt Department action is warranted as the most effective method to recover depleted populations.

Predator population viability – "Maintenance of viable predator populations" is referenced but not defined in 5 AAC 92.106(2)(B). For the purpose of implementing IM while ensuring sustainability of predators, evidence that predator populations remain viable will be 1) existence of adjacent areas occupied by predators and in which predation control (removal rate >55% has not been conducted within 5 years; and 2) adequate (potentially increased) prey populations within predation control areas.

Contiguous expanses of occupied wolf and bear habitat exist across mainland Alaska with a few exceptions near urban centers where habitat fragmentation and humans substantially reduce or functionally exclude large predators. Predator control is conducted in rural areas typically surrounded by largely intact and relatively inaccessible wild lands. These refugia support source populations of bears and wolves that can recolonize control areas when programs are suspended.

Compared with wolves, bears are omnivorous and less dependent on prey biomass. However, bears remaining in predation control areas are expected to respond positively to increases in prey populations because of the effectiveness of some individuals to kill newborn calves as well as yearlings and adults and by scavenging prey not killed by bears (Boertje et al. 1988).

Unlike much of the conterminous United States, most areas of Alaska have undergone limited habitat encroachment by human settlement or habitat conversion (e.g., agriculture). However, trails for vehicle access and the number of airstrips have increased for recreation or resource development in some areas, facilitating increased hunter access and harvest. The number of recreational cabins has also increased in remote areas. As settlement expands into bear habitat, conflicts between bears and humans can occur. Black bears and brown bears can be killed in defense of life or property. The Department has public education programs on strategies to avoid bear habituation to human or livestock foods to minimize conflicts. Furthermore, the Department closely monitors harvest of bears and wolves.

Scientific basis – Public confidence in IM programs includes the expectation of an informed decision process for assessing feasibility, implementation, and evaluation. A strategy of focusing IM programs spatially and technically to where they are most effective in achieving elevated harvest will serve to optimize cost efficiency. Progress toward objectives should be measured precisely and objectively using reliable information to implement, modify, or suspend IM programs or individual practices within IM programs. Whereas monitoring of populations, habitat, and harvest is sufficient for management of ungulate harvest, IM to elevate harvest requires greater data collection and in some instances research to evaluate new techniques, document management experiments, or convince advisory committees to authorize harvest of female or young moose. Changes in IM programs should utilize new information and managerial experience as part of adaptive management.

Sustainability – Sustainability is the capacity to endure and provide for long-term maintenance of ecosystems that provide vital goods and services to humans and other organisms. Sustainability encompasses 3 main components (listed below) and includes planning and responsible management of resource use.

a) Ecological sustainability – Management actions to achieve or maintain elevated harvests of big game must sustain the ecological capabilities of an area (maintain productivity and avoid degradation of living resources) to sustain a range of consumptive and nonconsumptive uses of wild lands in the future. Density dependence is a critical concept in ungulate population management. Managers can improve nutritional condition and productivity of ungulates by reducing density (through increased harvest or allowing more predation) or by enhancing forage resources for a given ungulate density. Elevated harvest is the goal of IM. However, predators should be capable of increasing in the event that ungulate harvest is inadequate (for whatever reason) to mitigate ungulate damage to forage resources. Damage is defined as unsustainable use caused by persistent forage removal that exceeds regenerative capacity of a plant, leading to an increasing proportion of dead stems on the plant or causing plant mortality. Predators shape the structure and function of ecosystems by moderating ungulate population growth and by reducing localized browsing pressure (e.g., stimulate local movements of ungulates that seek to reduce risk of predation). Habitat management may involve wild land fire policy, prescribed fire, or forestry practices. Where habitat enhancement is impractical or difficult to effect, harvest of female and young ungulates may be critical to manage their nutritional condition and protect forage resources from unsustainable use.

Management of range for forage and other habitat functions (e.g., snow interception or wind shelter) provides the means to convert solar energy into animal protein, a trait common to domestic livestock and wild game production systems. Foraging often stimulates an increase in biomass production via a growth response by plants. Some level of foraging stress to plants is sustainable and indeed required to maximize forage production. Evidence of increase in proportional biomass removal should be viewed as a means to gauge effect of ungulate management on the forage base along a gradient. High but sustainable levels of removal may be acceptable, but at that level managers should ensure that tools to reduce ungulates or increase forage production are readily available to prevent range damage.

b) Social sustainability – Implementation and evaluation of IM programs requires public involvement. The range of public desires for wildlife resources requires different management strategies in different areas of the state. Some federal lands have conflicting mandates that may require additional administrative review and analysis related to potential approval and implementation of IM practices. Public lands compose about 89% of Alaska (29% state lands and 60% federal lands), and diverse resource management values are expressed by residents for state lands and by U.S. citizens (including Alaska residents) for federal lands. Implementation and evaluation of IM programs over the long term requires public understanding and acceptance of many factors, including 1) expectations or potential for "success" that may involve metrics of public satisfaction beyond the IM population and harvest objectives in codified regulation, 2) methods and means required to achieve objectives or other measures of "success," 3) economic tradeoffs among competing agency programs, 4) policy tradeoffs among competing public interests, and 5) reasons for different approaches in different situations.

Public acceptance is required to maintain political support for the means to achieve and maintain elevated harvests, including predation control, habitat enhancement, sufficient access to public or private lands, harvest of various sex and age classes of ungulates, and strategies to mitigate conflict over harvest. Assessment of hunter satisfaction includes quantity of ungulate harvest, effort expended per unit harvest, composition of harvest (including young and females), and other factors relating to the subjective quality of the hunting experience. Controversy over social factors associated with hunting has historically led to "pendulum swings" with changes in political administrations that jeopardize the potential to initiate IM or to maintain IM practices once begun. Thus, failure to mitigate contentious issues ahead of time reduces the reliability of achieving or maintaining elevated harvest through IM by stopping progress before the time required for increase in the prey population.

