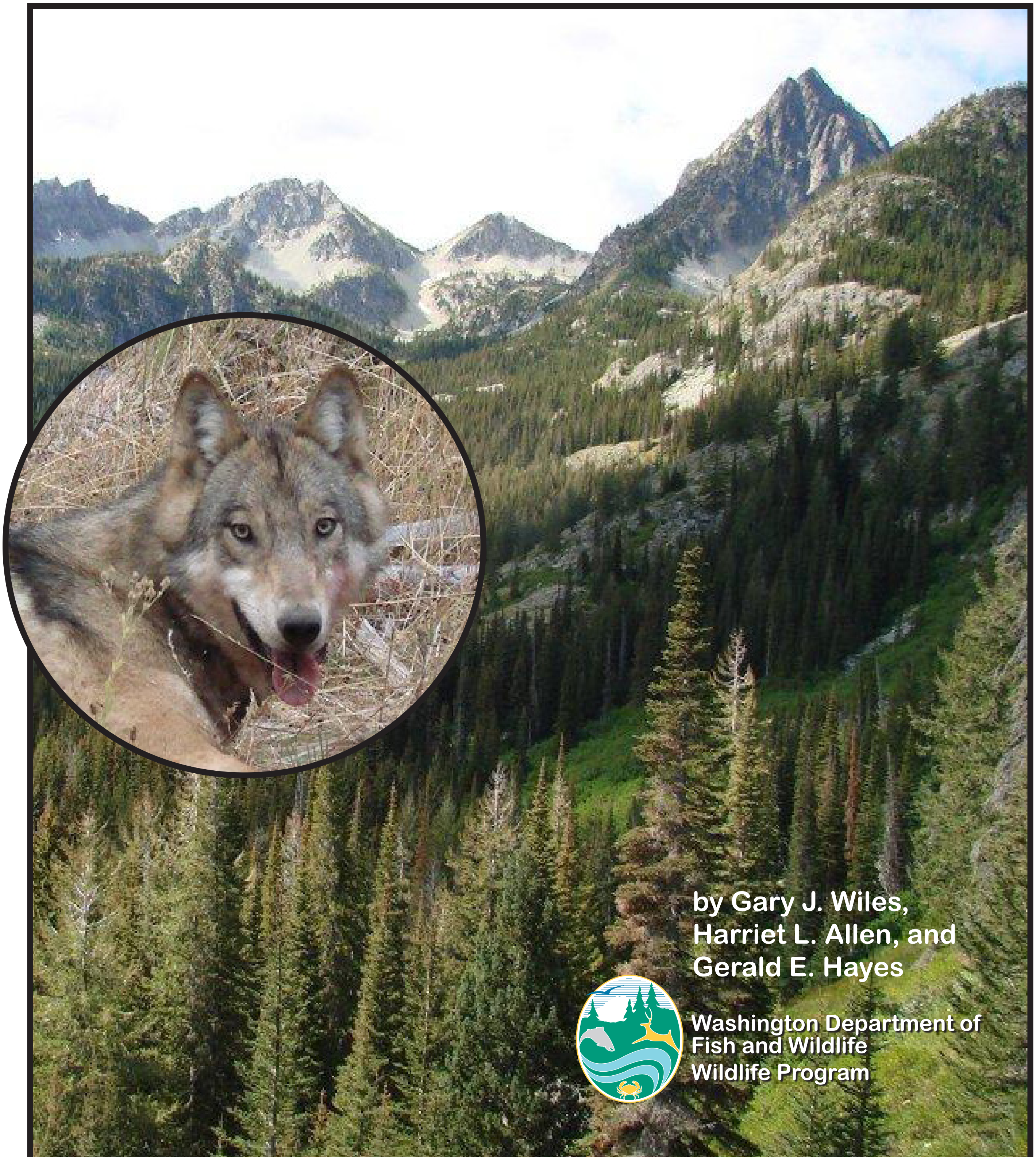
Wolf Conservation and Management Plan

STATE OF WASHINGTON December 2011



by Gary J. Wiles,
Harriet L. Allen, and
Gerald E. Hayes

Washington Department of
Fish and Wildlife
Wildlife Program

In 1990, the Washington Wildlife Commission adopted procedures for listing and delisting species as endangered, threatened, or sensitive and for writing recovery and management plans for listed species (WAC 232-12-297, Appendix A). The procedures, developed by a group of citizens, interest groups, and state and federal agencies, require preparation of recovery plans for species listed as threatened or endangered. This Wolf Conservation and Management Plan summarizes the historical and current distribution and abundance of wolves in Washington and describes factors that affect wolf recovery. It provides recovery goals for downlisting and delisting the species and prescribes strategies to achieve these goals, including management of conflicts with livestock and ungulates. As such, it serves as the recovery plan for wolves in Washington, per WAC 232-12-297.

A Draft EIS/Wolf Conservation and Management Plan for Washington was developed by the Washington Department of Fish and Wildlife (WDFW) during 2007-2009 and the Final EIS/Recommended Plan was completed in 2011 following public review. WDFW received extensive input from the advisory Wolf Working Group, which was comprised of 17 citizens from a broad range of perspectives and values. The group met eight times over a 15-month period in 2007 and 2008 to develop recommendations to the Department on a plan that would achieve wolf conservation and management. Following peer review by 43 reviewers, WDFW addressed their comments and met again with the Wolf Working Group in 2009 to review the changes. The Working Group provided additional comments on the revised draft, which were then incorporated in the Public Review Draft EIS/Plan. This document underwent a 95-day public review and blind peer review by 3 anonymous reviewers in 2009-2010. Nearly 65,000 people provided comments on the Draft EIS/Plan. WDFW addressed the public input and met with the Working Group in June 2011 for review and comment on the proposed changes. The Final EIS/WDFW Recommended Plan was presented to the Washington Fish and Wildlife Commission for consideration on August 4, 2011. The Commission held three workshops on the plan from August through November 2011, where additional public comment was taken. On December 3, 2011, the Fish and Wildlife Commission unanimously adopted the Recommended Plan, with revisions. Information on the full process to develop the plan is posted at:
http://wdfw.wa.gov/conservation/gray_wolf/mgmt_plan_process.html.

For additional information about wolf recovery or other state listed species, see:
http://wdfw.wa.gov/conservation/endangered/, or contact:

Endangered Species Section Manager
Washington Department of Fish and Wildlife
600 Capitol Way North
Olympia, WA 98501-1091

This plan should be cited as:
Wiles, G. J., H. L. Allen, and G. E. Hayes. 2011. Wolf conservation and management plan for Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 297 pp.

Cover photos by Gary J. Wiles.

WOLF CONSERVATION AND MANAGEMENT PLAN FOR WASHINGTON

Prepared by

Gary J. Wiles
Harriet L. Allen
Gerald E. Hayes

Washington Department of Fish and Wildlife
Wildlife Program
600 Capitol Way N
Olympia, Washington

December 2011

TABLE OF CONTENTS

ACKNOWLEDGMENTS 6
EXECUTIVE SUMMARY 8
1. INTRODUCTION 12
2. BACKGROUND 16
  A. History of Wolves in Washington and Surrounding Areas 16
  B. Current Status of Wolves 20
  C. Biology 25
  D. Legal Status 36
  E. Social, Cultural, and Economic Values 40
3. WOLF CONSERVATION 46
  A. Scientific Basis for Conservation Planning 46
  B. Recovery Objectives for Washington 58
  C. Management after Delisting 70
4. WOLF-LIVESTOCK CONFLICTS 72
  A. Wolf Depredation on Livestock 72
  B. Management Tools for Reducing Wolf Depredation 76
  C. Compensation Programs for Wolf-Related Losses and Deterrence in Other States 81
  D. Predicting Losses of Ranch Animals in Washington Due to Wolves 84
  E. Management of Wolf-Livestock Conflicts in Washington 85
  F. Proactive Measures to Reduce Wolf-Livestock Conflicts in Washington 89
  G. Compensation for Wolf-Caused Livestock Depredation in Washington 90
5. WOLF-UNGULATE INTERACTIONS 95
  A. Wolf Predation of Ungulates 95
  B. Recent Impacts of Wolves on Ungulates in Other States 99
  C. Ungulate Status in Washington 101
  D. Wolf-Ungulate Interactions on Wintering Grounds 113
  E. Predicted Levels of Wolf Predation on Ungulates in Washington 114
  F. Management of Wolf-Ungulate Interactions in Washington 115
6. WOLF INTERACTIONS WITH OTHER SPECIES 118
  A. Wolves and Other Carnivores 118
  B. Wolves and Scavengers 121
  C. Wolves and Listed/Candidate Species 121
7. WOLF-HUMAN INTERACTIONS 123
  A. Human Safety 123
  B. Interactions with the Public 125
  C. Interactions with Domestic Dogs 126
  D. Wolf Hybrids and Pet Wolves 127
  E. Tapeworm Disease and Wolves 128
8. LAND MANAGEMENT 130
  A. Federal Land 130
  B. State Land 131
  C. Private Land 131
9. INFORMATION AND EDUCATION 133
10. RESEARCH 134