Hunter access may be improved through construction of trails or airstrips or by adjusting seasons to accommodate better access conditions. Management actions that result in more bulls to harvest often result in growth of the female segment of the population. When high populations of ungulates are achieved, there must be public understanding and majority support at the local Fish and Game advisory committee level and in the Board process for strategies of harvesting various sex and age classes. This type of harvest may be required to achieve the high levels of harvest specified in IM harvest objectives and to ensure that forage resources do not sustain long-term degradation from overuse.

Social tradeoffs associated with intensive management include food security concerns, satisfaction of hunters and other user groups, conflicts between public stakeholders, uncertainty of outcomes, allocation of ungulate harvest among residents (regions of state) and between residents and nonresidents, type of access, trespass on private property, methods and means of ungulate harvest or predator control, and other factors. Decisions on acceptable methods of game management and the levels and types of harvest should assess the tradeoffs of IM, including greater security of food supply through reduced reliance on red meat imported from outside Alaska (presently about 85% of total supply; Paragi et al. 2010) or other defined benefits for Alaskans. Support for IM is often greater in the local area where perceived benefits may directly accrue than in larger geographic regions or statewide because the public is often less informed on specific facets or potential outcomes of IM programs in distant areas.

Educational outreach and public participation in defining the objectives, methods, decision criteria, and acceptable outcomes are essential for individual IM practices and long-term sustainability of IM programs (e.g., Riley et al. 2003). Public stakeholders must recognize that various harvest strategies will be necessary and that annual weather events (deep snow or icing), shift in climate (e.g., warmer and drier conditions for inland areas), and other unpredictable factors will continue to affect population size and future harvest opportunities, regardless of IM practices. Uncertainty of the outcomes for proposed programs where area-specific parameters are unknown or poorly understood should be communicated so the public understands the expectation of timeframe to achieve objectives, potential for achieving objectives, and value of additional data collection to reduce scientific uncertainty. In some IM areas, outcomes other than harvest may have been identified (e.g., objective to restore the Fortymile caribou herd to its historic range).

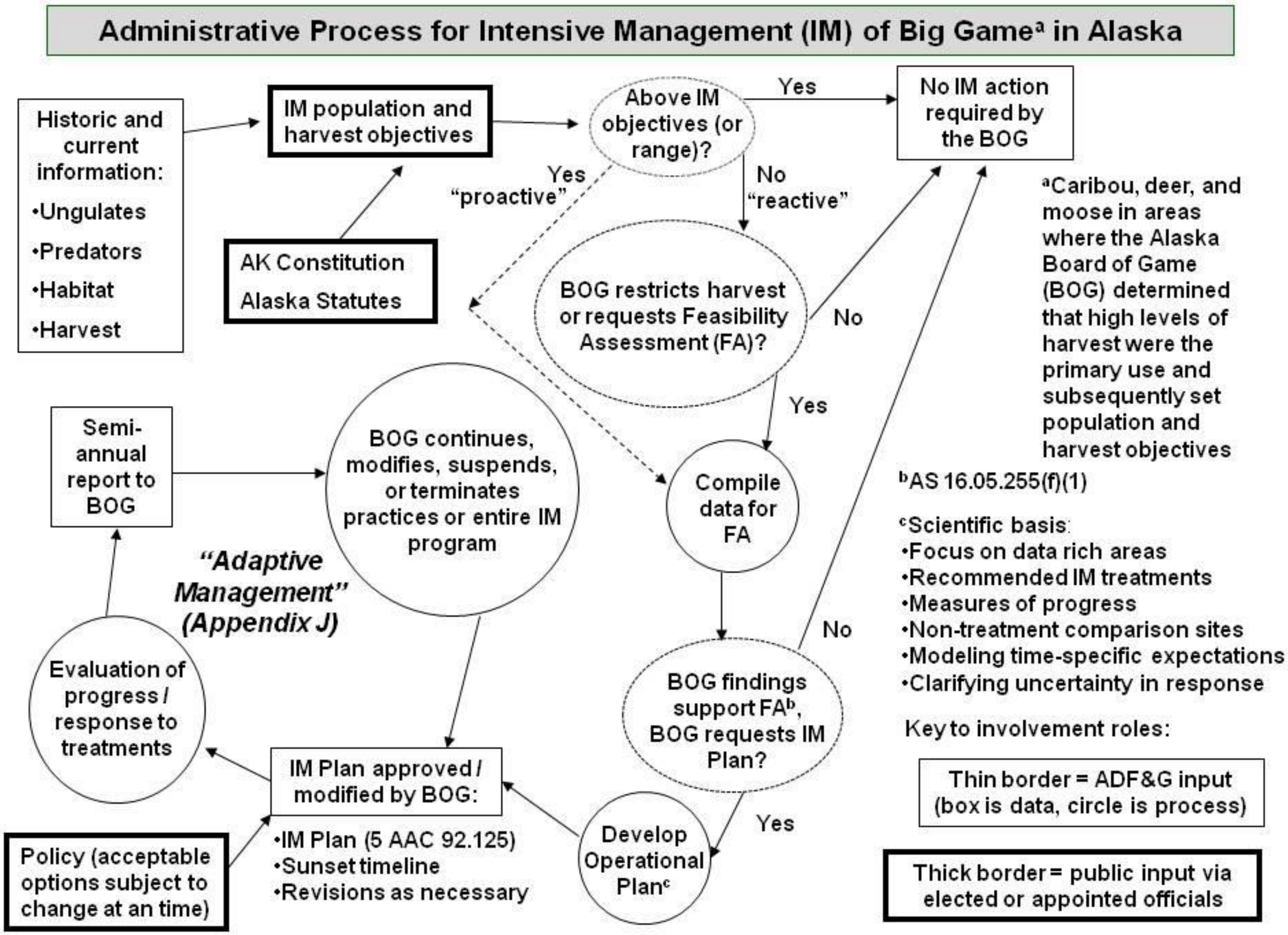
The public should also define risk tolerance (willing to accept consequences) for making incorrect decisions to implement or suspect predation control or conduct prescribed fire based on the precision of survey data for biological parameters. Public stakeholders and decision-makers should understand the tradeoffs with existing funding and agency workload for existing IM programs and other wildlife conservation programs when new IM programs are proposed.