11. REPORTING AND EVALUATION 135
12. GOALS, OBJECTIVES, STRATEGIES, AND TASKS 136
A. Goals 136
B. Objectives, Strategies, and Tasks 136
13. COSTS AND FUNDING PRIORITIES FOR IMPLEMENTATION 160
14. ECONOMIC ANALYSIS 166
A. Washington's Population and Economy 167
B. Livestock Production 167
C. Big Game Hunting 182
D. Wildlife Tourism 195
E. Forest Products Industry 200
F. Other Potential Economic Impacts 201
15. LITERATURE CITED 202
PERSONAL COMMUNICATIONS 230
GLOSSARY OF TERMS 232
Appendix A. Washington laws: Washington Administrative Code 232-12- 011 237
Appendix B. WDFW Wolf Working Group members. 243
Appendix C. The Wolf Working Group letter from June 30, 2008, that accompanied the August 2008 peer review draft of the Wolf Conservation and Management Plan. 245
Appendix D. A list 43 reviewers submitting comments on the draft Wolf Conservation and Management Plan during the scientific peer review period conducted from August to October 2008 and the blind peer review period from October 2009 to February 2011. 247
Appendix E. A map of Washington's 39 counties 248
Appendix F. Washington laws: (1) Revised Code of Washington 77.36. Wildlife damage, and (2) Washington Administrative Code 232-36. Wildlife interaction regulations. 249
Appendix G. Development of wolf population models for RAMAS© analysis by the Washington Department of Fish and Wildlife. 265
Appendix H. Results of nine scenarios of wolf population modeling in Washington 277
Appendix I. Summary of the Wolf Working Group's discussions related to the recovery objectives, recovery regions, and translocation elements of the plan 280
Appendix J. The minority report on proposed numbers of successful breeding pairs for achieving the downlisting and delisting of wolves in Washington, which was submitted by six members of the state's Wolf Working Group in May 2008. 284
Appendix K. Current response guidelines for reporting suspected wolf activity in Washington 286

LIST OF TABLES

Table 1. Miscellaneous reports of wolves in Washington from 1916 to the 1950s. 19
Table 2. Prey selection by wolves at various locations in the central and northern Rocky Mountains of the United States and Canada and other areas of British Columbia. 29
Table 3. Land ownership of potentially suitable wolf habitat (≥50% probability of occupancy, modeled by B. Maletzke, using Oakleaf et al. 2006) in the three recovery regions in WA.........63
Table 4. Range of numbers of packs, lone wolves, and total number of wolves that might correspond to numbers of successful breeding pairs at different recovery stages in WA..........65
Table 5. Confirmed livestock and dog losses from wolf predation in Idaho, Montana, and Wyoming, 1987-2010. 74
Table 6. Confirmed livestock and dog losses from wolf predation in Minnesota, Wisconsin, and Michigan during even-numbered years from 1980-2008..75
Table 7. Percent use of different proactive methods among ranchers and farmers employing such techniques to prevent predation losses of livestock in Washington....................................78
Table 8. Predicted estimates of confirmable depredations of livestock and domestic dogs for four different future population size categories of wolves in Washington.. 85
Table 9. State management options to address depredation of livestock during wolf recovery phases in Washington. 86
Table 10. Compensation levels for each confirmed and probable wolf depredation of livestock in Washington. 92
Table 11. Current population estimates of the 10 major elk herds managed by WDFW in WA.....103
Table 12. Examples of elk mortality in Washington. 103
Table 13. Projected numbers of elk and deer that may be killed annually by four different population size categories of wolves in Washington..115
Table 14. Current (2011) and future (2012-2017) estimated costs for implementing high priority tasks in the Wolf Conservation and Management Plan. 165
Table 15. Inventories of livestock and farmland in Washington's 39 counties in 2002....................168
Table 16. Numbers of cattle and sheep operations by size category and geographic region for Washington's 39 counties in 2002 (NASS 2004). 170
Table 17. Numbers and acreages of active grazing leases by livestock category on lands owned by four federal and state agencies in Washington. 173
Table 18. Annual death losses of livestock from different causes and their monetary values for Washington in 2004-2005 (NASS 2005, 2006)..174
Table 19. Predicted estimates of confirmable depredations of livestock and domestic dogs and their estimated monetary values (in current dollars for 2007) for four different future population size categories of wolves in Washington..178
Table 20. Average total payments per year for confirmed and probable livestock losses due to wolf predation by wolf population size category during early recovery phases in the northern Rocky Mountain recovery region, Wisconsin, and Michigan. 179
Table 21. Estimated total expenditures by hunters and average expenditures per hunter for all types of hunting combined in Washington in 2006 (from USFWS and USCB 2008). 189
Table 22. Estimated total expenditures and average expenditures per participant for all types of wildlife-watching activities in Washington in 2006, including both those around the home and away from home (from USFWS and USCB 2007, 2008)...196

LIST OF FIGURES

Figure 1. Map of present-day Washington (with counties) showing locations of the four main fur trading posts operated by the Hudson's Bay Company from 1827 to 1859. 17
Figure 2. Distribution of confirmed wolf packs within recovery regions in Washington as of July 2011. 23
Figure 3. Identification characteristics used to distinguish wolves from coyotes. 26
Figure 4. Map of the area (gray shading) designated by the U.S. Fish and Wildlife Service as the Northern Rocky Mountain distinct population segment of gray wolves. 38
Figure 5. Estimated suitable wolf habitat likely (≥ 50% probability) to be occupied in Washington (gray shading), using the parameters of Oakleaf et al. (2006).. 51
Figure 6. Estimated suitable wolf habitat in Washington depicted in two studies: (a) suitability was defined as those lands with a 50% or more probability of occurrence (Larsen and Ripple 2006); and b) suitability was represented by values greater than 0.5 (Houts 2003)........52
Figure 7. The estimates of Carroll et al. (2006) of (a) suitable wolf habitat in Washington (gray shading) based on vegetation parameters, and (b) potential wolf distribution predicted by the PATCH model under current habitat conditions.. 53
Figure 8. Potential wolf distribution in Washington and surrounding areas as predicted by Carroll (2007)........................54
Figure 9. Washington's three gray wolf recovery regions (Eastern Washington, Northern Cascades, and Southern Cascades and Northwest Coast) superimposed on the estimated suitable habitat for wolves (≥50% probability of occupancy, modeled by B. Maletzke, using Oakleaf et al. 2006). 60
Figure 10. Modeled high quality habitat for wolves in Washington (i.e., >80% probability of occupancy), as determined by B. Maletzke using the parameters of Oakleaf et al. (2006). 61
Figure 11. Public (federal and state), private and tribal landownership of potentially suitable wolf habitat (≥50% probability of occupancy, modeled by B. Maletzke, using Oakleaf et al. 2006) in the three recovery regions in Washington. 62
Figure 12. Percent of livestock death losses due to predators and other causes in Idaho, Montana, and Wyoming combined (adapted from NASS 2005, 2006)........................77
Figure 13. Ten major elk herds managed by WDFW in Washington........................102
Figure 14. Distribution of four deer subspecies in Washington. 107
Figure 15. Primary distribution (shaded area) of moose in Washington. 111
Figure 16. Distribution (shaded areas) of bighorn sheep in Washington. 112
Figure 17. Approximate distribution (shaded areas) of mountain goats in Washington. 112
Figure 18. Relationships between confirmed losses of (a) cattle, (b) sheep, and (c) dogs and minimum fall wolf numbers in Idaho, Montana, and Idaho through 2007. 177
Figure 19. Trends in numbers of tags sold and hunters participating in general deer and elk seasons (all weapons) statewide in Washington, 1997-2006........................184
Figure 20. Trends in numbers of hunter days during general deer and elk seasons (all weapons) statewide in Washington, 1997-2006 (excluding 1999). 184
Figure 21. Trends in statewide numbers of deer and elk killed and hunter success during general and permit seasons (all weapons) combined in Washington, 1997-2006. 185
Figure 22. Percent of statewide deer and elk harvest (all weapons) according to WDFW region number, 1997-2006........................185