c) Economic sustainability – Economics addresses the efficient allocation of scarce resources (standard comparison is monetary) to determine the mix that maximizes the benefits to society. Intensive management has potential to influence wild meat production (thus allocation among competing interests), recreational aspects of hunting, and wildlife viewing. Intensive management programs are supported by state license fees in a dedicated fund, matching federal aid revenue generated from an excise tax on firearms, ammunition, and archery equipment, as well as general funds from the state legislature. Conducting or administering lethal predation control is done with state funds. These expenditures must be perceived by hunting constituents and other members of the public as providing a net positive benefit to society relative to resources expended when evaluated with measures of added value.

The potential for the public to effectively carry out lethal control of predators is contingent on interest of participation (choice of activity) balanced with cost of participation (equipment, fuel, time). The pool of participants is fluid and is particularly important to the effectiveness of predation control programs in remote communities where the number of feasible participants (e.g., private pilots of fixed-wing aircraft) is often limited and operational costs are relatively high. Experimentation with public involvement in predator control can be costly but may illustrate options that become economically feasible with greater voluntary participation (e.g., growth in incentive to obtain bear meat by snaring instead of hunting). Where public participation is limited or access is difficult, Department-conducted control using helicopters may be more expensive, but greater flexibility in access may increase cost effectiveness if helicopters ultimately effect removal of adequate numbers of predators to increase ungulate survival, allowing population growth. Use of helicopters for wolf control early in the winter would be optimal to reduce predation before a decline in ungulate body condition (potentially increasing susceptibility to predation), but can be a conflict with the financial interests of local ground-based wolf trappers who would prefer agency control programs later in the winter.

Sustained yield – Sustained yield (any number harvested that does not cause a long-term population decline) is based on abundance and demography (age-sex composition). This number can be inferred by long-term monitoring of different harvest levels and associated monitoring of abundance to detect a decline, either directly (population estimate) or indirectly by other information. Sustained yield may also be represented as a harvest rate (proportion of total population), which requires a population estimate.

APPENDIX C. General diagram of the administrative process for intensive management in Alaska.



APPENDIX D. Important considerations for sustained yield when implementing predator management programs.

Managing ungulates for elevated harvest outside of urban and suburban Alaska requires sustained yield of prey and predators so that their populations persist over the long term (see state case law in Appendix A). Reducing predators by a significant amount to cause a decline in numerical abundance over a defined area does not mean the population will no longer be able to persist in that area. Sustainability of managed populations is defined in the context of a geographic area, abundance, and time.

First, geographic area defines ecological and population scale. Movements of wolves across vast areas of contiguous occupied habitat are well documented for mainland Alaska. Male black bears and male brown bears also have high dispersal capabilities, as do wolves of both sexes. What actually constitutes a population is subjective for mainland wolves and bears because even urban areas and the highest mountains represent only localized barriers to movement or gene flow among many populations across Alaska. Management-induced reductions in predator abundance at the scale of IM programs, even across relatively large areas of mainland Alaska, are small relative to the geographic extent of occupied predator habitat and not expected to have lasting effects due to the vast refugia where predators are relatively unexploited or completely protected (e.g., some national parks). As such, sustainability is achieved at the landscape scale because individuals are free to move and repopulate areas where abundance was reduced. Reoccupation of the Kenai Peninsula by wolves several decades after extirpation in early 20th century provides a context for geographically isolated areas (Peterson et al. 1984). Similar case studies documenting large predator recolonization of islands from mainland habitats following natural or human-caused extirpation on the islands do not exist for Alaska, but potential is presumed to decline with increasing distance and other factors influencing open-water crossings by predators.

Second, predators and prey exist naturally and in managed situations across a range of population abundance and demography, and their respective rates of survival and reproduction may also differ. For example, there are small, isolated moose populations (e.g., Berners Bay north of Juneau) that support a harvest of fewer than 10 animals per year. In contrast, similar sized areas in the Interior along access corridors (rivers, trails, roads) can support greater harvest because of large areas of contiguous moose habitat and immigration of moose from adjacent areas with limited hunter access. Both are sustainable harvest management systems. The same is true for predators. Predator density and rates of survival and mortality vary significantly across the state, yet most populations can sustain some level of harvest. Harvested predators can be replaced through reproduction and immigration from adjacent areas. Immigration is especially important for young bears requiring new range without competition from established bears. Predators at lower density may experience reduced natural mortality (e.g., harvesting adult male bears can result in less cannibalism). Thus, bear and wolf populations that are reduced by active management or control programs may still have a sustainable harvest, but it will be lower than the sustainable harvest at the prereduction level.