Figure 23. Map of WDFW's six administrative regions. Map numbers correspond to designated region numbers. 186
Figure 24. Trends in hunter numbers for moose, bighorn sheep, and mountain goats in Washington, 1997-2006. 186
Figure 25. Trends in numbers of hunter days for moose, bighorn sheep, and mountain goats in Washington, 1997-2006. 187
Figure 26. Trends in hunter harvest of moose, bighorn sheep, and mountain goats in Washington, 1997-2006. 187
Figure 27. Trends in hunter success for moose, bighorn sheep, and mountain goats in Washington, 1997-2006. 188
Figure 28. Representation of non-resident hunters as a percentage of total hunting customers in Washington and their contribution to WDFW hunting revenues, according to species and averaged for fiscal years 2002-2007....189
Figure 29. Trends in hunting revenues generated by the WDFW hunting program for all species combined (i.e., big game, small game, and migratory birds) and separately for deer and elk for fiscal years 2002-2007....190
Figure 30. Trends in hunting revenues generated by WDFW for bighorn sheep, moose, and mountain goats for fiscal years 2002-2007....191

ACKNOWLEDGMENTS

Many people contributed to the preparation of the Wolf Conservation and Management Plan for Washington. Foremost among these were the members of the Wolf Working Group: Daryl Asmussen, John Blankenship (replaced by Linda Saunders in 2011), Duane Cocking, Jeff Dawson, Jack Field, George Halekas, Kim Holt, Derrick Knowles, Colleen McShane, Ken Oliver, Tommy Petrie, Jr., Gerry Ring Erickson, John Stuhlmiller, Arthur Swannack, Bob Tuck, Greta Wiegand, and Georg Ziegltrum, and former member Paula Del Giudice. Their discussions, suggestions, edits, and long hours of involvement were crucial to the development of this plan. Paul De Morgan of RESOLVE was invaluable through his participation as facilitator of the Wolf Working Group. Turner Odell and Rob Williams of RESOLVE assisted with facilitation activities.

Rocky Beach, Donny Martorello, and Madonna Luers of WDFW made significant contributions to early drafts of the document. WDFW staff that helped with aspects of the plan included Nate Pamplin, Jerry Nelson, John Pierce, Phil Anderson, Derek Stinson, Anthony Novack, Dave Ware, Joe Buchanan, Steve Pozzanghera, Dave Brittell, Jeff Lewis, Paul Frame, Rena Henson, Eric Fiedler, and Steve Zender, with other contributions from Scott Fitkin, Paul Wik, Dana Base, Kevin Robinette, Scott McCorquodale, Woody Myers, Cliff Rice, Pat Fowler, Jay Shepherd, Jim Watson, Ken Warheit, Sue Wisner, Kristin Mansfield, Lauri Vigue, Pat Miller, Bob Everitt, and Sandra Jonker. Justin McCarron provided data on WDFW license sales and revenue figures. Teresa Eturaspe advised on development of the Draft Environmental Impact Statement (EIS) and its release for public review. Bob Zeigler assisted with release of the Final EIS. Shelly Snyder and Brian Hall prepared many of the maps used in this plan. Katey Jones, Wendy Ware, Dolores Schmid, Susan Lasiter, Michael Day, Cody Arocho, and Nanette Baker gave administrative support. Peggy Ushakoff, John Burrows, and Doug Hoyer helped with updates to the agency's wolf webpage.

Carolyn Sime of Montana Fish, Wildlife & Parks, Steve Nadeau of the Idaho Department of Fish and Game, Russ Morgan of the Oregon Department of Fish and Wildlife, and Adrian Wydeven of the Wisconsin Department of Natural Resources kindly discussed issues relating to wolves in their respective states. Ed Bangs of the U.S. Fish and Wildlife Service answered many background questions on wolf management in the northern Rocky Mountain states. George Ulin of the Washington Outfitters and Guides Association provided information on Washington's outfitting industry. Drs. Ben Maletzke and Rob Wielgus of Washington State University developed a framework for conducting a population analysis; and Dr. Maletzke modeled potentially suitable habitat for wolves in Washington.

Other useful information on wolves or related topics came from Carlos Carroll, Brad Compton, Jesse Timberlake, Jeff Allen, Patti Happe, Brian Harris, Mike Jimenez, Russ Morgan, Bill Gaines, Bob Kuntz, James Begley, John Pollinger, Garth Mowat, Roger Woodruff, Chad Heuser, Julie Callahan, Tom Buckley, Linda Simpson, Carol Chandler, John Ehrenreich, Bobbie Thorniley, Tom MacArthur, Don Youkey, Dayton Duncan, Darrell Reynolds, Pat Ryan, Dana Peterson, Suzanne Stone, and Justin Gude. Carolyn Sime, Curt Mack of the Nez Perce tribe, Rick Williamson of USDA Wildlife Services, Carter Niemeyer, formerly of the U.S. Fish and Wildlife Service and USDA Wildlife Services, Mark Henjum of the U.S. Forest Service, Jerry Nelson of WDFW, Teresa Eturaspe of WDFW, Nate Pamplin of WDFW, Dave Brittell of WDFW, and Sheila Lynch of the Washington State Office of the Attorney General each gave presentations at Wolf Working Group meetings on topics related to wolves or other issues pertaining to the management of natural resources in Washington.

Thanks are extended to the following people who provided technical comments during scientific peer review of the document: David Anderson, Ed Bangs, Dana Base, Jeff Bernatowicz, Carlos Carroll, Francis Charles, Tim Cullinan, John Duffield, Scott Fitkin, Richard Fredrickson, Bill Gaines, Jon Gallie, Chris Hammond, Patti Happe, Jeff Heinlen, Mark Henjum, Eric Holman, Jim Holyan, Jeanne Jerred, Mike Jimenez, Mike Livingston, Curt Mack, David Mech, Will Moore, Russ Morgan, Garth Mowat, Shannon Neibergs, Carter Niemeyer, Anthony Novack, Mark Nuetzmann, John Oakleaf, Jim Peek, John Pierce, Cliff Rice, Ella Rowan, Jennifer Sevigny, Carolyn Sime, Doug Smith, Dan Trochta, David Vales, Dave Ware, Paul Wik, and Roger Woodruff. Todd Fuller, three anonymous reviewers, Dan Vogt, and Darin Cramer assisted with blind peer review of the plan. Neil Wise, Bill Frymire, and Joe Shorin of the Washington State Office of the Attorney General also reviewed the plan.

Appreciation is expressed to the nearly 65,000 people who responded during the public review period and to those who attended the 12 public meetings and seven scoping meetings. Thanks are also expressed to the WDFW regional staff who assisted with conducting the public meetings.

Acknowledgment is also given to the authors of the wolf conservation and management plans for Montana and Oregon (MFWP 2003, ODFW 2005). These plans were the basis for material appearing in this current document.

EXECUTIVE SUMMARY

The Wolf Conservation and Management Plan for Washington has been developed to guide recovery and management of gray wolves as they naturally disperse into the state and reestablish a breeding population. No wolves have ever been or will be reintroduced into Washington from areas outside the state as part of this plan. This is a state plan. There is no requirement for federal approval of the plan because the U.S. Fish and Wildlife Service (USFWS) has not established federal recovery criteria for wolves in Washington. When approved, the state wolf plan will apply statewide. However, implementation of some measures addressing conflicts (specifically, lethal control) will have to be consistent with federal law in those areas where wolves remain federally listed.

Wolves were classified as endangered in Washington under federal law in 1973 and under state law in 1980. Currently, wolves in the western two-thirds of Washington are listed as endangered under federal law; in the eastern third of the state they have been removed from federal listing. They are listed as endangered under state law throughout Washington. The USFWS is the lead management authority over wolves where they remain federally listed in the state and the Washington Department of Fish and Wildlife (WDFW) is the lead where wolves are federally delisted.

Gray wolves were formerly common throughout most of Washington, but they declined rapidly between 1850 and 1900. The primary cause of this decline was the killing of wolves by Euro-American settlers as ranching and farming activities expanded. Wolves were essentially eliminated as a breeding species from the state by the 1930s. The first fully documented breeding pack was confirmed in 2008. As of July 2011, there were five confirmed packs in the state: two in Pend Oreille County; one in Pend Oreille/Stevens counties; one in Kittitas County; and one in Okanogan/Chelan counties. Only one of these, in Pend Oreille County, was a successful breeding pair in 2010. There were also indications of single additional packs in the Blue Mountains and North Cascades National Park; and at least a few solitary wolves also likely occur in other scattered locations of Washington.

Human-related mortality, particularly illegal killing and legal control actions to resolve conflicts, is the largest source of mortality for the species in the northwestern United States and illegal killing has already been documented in Washington.

Wolves are dispersing into Washington from populations in adjacent states and provinces (Idaho, Montana, Oregon, and British Columbia) and some are forming resident breeding packs. In response to this, the need for a state recovery plan per WAC 232-12-297, and in anticipation of the eventual return of all wolf management to the state, the WDFW initiated development of a Draft Environmental Impact Statement (EIS) for a state wolf conservation and management plan under the State Environmental Policy Act (SEPA) in 2007. At that time, the former WDFW Director appointed an advisory Wolf Working Group comprised of 17 citizens to provide recommendations on the plan to the agency. Its members represented a broad range of perspectives and values with regard to wolf conservation and management and were representative of the geographic scope of Washington. Public scoping meetings were held around the state and multiple levels of reviews were conducted. Discussions among members of the Wolf Working Group helped frame issues for the plan. Recommendations and suggestions from the public scoping, the Wolf Working Group, scientific peer review, public review, WDFW reviews, and changes made by the Fish and Wildlife Commission have been incorporated into the plan.

The purpose of the plan is to ensure the reestablishment of a self-sustaining population of gray wolves in Washington and to encourage social tolerance for the species by addressing and reducing conflicts. Goals of the plan are to:

- Restore the wolf population in Washington to a self-sustaining size and geographic distribution that will result in wolves having a high probability of persisting in the state through the foreseeable future (>50-100 years).
- Manage wolf-livestock conflicts in a way that minimizes livestock losses, while at the same time not negatively impacting the recovery or long-term perpetuation of a sustainable wolf population.
- Maintain healthy and robust ungulate populations in the state that provide abundant prey for wolves and other predators as well as ample harvest opportunities for hunters.
- Develop public understanding of the conservation and management needs of wolves in Washington, thereby promoting the public's coexistence with the species.

Three recovery regions were delineated for the state: (1) Eastern Washington, (2) Northern Cascades, and (3) Southern Cascades and Northwest Coast. Target numbers and distribution for downlisting and delisting within the three recovery regions are:

- To reclassify from state endangered to state threatened status: 6 successful breeding pairs present for 3 consecutive years, with 2 successful breeding pairs in each of the three recovery regions.
- To reclassify from state threatened to state sensitive status: 12 successful breeding pairs present for 3 consecutive years, with 4 successful breeding pairs in each of the three recovery regions.
- To delist from state sensitive status: 15 successful breeding pairs present for 3 consecutive years, with 4 successful breeding pairs in each of the three recovery regions and 3 successful breeding pairs anywhere in the state.

- In addition to the delisting objective of 15 successful breeding pairs distributed in the three geographic regions for 3 consecutive years, an alternative delisting objective is also established whereby the gray wolf will be considered for delisting when 18 successful breeding pairs are present, with 4 successful breeding pairs in the Eastern Washington region, 4 successful breeding pairs in the Northern Cascades region, 4 successful breeding pairs distributed in the Southern Cascades and Northwest Coast region, and 6 anywhere in the state.

The recovery objectives for downlisting and delisting wolves were developed from a combination of current scientific knowledge about wolves in other locations and in Washington, wildlife conservation and population viability principles, and discussion among the Wolf Working Group, with input from WDFW, scientific peer review, an analysis of assumptions and risks, and changes made by the Fish and Wildlife Commission. Fifteen breeding pairs, which represent an estimated 97-361 wolves, are considered minimal to achieve recovery. Several components of the delisting objectives serve to reduce the risk to long-term viability of a wolf population in Washington. These include the geographic distribution requirements across the three recovery regions, the use of successful breeding pairs as a measurement standard, and the three-year requirement for maintaining population robustness on the landscape. It is further recognized that the long-term viability of the state's wolf population will also depend, in part, on immigration from Idaho, Montana, British Columbia, and Oregon.

Persistence modeling suggested that as long as the population was allowed to grow and populate new areas, 15 successful breeding pairs was an adequate recovery objective for delisting. Given those modeling assumptions, there was little or no probability that the population would fall below the delisting goal during the 50 years. However, under scenarios that capped the population at 15 breeding pairs, there was a 93% probability that the wolf population would fall below the delisting goal of 15 breeding pairs during the 50 years and require relisting, even with immigration. With no immigration, the probability rose to 97%.

Translocation is a conservation tool available in the plan that could be used to move wolves from one recovery region to another if they failed to reach the recovery region through natural dispersal. If it were proposed, it would go through an extensive public review process.

The plan outlines a range of management options to address wolf-livestock conflicts. These include both proactive, non-lethal (e.g., modified husbandry methods and non-lethal deterrents) and lethal management options. Implementation of these will be based on the status of wolves to ensure that recovery objectives are met. Non-lethal management will be emphasized while the species is recovering and will transition to more flexible approaches as wolf recovery advances toward a delisted status. The plan includes a program to compensate livestock producers for livestock that is killed or injured by wolves. Under this plan, compensation would be paid for confirmed and probable wolf losses. The plan includes a two-tiered payment system, with higher payments on grazing sites of 100 or more acres where WDFW determines it would be difficult to survey the entire acreage, because it may be difficult to find carcasses on larger sites. Standard payments would be paid on smaller sites of less than 100 acres. The plan also includes working with a multi-interest stakeholder group to evaluate development of a program to compensate livestock owners for unknown losses. The ability to pay compensation will be dependent on available funding and the plan identifies tasks to pursue a variety of potential funding sources.

The effects that wolves will have on elk, deer, and other ungulate populations and hunter harvest are difficult to predict. In Idaho, Montana, and Wyoming, where wolf populations currently number more than 1,600 wolves, most elk and deer populations remain at or above management objectives. Wolves have contributed to declining elk populations in a few areas, but are usually one of several causes, including declining habitat conditions, past high human harvest, severe weather conditions, and predation by other predators. In the Great Lakes region, where there are about 4,000 wolves, white-tailed deer populations are thriving and often above local management goals, and annual hunter harvest has remained high. These data suggest that when wolf populations in Washington are in the initial stages of recovery, they could have some localized impacts on elk and deer abundance or habitat use, but little to no effect would be expected on overall ungulate populations in the state. Impacts would be somewhat greater during the latter stages of recovery, but are still expected to be relatively small on a statewide level.

The plan includes management options to address local impacts, if they occur. If WDFW determines that wolf predation is a primary limiting factor for an "at-risk" ungulate population, and the wolf population in that wolf recovery region is at least 4 successful breeding pairs, WDFW could consider moving of wolves, lethal control, or other control techniques in localized areas to reduce wolf abundance in the area occupied by the ungulate population. Management options would include both non-lethal (e.g. moving them to other areas) and lethal measures; non-lethal options would be prioritized while the species is listed.

Two independent public attitude surveys conducted in 2008 and 2009 showed high overall support (~75%) for wolf recovery in Washington among the general public. Implementation of a public outreach and education program is a high priority in the wolf conservation and management plan. It includes providing information and outreach about wolves, living with wolves, preventing and addressing conflicts with livestock and dogs, and wolf-ungulate interactions. It also identifies a task to conduct public attitude and knowledge surveys to determine information needs and develop an outreach plan.

Because wolves are habitat generalists, restrictions on human development and other land use practices should not be necessary to recover wolves in Washington. Experience in the northern Rocky Mountains and the Great Lakes has shown that no restrictions, other than those occasionally needed to temporarily prevent excessive disturbance at occupied den sites, have been necessary to conserve wolves.

The plan provides an analysis of potential economic impacts (both negative and positive) to specific sectors of Washington's economy as wolves become reestablished in the state. At populations of 50 and 100 wolves, which roughly correspond with the upper levels of abundance during the state endangered and threatened phases, a few livestock producers could be affected. As wolf populations increase in numbers and distribution, more producers could be affected. Depending on funding availability, it is expected that most livestock losses would be offset by compensation programs and assistance with proactive measures. Similarly, populations of 50 and 100 wolves should have few negative effects on big game hunting overall. Larger populations are expected to have greater impacts on game abundance and hunting opportunity, but such impacts become increasingly difficult to predict. Washington could conceivably develop a wolf-related tourist industry, depending on where wolves reestablish, the population levels they achieve, and the ability of tourists to see or hear wolves. Wolf recovery is anticipated to have no economic impact on the state's forest products industry.