Finally, wildlife abundance naturally varies over time. This can occur annually (births and deaths or dispersal) and over decades (change in environmental conditions, such as climate and habitat). The ability of a given wildlife population to sustain a certain level of harvest will thus vary relative to changing conditions. The temporal aspect of the sustainable harvest will depend on the duration of the predator reductions and its relationship to carrying capacity and population growth potential for the predator. In practice, sustainable harvest for reduced wolf and bear populations is no different than sustainable harvest of reduced ungulate populations near urban areas to reduce wildlife-human conflict. In both instances, reduced density on the same range generally means better nutritional condition (less competition for food) and often higher reproductive rates. Wolves and bears can be maintained purposefully at lower abundance than prey resources could support but will have the potential to recover in abundance when removal is lessened or ceased, particularly when prey densities have increased (the intent of IM programs).

To define the maximum sustainable removal of predators in a specific area for a given period, studies will require temporarily reducing predator populations for a defined period to a lower density (abundance per unit area) than the habitat and food resources would otherwise support (see definition of “regulation” in Appendix B). The maximum sustainable yield depends on environmental conditions, thus can change over time. Replicate studies in different areas of similar habitat would strengthen inference. Modeling simulations using recently acquired demographic data on various populations may also provide insights on sustainable removal rates. Presently there is no evidence from changes in annual harvest data or other information that any wolf (Harper 2009a), black bear (Harper 2008), or brown bear (Harper 2009b) population in Alaska at the spatial scale of game management subunit is in long-term decline in abundance as a result of harvest or a predation control program. The Department recognizes that caution is required when using harvest data alone to infer bear demography or trend in abundance (e.g., Harris and Metzgar 1987, Garshelis 1990).

Recovery from abundance reduction

Population recovery rate is defined for this document as the time, following strong reductions, when prior abundance is achieved. There are several case studies from Alaska and western Canada on recovery rates of wolves following population reductions. Increase in ungulate prey biomass within control areas has stimulated density-dependent increases in wolf reproduction (Boertje and Stephenson 1992). This phenomenon, in concert with immigration (Adams et al. 2008), has allowed wolf populations that were reduced by 49–86% from pre-control abundance to regain or exceed pre-control abundance in as few as 3 years after 8 control programs (5 with quantified pre-control abundance) ended in Alaska and western Canada (National Research Council 1997:52–53). This recovery occurred often while ground-based hunting and trapping of wolves continued.

A recent study in Interior Alaska measured black bear population recovery after an experiment where bears were captured and translocated out of the control area. Black bears were reduced during 2003 and 2004 in the McGrath area of Unit 19D from an estimated population of approximately 96 independent bears (males and females ≥2 years old) to 4 bears in the study area by 2004. By 2007, there were approximately 70 black bears in the study area (Keech et al. 2011), and by 2010 there were approximately 105 black bears (Alaska Department of Fish and Game, unpublished data, Fairbanks). During the post-treatment recovery phase, bear harvest was allowed, but relatively few black bears (4–5 annually) were taken in the study area. This suggests that black bear density in a small remote area with surrounding refugia can recover to pre-removal density in about twice the time that wolves take to recover (see prior paragraph), albeit in much larger areas. Over the past few decades, black bears have reestablished populations across many areas of their historic range in the United States, attesting to the dispersal capability and resilience of this species (e.g., Garshelis and Hristienko 2006).

There have been 2 experimental reductions of Interior brown (grizzly) bears in central Alaska with corresponding estimates of abundance. The first experimental area was the upper Susitna River drainage on the south side of the Alaska Range. This area included 2 evaluations of density change relative to harvest in areas of different hunter accessibility where maximum sustained yield was assumed to be 5% (Miller 1993). Ballard and Miller (1990) reported effects of a Department translocation of 47 bears (about 60% of the studied population) in 1979 from a study area on the border of Units 13B and 13E accessible to the Denali Highway. Miller (1990) then compared the 1979 density estimate to a subsequent estimate in 1987. Despite liberalized hunting opportunity and substantially increased harvest in the study area during this period, change in brown bear population density was statistically insignificant (Miller 1990:Fig. 4). The cumulative harvest rate from marked animals during this period was 8% (Miller 1993:14). A nearby study area more remote from the highway was surveyed in 1985 and again in 1995. Brown bear density increased marginally from 1985 to 1995 with an estimated harvest rate derived from marked animals of 10.8% during 1980–1995 (Miller 1997:9–10). With continued harvest liberalization in Unit 13, the take of brown bears continued to increase unit-wide and has remained relatively high and stable since the early 1990s. Tobey and Schwanke (2009) reported an annual harvest rate of approximately 10% for Unit 13 based on recent extrapolated population estimates. No significant trends in sex ratio, age, skull size, or other harvest data have been detected in recent years, suggesting little change in brown bear population demographics or abundance in Unit 13 during this period. Since 2006, research has been conducted in a heavily hunted portion of Unit 13A that aims to improve our understanding of brown bear movements, population dynamics, and effects of harvest through the use of radiotelemetry and population surveys (Tobey and Schwanke 2010).

The second experimental reduction in brown bears was conducted in 3 phases in Unit 20A on the north side of Alaska Range. This study began in 1981 and produced an initial brown bear density estimate in 1986, monitored a brown bear harvest increase from 6.5% (average 1965–1980) to 11% (average 1986–1991), and produced a subsequent density estimate in 1992. The study documented a 36% decline in bears ≥2 years old (32% decline in adult females) based on direct observation methods (change was not statistically significant because of low density of bears; Reynolds 1997:2–3). Although the sustainable rate of adult female harvest was modeled considering natural mortality also, a definitive evaluation of the 11% harvest rate for both sexes was not completed. However, Reynolds and Ver Hoef (2000:8) noted that if their estimates of 2–5 year old female survival rates were accurate and preliminary estimates of sustained yield for this population could be validated with other modeling, "…many bear populations in Alaska could be subjected to higher mortality rates than are presently allowed with minimal effect." Brown bear harvest in Unit 20A has been subsequently managed for an estimated 3-year average rate of ≤8% for bears ≥2 years old (Young 2009) to be conservative until there is a definitive evaluation of the higher harvest rate.