Adequate funding for implementing the activities described in this plan is vital to its success. The plan includes estimated costs for activities needed to accomplish important tasks in the first six years of the plan. WDFW will seek funding from a variety of sources, including special state and federal appropriations and private sources, and will initiate partnerships with universities, agencies, non-governmental organizations, and other entities to carry out wolf conservation and management actions in Washington.

1. INTRODUCTION

The gray wolf (*Canis lupus*) is an endangered species throughout Washington under state law (WAC 232-12-014, Appendix A) and under federal law (Endangered Species Act) in the western two-thirds of Washington. Wolves in the eastern third of Washington were removed from federal listing in May 2011 and are now under state management.

Historically, wolves were found throughout most or all of Washington. They were essentially extirpated from the state by the 1930s through trapping, poisoning, and shooting. Although wolf populations have been absent from Washington for more than 70 years, small numbers of individuals have periodically dispersed into the state during that time to the present.

This plan was developed as the first wolf packs were becoming reestablished in Washington. Increased dispersal of wolves into Washington, with the eventual reestablishment of a breeding population, is expected as a result of the recovery of wolf populations in the neighboring states of Idaho and Montana. Wolves are expected to disperse into northeastern Washington from Idaho, Montana, and British Columbia; into southeastern Washington from Idaho and Oregon; and into the North Cascades from British Columbia and northeastern Washington.

The Washington Department of Fish and Wildlife (WDFW) initiated development of a Wolf Conservation and Management Plan for Washington in response to the anticipated dispersal of wolves into Washington, the need for a state recovery plan per WAC 232-12-297, and the eventual return of wolves to state management. In January 2007, former WDFW Director Jeff Koenings, appointed 18 members to a Wolf Working Group (Appendix B) to advise WDFW in the development of the plan. The 18 stakeholders represented a broad range of perspectives and geographic distribution in Washington, and were expected to present those values in the development of the plan. The Working Group was reduced to 17 members during the course of its meetings, when one person was no longer able to participate.

The Working Group began meeting in February 2007. In giving direction to the group, Director Koenings noted that wolves are an important and valued component of a healthy ecosystem in Washington and that the reestablishment of a sustainable wolf population in Washington would only occur if there is a fair balance between conservation needs and the needs of the public. The expectation for the Working Group was that it would provide input to WDFW for key elements of the plan and critically review its content in light of biological, social, and political considerations.

The Director specified two “sideboards” for the group to work within:

- First, the option of managing for no wolves in Washington was not a viable alternative, and
- Second, WDFW would not reintroduce wolves to Washington from another state.

He also noted that the plan would not attempt to recover wolves to historical population levels; this would be an unattainable goal given the many changes to Washington’s landscape during the past 150 years. The Working Group was asked to strive for consensus, as much as possible, to guide the plan. Working Group meetings were facilitated by a professional negotiator, Paul De Morgan of RESOLVE.

The group met six times during 2007 and twice in 2008; seven public scoping meetings were also held throughout the state during August 2007. The Working Group developed a letter at the conclusion of the eighth meeting (see Appendix C, June 30, 2008 letter from the Group) to accompany the peer review draft. The letter described the many considerations that went into their negotiations to craft a balanced package of conservation and management recommendations that WDFW could use in the preparation of the peer review draft. While the letter represented the Working Group's thoughts at that stage of the plan's development, it still offers insights into the complex and diverse issues that must be addressed in crafting a balanced, fair, and cost effective plan that has a high probability of success.

The August 2008 version of the draft plan, which included the Working Group's recommendations, was sent out for peer review by WDFW. Forty-three reviewers with expertise on wolves, genetics, economics, state and federal wolf management, and other topics responded with critical reviews, comments, corrections, and suggestions (see Appendix D, List of Peer Reviewers). The results of the peer review and internal WDFW review were then incorporated into a new version of the draft plan completed in July 2009. The Working Group met in September 2009 to review the revised version and offer more comments, which were then incorporated in a Public Review Draft. The draft EIS/plan underwent a 90-day public review under the State Environmental Policy Act (SEPA) process from October 2009 to January 2010, including 12 public meetings throughout the state, and blind peer review by 3 anonymous reviewers. Nearly 65,000 people provided comments on the draft documents. WDFW addressed the public input and conducted additional internal review. The Working Group met in June 2011 to review the changes resulting from the public, blind peer, and internal WDFW reviews prior to completion of the final recommended plan and presentation to the Washington Fish and Wildlife Commission in August 2011 for consideration and approval. The Commission held three workshops on the plan from August through November 2011, where additional public comment was taken. On December 3, 2011, the Fish and Wildlife Commission unanimously adopted the Recommended Plan, with revisions.

WDFW's Listing and Delisting Procedures (WAC 232-12-297, Appendix A) require the development of recovery plans for species that are state listed as endangered or threatened and management plans for species listed as sensitive. These plans identify measurable recovery objectives and outline strategies to achieve those objectives so that the species can be downlisted and eventually delisted in the state. The Wolf Conservation and Management Plan for Washington will meet the needs of a state recovery plan and at the same time will provide for management of wolves while they are state listed as endangered, threatened, and sensitive. A wide range of perspectives and values related to wolves and wolf management were heard in developing and refining the plan. The result is a plan that is intended to serve the broad interests of the citizens of Washington for both conservation and management of wolves in the state.

The conservation and management strategies in this plan are for state planning purposes only and conform only to the requirements of state law. There is no requirement for federal approval of the plan. Wherever wolves are federally listed in Washington, WDFW would consult and coordinate with the U.S. Fish and Wildlife Service prior to implementing management actions to ensure consistency with federal law. Washington was not included in the original Northern Rocky Mountain Wolf Recovery Plan (USFWS 1987); only the states of Idaho, Montana, and Wyoming were included. The federal delisting criteria for the Northern Rocky Mountain (NRM) distinct population segment (DPS) required Idaho, Montana, and Wyoming to have state wolf conservation plans, but did not require Washington to have a wolf conservation plan approved by the U.S. Fish and Wildlife Service.

There are no federal wolf recovery objectives for Washington, but the eastern third of the state was included in the NRM DPS when it was designated in 2007 to account for dispersing wolves from Idaho and Montana populations. While there is no federal recovery plan for wolves in the western two-thirds of Washington, the U.S. Fish and Wildlife Service has initiated a status review of wolves in the Pacific Northwest, including Washington, Oregon, and California (USFWS 2011a). The review will determine whether a Distinct Population Segment should be designated for the Pacific Northwest, and if so, will determine the status of wolves within the DPS. If a DPS were established, a federal recovery plan would be developed, which would include recovery objectives.

The purpose of the state plan is to ensure the reestablishment of a self-sustaining population of gray wolves in Washington and to encourage social tolerance for the species by addressing and reducing conflicts. The goals of the Wolf Conservation and Management Plan for Washington are to:

- Restore the wolf population in Washington to a self-sustaining size and geographic distribution that will result in wolves having a high probability of persisting in the state through the foreseeable future (>50-100 years).
- Manage wolf-livestock conflicts in a way that minimizes livestock losses, while at the same time not negatively impacting the recovery or long-term perpetuation of a sustainable wolf population.
- Maintain healthy and robust ungulate populations in the state that provide abundant prey for wolves and other predators as well as ample harvest opportunities for hunters
- Develop public understanding of the conservation and management needs of wolves in Washington, thereby promoting the public's coexistence with the species.

To meet these goals, the plan includes such tasks as identifying and managing toward population objectives, developing a response strategy for conflicts, engaging in public outreach and education, and conducting ongoing monitoring and research. As specified in WAC 232-12-297, section 11.1, recovery or management plans are to include, but not be limited to: (1) target population objectives, (2) criteria for reclassification, (3) an implementation plan for reaching population objectives that will promote cooperative management and are sensitive to landowner needs and property rights, (4) public education needs, and (5) a species monitoring plan. The overall plan will estimate resources needed from and impacts to WDFW, other agencies (including federal, state, and local), tribes, landowners, and other interest groups. The plan will consider various approaches to meeting recovery objectives including, but not limited to, regulation, mitigation, land acquisition, incentives, and compensation mechanisms.