A multi-agency study of coastal brown bear abundance at apparently sustainable harvest rates occurred at Black Lake on the Alaska Peninsula (Unit 9E). This population has ready access to major salmon runs and has been managed for trophy qualities (e.g., abundance of large males). Miller and Sellers (1992) estimated brown bear abundance in 1989 and proportional harvest as 7.7% of the studied population (all age classes) based on marked bears in the study area, 6.4–7.1% by extrapolating density to a portion of the study area (all age classes) and comparing harvest, and 11.4% from bears ≥2 years old that were marked in the study area within 2 years of harvest. The last estimate was within the harvest range reported from the 1970s for this area (8.5–17.1% for bears ≥2 year). Bear abundance has apparently remained stable in the study area, with aerial stream counts of bears averaging 145 during 1998–2002 compared to an average of 121 during 1991–1996 (Sellers 2003). There has been stable age-sex composition of bears observed in stream surveys and stable sex ratio in the harvest generally across Unit 9 since the early 2000s (Butler 2009).

Despite increased information from these 3 study areas, further research is required to estimate the maximum sustainable yield before a long-term decline in abundance would occur for these and other brown bear populations. Comparatively more is known about sustainable harvest rates in Alaska for wolves (e.g., Table 7 in Adams et al. 2008) than bears (Harper 2008, 2009b).

Where bear population estimates are lacking to quantify harvest rates, area wildlife managers gauge trends in populations through harvest data and other incidental information (e.g., reports from local pilots or residents). Black bear harvest is monitored through mandatory hunter reporting on harvest tickets or having a metal seal affixed to the hide and skull. Brown bear harvest requires mandatory sealing statewide. Managers monitor long-term harvest data for significant trends or abrupt changes in overall harvest numbers, harvest chronology, harvest location, sex ratio, age, and skull size that are expected to corroborate trends in population demographics and abundance. Harvest data are best examined over larger areas that permit greater sample sizes and integrate movements of animals that could confound understanding of population dynamics at smaller scales, particularly where degree of immigration from adjacent areas less accessible to hunters or areas closed to hunting is unknown (e.g., Tobey and Schwanke 2009). Alternatively, defining harvest rates precisely from bear population estimates in a given area and time period has expenses and logistic challenges that exceed those for remote ungulate surveys at low density. If large or rapid changes in parameters of bear harvest occur, research on root causes is warranted. The use of harvest data to infer bear demography or trend in abundance (Harris and Metzgar 1987, Garshelis 1990) and the level of research validation necessary for bear management programs in Alaska (e.g., Miller et al. 2011) are topics of debate among scientists.

APPENDIX E. Relationship between intensive management documents from the Alaska Department of Fish and Game (feasibility assessments, operational plans, reports to the Alaska Board of Game) and intensive management principles and guidelines.

IM PRINCIPLE	1. Ecological sustainability			2. Scientific information			3. Social sustainability									4. Explicit decisions	5. Economic sustainability	
IM GUIDELINE	1.1 a	1.1 b	1.1 c	2.1 a	2.1 b	2.1 c	3.1 a	3.1 b	3.1 c	3.2 a	3.2 b	3.2 c	3.2 d	3.2 e	3.2 f	4.1	5.1	5.2
GUIDELINE DESCRIPTION	Nutrition of prey	Habitat management	Predator population viability, post-control recovery	Size and location of intensive management area	Scientific methods	Monitoring, research, non-treatment comparisons	Define objectives, parameters, measures of progress	Identify and mitigate stakeholder conflicts	Hunter acceptance of harvest methods	Stakeholders affirm objectives and acceptable practices	Communication	Clarify uncertainty of outcomes	Feasibility assessment provided to Board of Game	Regular assessment of progress	Evaluation of intensive management objectives	Decision framework, data quality, tradeoffs	Costs and results	Public involvement in predator control
Feasibility Assessment	X	X	X			X	X	X	X		X	X	X		X			X
Operational Plan	X	X	X	X	X	X	X	X		X	X	X			X	X		X
Department Report			X	X		X					X			X			X	X

APPENDIX F. Abbreviated outline of feasibility assessment template.

- Overall assessment of potential to increase harvest
- Department recommendation on management strategy and measures of progress
- Biological factors
- Societal factors
- Economic factors
- Availability of biological and harvest information
- Potential to achieve ungulate population and harvest objectives
- Review of IM objectives, current status, and management strategy
- Appendix A. Legal elements and criteria for IM objectives and a feasibility assessment
- Appendix B. Feasibility assessment in the context of multiple IM programs

APPENDIX G. Abbreviated outline of operational plan template.

- Background
- Adaptive Management Framework
  - Treatments (e.g., predators, prey, prey harvest, habitat)
  - Anticipated response to treatments
  - Evaluation criteria and study design to document treatment response
  - Decision framework to implement or suspend a treatment
  - Public involvement
  - Other considerations
- Appendix. Summary of supporting information

APPENDIX H. Abbreviated outline of department report template.[19]

- Description of IM program and Department recommendation for reporting period
- Prey data
- Predator data
- Habitat data and nutritional condition of prey species
- Costs specific to implementing intensive management
- Department recommendation details (annual) or program evaluation (renewal year)
- Appendix. Purpose and context of department report

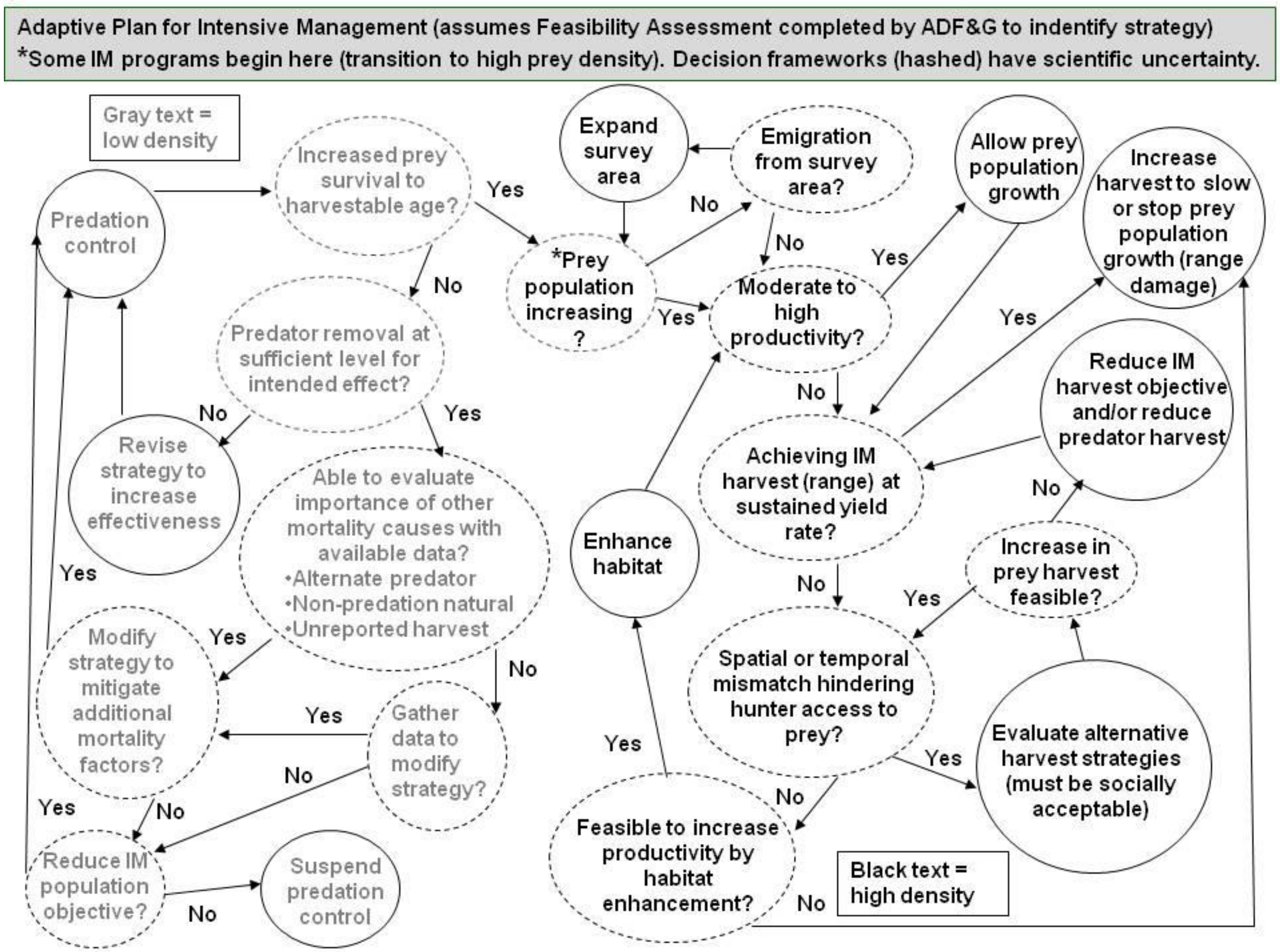
[19] This outline is for the annual report in February. The semi-annual update in August includes only sections with new information collected since February of the same year.

APPENDIX I. Biological risk factors[a] in decisions on whether to start or end predation control for increased prey abundance based on results of population survey that has uncertainty in measuring the true but unknown prey abundance.

Option →	Start predation control				End predation control			
Decision ↓	Take action		Take no action		Take action		Take no action	
Prey abundance estimated from survey greater than management objective (true but unknown abundance)?	Yes	No	Yes	No	Yes	No	Yes	No
Risk factor (consequence of incorrect decision based on survey estimate)	Continued prey population growth (decline in nutritional condition)[b]	None[c]	None	Continued low prey abundance and delayed recovery[d]	None	Continued low prey abundance and delayed recovery	Continued prey population growth (decline in nutritional condition)	None