In developing this plan, WDFW sought to establish a wolf conservation program that is achievable, realistic, fair, flexible, cost-effective, defensible, sustainable, fundable, engages the public, and provides incentives for meeting wolf conservation goals. Several aspects of the plan are critical to its success. One of the first and foremost is to have broad support to ensure sufficient funding for implementing the plan. Conservation tools and strategies will need to be implemented to achieve a healthy, self-sustaining wolf population. Because human tolerance has been and remains the primary limiting factor for wolf survival, tolerance and acceptance must be adequately addressed for citizens who will be directly affected by the presence of wolves. This makes technical assistance, compensation, and outreach some of the highest priorities for wolf conservation. Actions minimizing conflict and effective enforcement against illegal actions harming wolves also are key parts of achieving conservation goals. An active outreach and education program must offer guidance and information about living with wolves and about rules and regulations related to management. Recovery of wolves means recognizing them as a native species of Washington, with legal, social, cultural, and biological value, and having an important ecological role in maintaining native ecosystem functions and processes. Wolves will need to be managed in concert with other species, particularly primary prey and other large carnivores. While many of these species have their own management or recovery plans, none can be managed in isolation.

2. BACKGROUND

The chapter provides background information on a variety of subjects pertaining to wolves, as follows:

- the history of wolves in Washington and surrounding geographic areas (Section A)
- the current status of wolves in Washington and surrounding areas (Section B)
- the identification and biology of wolves (Section C)
- legal status of wolves in Washington under federal, status, and tribal law (Section A)
- public attitudes and cultural values towards wolves (Section E)

A. History of Wolves in Washington and Surrounding Areas

Gray wolves were common throughout most of Washington before 1800. Some authors have suggested that wolves did not occur in the Columbia Basin (Young and Goldman 1944, Booth 1947, Dalquest 1948), but this is seemingly contradicted by several reports. Douglas (1914) occasionally observed wolves while traveling in shrub-steppe areas between The Dalles, Oregon, and Walla Walla in March 1826, whereas Suckley and Cooper (1860) described them as abundant in this same area and habitat in the mid-1850s despite the absence of large ungulate prey. Records also exist of wolves in the vicinity of the Walla Walla Valley (Wilkes 1844) and in southern Grant County (Dalquest 1948; see Appendix E for a map of counties in Washington).

Typical winter wolf densities range from about 46-98 wolves/1,000 square miles across much of the northern United States and southern Canada (Fuller et al. 2003). Applying these densities to derive a historical population estimate for Washington (land size = 67,578 square miles), but using reduced densities for the Columbia Basin (estimates of 12-25 wolves/1,000 square miles; size = 22,754 square miles), suggests that the state held about 2,300-5,000 wolves before Euro-American settlement.

<u>Fur Trading, Bounties, and Extermination in Washington</u>

Trapping of wolves as a commercial source of fur began in earnest during the 1820s following the establishment of the Hudson's Bay Company in the Pacific Northwest. The company initiated an elaborate trading system with Native Americans across the region. Fur trading occurred at four forts located in Washington (Figure 1). From 1821 to 1859, a total of 14,810 wolf pelts were traded at the following locations: Fort Nez Perces, located at the junction of the Columbia and Walla Walla Rivers, 8,234 pelts; Fort Colville located along the Columbia River in present-day Stevens County, 5,911 pelts; Fort Vancouver located at present-day Vancouver, Clark County, 416 pelts; and Fort Nisqually in southern Puget Sound, 249 pelts (Hudson's Bay Archives 1988, Laufer and Jenkins 1989). These totals include animals taken not only from Washington, but originating from parts of British Columbia, Idaho, Oregon, and perhaps western Montana as well.

Despite the fur trade, wolves remained common in many areas of Washington into at least the 1850s. In 1839, Elkanah Walker reported that wolves were "thick" at Tshimakain mission (near present-day Ford in Stevens County), making it necessary to corral horses at night for protection (Gibson 1985: 176). Wolves were also a problem at Cowlitz Farm (operated by the Hudson's Bay

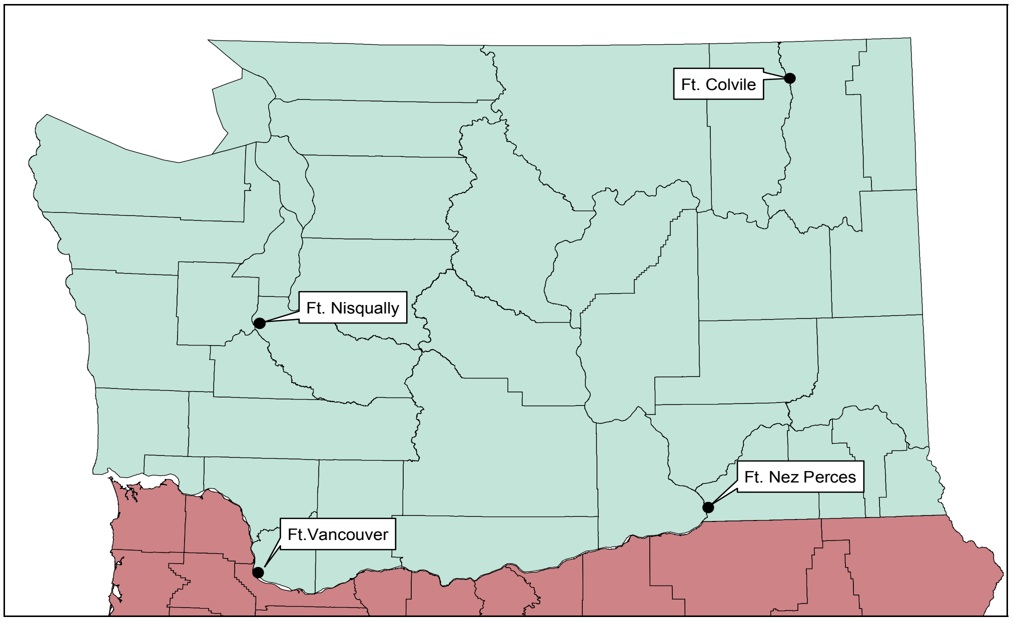


Figure 1. Map of present-day Washington (with counties) showing locations of the four main fur trading posts operated by the Hudson's Bay Company from 1827 to 1859.

Company near present-day Toledo in Lewis County) in 1841 and required "large numbers of cattle …… [to be brought in each] night, which is a very necessary precaution …… in consequence of the numerous wolves that are prowling about; in some places it becomes necessary for the keeper to protect his beasts even in the daytime" (Wilkes 1844). Joseph Drayton of the Wilkes expedition remarked in 1841 that "wolves were very numerous … and exceedingly troublesome" between Fort Walla Walla (at its initial site along the Columbia River) and the Whitman mission in present-day Walla Walla County (Wilkes 1844). Joseph Heath, an early resident of western Washington, noted that wolves were "very common" on the Nisqually Plains (present-day Pierce County) during the winter of 1844-1845 (Heath 1979:14-15). Suckley and Cooper (1860), who visited Oregon and Washington Territories from 1853 to 1857, described wolves as "exceedingly numerous …… from the Cascades to the Rocky Mountain Divide." They also reported that wolves were abundant in the headwaters of the rivers flowing into the Columbia River from the Cascades and the Blue Mountains, and stated that abundance had increased after the introduction of sheep into the region. As late as 1889, Linsley (1889) described the region near the Pend Oreille River as being "…… full of black and silver gray wolves……" He and his partner trapped or shot 40 wolves in the area during the winter of 1888-1889. Wolves were also remained common parts of the Olympic Mountains in 1890 (Lien 2001:137, 322).

Euro-American settlement of the Pacific Northwest brought immediate efforts to control wolves. The Hudson's Bay Company used strychnine for poisoning wolves at its early farming operations in Washington and set high prices on wolf skins to encourage killing by Native Americans (Heath 1979: 32; Gibson 1985: 120). Residents of the Oregon country (which included Washington) convened their first "Wolf Meeting" in 1843 and established a $3 wolf bounty (Young 1946, Laufer and Jenkins 1989). During an 18-month period in 1841-1842, a shepherd at Nisqually Farm killed more than a hundred wolves (Gibson 1985: 120). By the mid-1850s, wolves had become "quite scarce" on the Nisqually Plains because of poisoning efforts to protect local sheep herds (Suckley and Cooper 1860).

Although poorly documented, wolves were heavily persecuted during the last half of the 1800s as ranching and farming became established in the state, and were eliminated from most areas by 1900 (Dalquest 1948). Poisoning, trapping, and shooting were common control techniques, and a bounty of $15 per wolf was paid by the state in the early 1900s (Harding 1909, Adamire 1985). Wolf populations held out somewhat longer in a few more remote locations. One of these was on the Olympic Peninsula, where estimates of 115 wolves in 1910 and 40-60 wolves in 1919 were made (Webster 1920, Scheffer 1995). However, this population declined rapidly thereafter and was nearly gone by the late 1930s (e.g., Scheffer 1995, Beebe no date). Adamire (1985) reported that bounties were paid on 46 wolves by the Clallam County auditor's office from 1906-1929. Johnson and Johnson (1952) remarked that sightings by experienced observers suggested that a few wolves may have continued to persist in the Queets River drainage and perhaps elsewhere in the Olympic Mountains until as late as the early 1950s. Murie (1935) recommended as early as 1935 that consideration be given to reintroducing wolves to the Olympic Mountains.