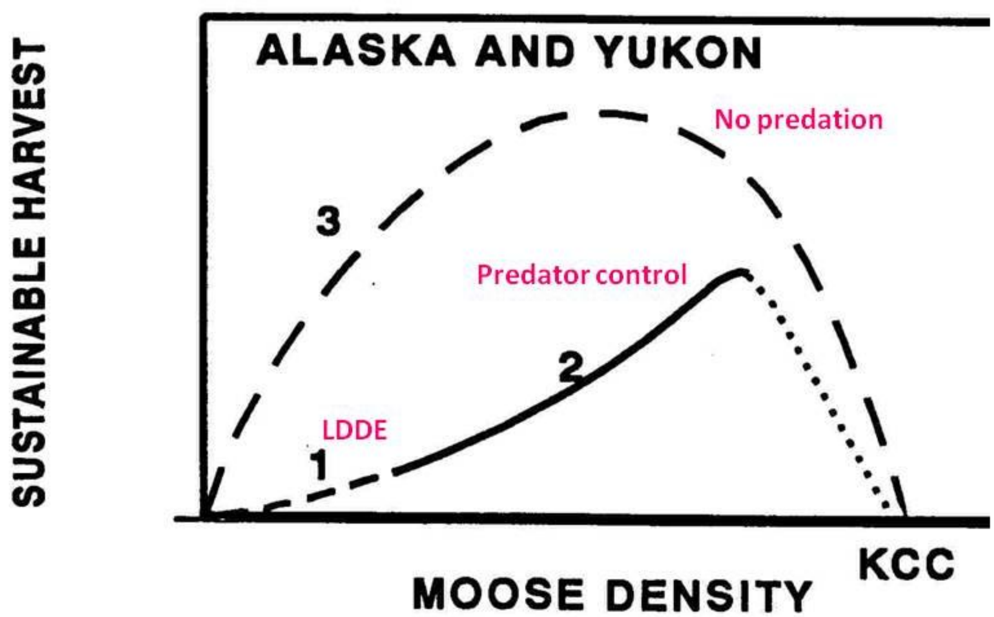
[a] Risk defined in context of prey; assumes predator abundance will recover when predation control ends.
[b] Adequate harvest across all age and sex classes of an ungulate could prevent continued population growth and potential range damage. However, risk occurs if access for hunts is poor or the level of harvest in accessible areas is constrained (e.g., authority of Fish and Game advisory committees to prohibit antlerless harvest of moose) to limit competition or maintain the quality experience of the hunt.
[c] Risk defined as "none" assumes that the moose density at the management objective is sustainable for the present condition of habitat in the survey area.
[d] Biological risk has management implication of prolonged low yield of sustainable prey harvest.

APPENDIX J. General diagram of adaptive management for intensive management of big game in Alaska.



APPENDIX K. Conceptual model for increasing sustainable harvest of moose based on case studies from Alaska and Yukon.

Food-based carrying capacity (Kcc) represents the maximum number of animals that can be supported on a defined landscape (density). Food-based carrying capacity is the point where individuals are in poor nutritional condition with low reproductive output, and forage resources may be damaged by unsustainable browsing or grazing. Experimental research on ungulates where no predation occurs (scenario 3) demonstrates that the highest survival of young, greatest rate of population growth, and highest sustainable harvest is at about half of Kcc. Natural situations with large predators in boreal forest keep moose at a low density dynamic equilibrium (LDDE) of 0.1–1.1 moose/mi^2, which allows a relatively low sustainable harvest (scenario 1). Adequately reducing predation by wolves and bears in boreal systems has allowed increased harvest of moose (scenario 2). The relative importance of predation by wolves and bears varies among areas, and the relative effectiveness of reducing primarily one predator to increase moose harvest where one or more predators exist is not well documented.[20]



---

[20] Figure modified from Figure 18b in Gasaway et al. 1992.

APPENDIX L. Literature cited.[21]

ADAMS, L. G., R. O. STEPHENSON, B. W. DALE, R. T. AHGOOK, AND D. J. DEMMA. 2008. Population dynamics and harvest characteristics of wolves in the central Brooks Range, Alaska. Wildlife Monographs 170.

BALLARD, W. B., AND S. D. MILLER. 1990. Effects of reducing brown bear density on moose calf survival in southcentral Alaska. Alces 26:9–13

BOERTJE, R. D., AND C. L. GARDNER. 2003. Reducing mortality on the Fortymile caribou herd. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Performance Report. Grants W-27-1 through W-33-1, Project 3.43. Juneau, Alaska.

BOERTJE, R. D., W. C. GASAWAY, D. V. GRANGAARD, AND D. G. KELLEYHOUSE. 1988. Predation on moose and caribou by radio-collared grizzly bears in east central Alaska. Canadian Journal of Zoology 66:2492–2499.

BOERTJE, R. D., M. A. KEECH, AND T. F. PARAGI. 2010. Science and values influencing predator control for Alaska moose management. Journal of Wildlife Management 74:917–928.

BOERTJE, R. D., AND R. O. STEPHENSON. 1992. Effects of ungulate availability on wolf reproductive potential in Alaska. Canadian Journal of Zoology 70:2441–2443.

BUTLER, L. 2009. Unit 9 brown bear. Pages 113–124 *in* P. Harper, editor. Brown bear management report of survey and inventory activities 1 July 2006–30 June 2008. Alaska Department of Fish and Game. Grants W-33-5 and W-33-6, Project 4.0. Juneau, Alaska.

GARDNER, C. L. 1995. Unit 20E brown bear. Pages 221–238 *in* M. V. Hicks, editor. Alaska Department of Fish and Game. Brown bear management report of survey and inventory activities 1 July 1992–30 June 1994. Grants W-24-1 and W-24-2, Study 4.0. Juneau, Alaska.

GARSHELIS, D. L. 1990. Monitoring effects of harvest on black bear populations in North America: A review and evaluation of techniques. Proceedings of the Eastern Workshop Black Bear Research and Management 10:120–144.

GARSHELIS, D. L., AND H. HRISTIENKO. 2006. State and provincial estimates of American black bear numbers versus assessments of population trend. Ursus 17:1–7.

GASAWAY, W. C., R. D. BOERTJE, D. V. GRANGAARD, D. G. KELLEYHOUSE, R. O. STEPHENSON, AND D. G. LARSEN. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monographs 120.

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

[21] The electronic archive of wildlife research and management reports for the last decade is at http://www.adfg.alaska.gov/index.cfm?adfg=librarycollections.publicationsreports

HARPER, P. EDITOR. 2009a. Wolf management report of survey and inventory activities 1 July 2005–30 June 2008. Alaska Department of Fish and Game. Grants W-33-4 through W-33-6, Project 14.0. Juneau, Alaska.