Elsewhere, wolves remained in the southern Cascades until at least 1915, but had disappeared as a resident population by 1941 (Young and Goldman 1944). A few animals also persisted in the vicinity of Mt. Rainier until the 1920s, but Taylor and Shaw (1927, 1929) considered them "rare and of irregular occurrence" in the national park. Macy (1934) reiterated the rarity of the species at the park. Predator control efforts by the National Park Service and U.S. Bureau of Biological Survey at Mt. Rainier during the 1910s or 1920s (Cahalane 1939) may have contributed to the demise of wolves there. Dalquest (1948) reported that a few wolves might have survived in the northern Cascades between Lake Chelan and Mount Baker until at least the 1940s. A "band of a dozen wolves" was reported in the Aeneas Valley of eastern Okanogan County in 1914 (Hansen 1986). Booth (1947) gave evidence that a few wolves remained in the Blue Mountains until 1915 or perhaps later. The U.S. Forest Service estimated that only about 10 wolves in total survived on all national forest lands in the state by 1939 (Young and Goldman 1944).

Further illustrating the rarity of wolves in Washington by the early 1900s, extensive predator control work by federal trappers from the U.S. Bureau of Biological Survey succeeded in killing just 10 wolves on or near Forest Service lands in 1907 (Harding 1909) and only two wolves statewide between 1915 and 1929 (United State Congress 1929). Scattered records of wild wolves killed and reliable sightings were made at various localities from about 1916 into the 1950s. A sampling of these appears in Table 1. It seems likely that many of these individuals were dispersers from neighboring states and British Columbia rather than the survivors from remnant breeding populations.

Reports of wolves continued to occur in Washington during the next few decades, with greater effort devoted to documentation of records during the 1970s and 1980s. Sixty-eight records of the species held in the WDFW Heritage database for 1970-1989 were largely restricted to the Cascade Mountains and parts of northeastern Washington. Hansen (1986) summarized 42 reports from northeastern Washington made from before 1960 to 1985. Records were compiled from a variety of sources, including unpublished accounts, reports from the public, and trapper questionnaires. Twenty-four records were judged as probably accurate and 18 were possibly accurate. Eighteen originated from before 1960 to 1973 and 24 were from 1974 to 1985. Five records involved three or

Table 1. Miscellaneous reports of wolves in Washington from 1916 to the 1950s.

Location	Date	Record	Source
Sluiskin Falls, Mt. Rainier National Park	1916	Two seen	Taylor and Shaw (1927)
Near Nisqually Glacier, Mt. Rainier National Park	1916	One killed	Taylor and Shaw (1927)
Skate Mountain, Lewis County	1916	Three heard	Taylor and Shaw (1927)
Elwha, Hayes, and Lost rivers, Press Valley, Jefferson Co.	1916-1917	Tracks seen	Murie (1916-1917)
Near the former community of Wahluke, Grant Co.	1917	Two killed	Dalquest (1948)[a]
Clallam County	1917-1929	Bounties paid for 22 killed	Adamire (1985)
Cameron Creek, Jefferson Co.	1919	One trapped	Cameron (1949)
Elwha River drainage, Jefferson Co.	1920	One killed	Museum specimen[b]
Paradise Valley, Mt. Rainier National Park	1920	Tracks seen	Taylor and Shaw (1927)
North fork of the Quinault River, Jefferson Co.	About 1920	Two killed	Dalquest (1948)
Whatcom Co.	1922	Two sightings	Edson (1931)
Skamania Co.	1924	One killed	Guenther (1952)
Skagit Co.	1927	Bounty paid for one killed	Edson (1931)
Snohomish Co.	1927	Bounty paid for one killed	Edson (1931)
Snow Creek, Clallam/Jefferson Co.	1929	One seen	Scheffer (1995)
Snow Creek, Clallam/Jefferson Co.	1930	One seen	Scheffer (1995)
Near Tonasket, Okanogan Co.	1930	One trapped	Guenther (1952)
Near Prouty Mountain, Pend Oreille Co.	1932	One reported	Hansen (1986)
Near Camp Muir at Mt. Rainier National Park	About 1933	One seen	Macy (1934)
Twin Peaks, Snohomish Co.	1936	One killed	Booth (1947)
Near Granite Falls, Snohomish Co.	About 1945	One killed	Larrison (1947)[c]
Gray Wolf Creek, Clallam Co.	1946	Tracks seen	Scheffer (1995)
Monte Cristo area, Snohomish Co.	1940s	Tracks at several sites	Larrison (1947)
Taylor Ridge about 12 mi east of Republic, Ferry Co.	1950	One killed	Guenther (1952)
Near Curlew, Ferry Co.	1951	Two seen	Hansen (1986)
Sheep Creek drainage in northern Stevens Co.	Early 1950s	Four seen and heard	Hansen (1986)
North of Slate Creek, Pend Oreille Co.	1955	One seen	Layser (1970)

[a] Dalquest (1948) reported these as the last wolves killed in the Columbia Basin.
[b] This specimen (USNM 241614) is held at the National Museum of Natural History, Washington, D.C.
[c] Larrison (1947) also reported that he saw and heard a wolf near Pinnacle Lake, Mt. Pilchuck, Snohomish County, in August 1946, but the small size of the animal's tracks (2 inches by 3 inches) make this sighting doubtful.

more wolves, 10 were of two wolves, and 27 were of single animals; most reports of two or more wolves originated from 1973 or earlier. Two-thirds of the reports after 1973 came from the eastern half of the Colville National Forest, with most obtained from the Slate Creek/Sullivan Creek area on the east side of the Pend Oreille River. One wolf was killed near Mansfield, Douglas County, in 1975. Hansen (1986) gave brief descriptive accounts of many of these records.

Laufer and Jenkins (1989) compiled a similar account of wolf records from the Cascades for 1946 to 1988. Reports from this area represented 70% of all reports from the state during this period. A total of 49 reports came from the Cascades during 1973-1988. Thirty-one of these were analyzed in greater detail, with 19 rated as probably accurate and 12 as possibly accurate. Two records involved three or more wolves, five were of two wolves, and 24 were of single animals. These records were concentrated in the Baker Lake and Ross Lake areas of the North Cascades and in the vicinity of Mount Rainier.

Almack and Fitkin (1998) reviewed 913 reports of gray wolves in Washington from 1834 to 1994. Of these reports, 78 were judged to be confirmed observations: 55 were primarily bounty records from 1834 to 1929 (e.g., see Adamire 1985), three were from 1944 to 1975, and 20 were sighting or howling reports from 1989 to 1994.

History of Wolves in Neighboring States and British Columbia

As in Washington, wolves were formerly common and widely distributed in Oregon, Idaho, Montana, and Wyoming, but experienced serious declines following the arrival of Euro-American settlers and expansion of the livestock industry (Young and Goldman 1944). Bounties were enacted in the 1870s and 1880s in each of these states and contributed to declines. For example, 4,540 wolf hides were presented for payment in the first year of Montana's statewide bounty in 1884 (MFWP 2003). Prey scarcity caused by the elimination of bison and reductions of other ungulates also impacted wolves in Montana and Wyoming. Wolf numbers were severely reduced in these four states by the early 1900s and self-sustaining populations were virtually eliminated by 1930 (Robinson 2005). One exception to this occurred on national forest lands in the Oregon Cascades, where an estimated 130 animals remained in 1939 (Young and Goldman 1944); these animals were gone too by the 1940s. Scattered reports of sightings, tracks, and scat continued in these states (especially Montana and Idaho) into the 1970s and 1980s, with most animals thought to represent dispersers from Canada. In 1986, the first documented wolf den in Montana in more than 50 years was discovered in Glacier National Park (MFWP 2003).

Wolves originally occurred throughout British Columbia, but were eliminated from most of the southern portion of the province by 1930 and became fairly uncommon in remaining areas (Pisano 1979, Tompa 1983, Boitani 2003). Province-wide populations fell to their lowest levels during the 1920s and 1930s (Tompa 1983, Hayes and Gunson 1995). Numbers generally began recovering thereafter (except during a period of resumed control during the 1950s) and most of British Columbia was again occupied by the early 1990s, with the exception of the southernmost mainland from Vancouver to Nelson (BCMELP 1988, Hayes and Gunson 1995). Reoccupation of the East Kootenay region in the southeastern portion of the province did not occur until about 1980 (G. Mowat, pers. comm.).