HARPER, P. EDITOR. 2009b. Brown bear management report of survey and inventory activites 1 July 2006–30 June 2008. Alaska Department of Fish and Game. Grants W-33-5 and W-33-6, Project 4.0. Juneau, Alaska.

HARPER, P., EDITOR. 2008. Black bear management report of survey and inventory activities 1 July 2004–30 June 2007. Alaska Department of Fish and Game. Grants W-33-3 through W-33-5. Project 17.0. Juneau, Alaska.

HARRIS, R. B., AND L. H. METZGAR. 1987. Estimating harvest rates of bears from sex ratio changes. Journal of Wildlife Management 51:802–811.

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

KEECH, M. A., M. S. LINDBERG, R. D. BOERTJE, P. VALKENBURG, B. D. TARAS, T. A. BOUDREAU, AND K. B. BECKMEN. 2011. Effects of predator treatments, individual traits, and environment on moose survival in Alaska. Journal of Wildlife Management 75:1361–1380.

KIRCHHOFF, M. D., AND J. W. SCHOEN. 1987. Forest cover and snow: implications for deer habitat in southeast Alaska. Journal of Wildlife Management 51:28–33.

MILLER, S. D. 1990. Detection of differences in brown bear density and population composition caused by hunting. International Conference on Bear Research and Management 8:393–404.

MILLER, S. D. 1993. Impacts of increased hunting pressure on the density, structure, and dynamics of brown bear populations in Alaska's Game Management Unit 13. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Report. Projects W-22-6 and W-23-1 through W-23-5, Study 4.21. Juneau, Alaska.

MILLER, S. D. 1997. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in southcentral Alaska. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Report. Projects W-24-2 through W-24-4, Study 4.26. Juneau, Alaska.

MILLER, S. D., AND W. B. BALLARD. 1992. Analysis of an effort to increase moose calf survivorship by increased hunting of brown bears in south-central Alaska. Wildlife Society Bulletin 20:445–454.

MILLER, S. D., J. W. SCHOEN, J. FARO, AND D. R. KLEIN. 2011. Trends in intensive management of Alaska's grizzly bears, 1980–2010. Journal of Wildlife Management 75:1243–1252.

MILLER, S. D., AND R. A. SELLERS. 1992. Brown bear density on the Alaska Peninsula at Black Lake, Alaska. Final report on the density estimation objective and progress report on other objectives of cooperative interagency brown bear studies on the Alaska Peninsula. Alaska.

NATIONAL RESEARCH COUNCIL. 1997. Wolves, bears, and their prey in Alaska. National Academy Press, Washington, D.C.

PARAGI, T. F., S. C. GERLACH, AND A. M. MEADOW. 2010. Security of the red meat supply in Alaska. Agroborealis 41:36–37. http://www.uaf.edu/snras/publications/agroborealis/ (Accessed 10 October 2011).

PETERSON, R. O., J. D. WOOLINGTON, AND T. N. BAILEY. 1984. Wolves of the Kenai Peninsula, Alaska. Wildlife Monographs 88.

REGELIN, W. L., P. VALKENBURG, AND R. D. BOERTJE. 2005. Management of large predators in Alaska. Wildlife Biology in Practice 1:77–85.

REYNOLDS III, H. V. 1997. Effects of harvest on grizzly bear population dynamics in the northcentral Alaska Range. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Report. Grants W-24-1 through W-24-4, Study 4.25. Juneau, Alaska.

REYNOLDS III, H. V., AND J. M VER HOEF. 2000. Effects of harvest on grizzly bear population dynamics in the northcentral Alaska Range. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Research Performance Report. Grants W-24-5 through W-27-2, Study 4.28. Juneau, Alaska.

RILEY, S. J., W. F. SEIMER, D. J. DECKER, L. H. CARPENTER, J. F. ORGAN, AND L. T. BERCHIELLI. 2003. Adaptive impact management: An integrative approach to wildlife management. Human Dimensions of Wildlife 8:81–95.

SCHOEN, J. W., AND M. D. KIRCHHOFF. 1990. Seasonal habitat use by Sitka black-tailed deer on Admiralty Island, Alaska. Journal of Wildlife Management 54:371–378.

SELLERS, R. A. 2003. Unit 9 brown bear management report. Pages 103–113 *in* C. Healy, editor. Brown bear management report of survey and inventory activities 1 July 2000–30 June 2002. Alaska Department of Fish and Game. Grants W-27-4 and W-27-5, Project 4.0. Juneau, Alaska.

SMITH, C. A. 2011. The role of state wildlife professionals under the public trust doctrine. Journal of Wildlife Management 75:1539–1543.

TITUS, K. 2007. Intensive management of wolves and ungulates in Alaska. Transactions of the North American Wildlife and Natural Resources Conference 72:366–377.

TOBEY, R., AND B. SCHWANKE. 2010. Nelchina brown bear demographics. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Annual Performance Report. Grant W-33-8, Project 4.41. Juneau, Alaska.

TOBEY, R. W., AND R. A. SCHWANKE. 2009. Unit 13 brown bear. Pages 147–158 *in* P. Harper, editor. Brown bear management report of survey and inventory activities 1 July 2006–30 June 2008. Alaska Department of Fish and Game. Grants W-33-5 and W-33-6, Project 4.0. Juneau, Alaska.

WALTERS, C. J. 1986. Adaptive management of renewable resources. Blackburn Press, Caldwell, New Jersey.

YOUNG JR, D. D. 2009. Units 20A, 20B, 20C, 20F, and 25C brown bear. Pages 215–232 *in* P. Harper, editor. Brown bear management report of survey and inventory activities 1 July 2006–30 June 2008. Alaska Department of Fish and Game. Grants W-33-5 and W-33-6, Project 4.0. Juneau, Alaska.