B. Current Status of Wolves

Washington

Washington experienced a flurry of reported wolf activity during the early 1990s, primarily in the North Cascades, which presumably involved animals originating mostly from southern British Columbia. Adult wolves with pups were detected at two locations in the North Cascades in the summer of 1990. One of these sites was in the Hozomeen area of the Ross Lake National Recreational Area, where animals were present for more than a month (Church 1996, Almack and Fitkin 1998) and were again documented (without breeding evidence) in 1991, 1992, and 1993. It was later learned that a pet wolf released in this area in the early 1990s (Martino 1997) was responsible for some of these sightings (S. Fitkin, pers. comm.). The second location occurred northwest of Winthrop near the Pasayten Wilderness (Anonymous 1990, Gaines et al. 2000). Howling surveys conducted in the Okanogan and Wenatchee National Forests from 1991 to 1993 resulted in two confirmed wolf responses in backcountry areas, with one involving multiple individuals in the Lake Chelan-Sawtooth Wilderness and the other being a lone individual in the

Alpine Lakes Wilderness (Gaines et al. 1995; W. Gaines, pers. comm.). A sighting of a wolf with pups was also reported in the North Cascades in July 1996 (Church 1996). Additionally, one wolf was found dead near Calispell Lake in southern Pend Oreille County in May 1994 (Palmquist 2002; WDFW, unpubl. data). This animal was radio-collared and had immigrated from northwestern Montana.

Overall, from 1991 to 1995, Almack and Fitkin (1998) reported 20 confirmed wolf sightings in Washington. Sixteen of these were made in the Cascades and four in Pend Oreille County, although these records were probably biased towards observations in the Cascades. Almack and Fitkin (1998) concluded that small numbers of wolves existed in Washington, mostly as individuals and with one or two possible breeding packs that did not persist. No evidence of large packs or a recovering population was detected. Almack and Fitkin (1998) also confirmed the presence of free-ranging wolf-dog hybrids in the state and believed that a significant number of reported wolf observations probably represented hybrid animals.

Wolf reports in Washington declined from 1996 to 2001, probably due mainly to a reduced emphasis on data collection. However, reports began increasing again in about 2002 (WDFW, unpubl. data), as summarized in the following sections. This was likely a reflection of increased dispersal of wolves into Washington from adjacent recovering populations in Idaho and Montana, and resumed efforts by agency biologists and others to obtain and follow up on reports and to place remote cameras in the field.

Northeastern Washington

Many of the wolf reports in Washington between 2002 and 2007 originated from Pend Oreille and Stevens counties. These included a radio-marked female that dispersed from northwestern Montana and spent several weeks in northern Pend Oreille County in February 2002. It used sites near Metaline Falls and the Salmo-Priest Wilderness (Palmquist 2002) before leaving the area and moving into British Columbia. Several individual wolves were photographed by remote cameras at different locations in Pend Oreille County in 2007. A calf depredation in northernmost Stevens County in late August 2007 was attributed to one or more wolves by USDA Wildlife Services (R. Woodruff, pers. comm.).

In 2008 and again in May 2009, a probable mated pair (including a lactating female in 2009) was photographed by remote cameras in Pend Oreille County. DNA analysis of hair collected in 2009 verified the presence of a male wolf linked genetically to the southern Alberta-northwestern Montana-northern Idaho population (J. Pollinger, pers. comm.). Citizen reports, howling surveys, and remote cameras confirmed the presence of a breeding pack (named the Diamond Pack) in July 2009. The pack produced six pups in 2009, with at least four surviving until 2010. The breeding male was captured and radio-collared in July 2009 and a yearling female was radio-collared in 2010. The pack produced a litter of six pups in 2010 and numbered 12 wolves at the end of the year. The pack's home range covers about 350 square miles, with about 25% of its territory in Idaho. Den sites in 2009, 2010, and 2011 were confirmed to occur in Washington.

A pup belonging to a second pack (Salmo Pack) was trapped and radio-collared in northern Pend Oreille County in August 2010. Four adult-sized animals were seen on several occasions in the winter of 2010-2011, but the pack was not confirmed to contain a successful breeding pair (2 or more pups surviving until December 31). Although the den location has not yet been determined, sufficient telemetry locations were obtained in 2010 and 2011 to confirm that the pack is using both Washington and British Columbia, and that denning likely occurs in Washington. Confirmation of the den's location will determine whether this is counted as a Washington or British Columbia pack.

A third pack (Smackout Pack), located in west-central Pend Oreille County, was confirmed in July 2011. This pack was known to contain at least two adults and three or more pups as of July 2011; and one of the pups was captured and ear-tagged. Based on previous sighting reports and tracks in the area, this pack possibly existed in 2010, although there were no reports of adults and pups.

A radio-collared pup from a pack in Idaho (Cutoff Peak Pack) used a small segment of northeastern Pend Oreille County in 2010 and 2011. This pack occurs primarily in Idaho, where it presumably dens, and also extends into British Columbia (USFWS et al. 2011).

Northern Cascades

Multiple wolf reports from Okanogan County in 2008 led to confirmation of the first fully documented (through photographs, howling responses, and genetic testing) breeding by a wolf pack in Washington since the 1930s. A pack (named the Lookout Pack) with at least four adults/yearlings and six pups was confirmed in the western part of the county and adjacent northern Chelan County in the summer of 2008, when the breeding male and female were captured and radio-collared, and other pack members were photographed. Preliminary genetic testing of the breeding male and female suggested they were descended from wolves occurring in (1) coastal British Columbia and (2) northeastern British Columbia, northwestern Alberta, or the reintroduced populations in central Idaho and the greater Yellowstone area (J. Pollinger, pers. comm.).

The pack produced another litter of at least 4 pups in 2009, as well as a probable litter in 2007 based on a sighting report of 6-8 animals in nearby northern Chelan County in September 2007 (R. Kuntz, pers. comm.) and a report of 7-9 animals in Okanogan County in the winter of 2007-2008. The pack appears to have suffered significant human-caused mortality from illegal killing. In June, 2011, a federal grand jury indictment included the alleged killing of up to five wolves in 2008-2009, believed to be members of the Lookout pack. In May 2010, the Lookout breeding female disappeared several weeks after the suspected birth of a litter. This appeared to cause a breakdown in pack structure, with the breeding male ranging more widely and spending most of the summer alone. This pack was not considered a breeding pair at the end of 2010. However, sightings of multiple wolves (including the breeding male) traveling together in the winter of 2010-2011 indicate there are still two wolves inhabiting the Lookout Pack's territory. The pack occupied an area totaling about 350 square miles from 2008 to 2010.

Another pack (Teanaway Pack) was confirmed in north-central Kittitas County in June 2011, when the pack's breeding female was trapped and radio-collared. Evidence from remote cameras and other sources indicates that the pack held 3-4 adults and an unknown number of pups at that time, and that it probably existed in 2010. Genetic analysis revealed that the Teanaway female was likely a recent descendant of the Lookout male and female wolves originally radio-collared in 2008 (J. Pollinger, pers. comm.).

Tracks and scat that appeared to be from two wolves were found in the Ross Lake/Hozomeen area of North Cascades National Park in 2010 and remote cameras photographed two animals in this area during winter 2011. Further evidence collected in the spring of 2011 suggests that a pack is using this area, but that denning likely occurred in British Columbia rather than Washington.

Blue Mountains

There have been multiple reports of wolves in the Blue Mountains dating back to at least 2006. These include reports of 2-6 wolves in Asotin, Garfield, Columbia, and Walla Walla counties from 2008 to 2011 (P. Wik, pers. comm.) and a radio-collared female dispersing from an Oregon pack in early 2011. One or possibly two packs are probably present on the Washington side of the Blue Mountains, but remain unconfirmed. One or both of these likely spend significant amounts of time in adjacent areas of Oregon.

Statewide Summary

Wolf presence in Washington has expanded substantially since 2002. In July 2011, there were five confirmed packs in the state: two in Pend Oreille County (Diamond, Salmo), one in Pend Oreille and Stevens counties (Smackout), one in Kittitas County (Teanaway), and one in Okanogan/Chelan counties (Lookout) (Figure 2). Only one (Diamond) was a successful breeding pair in 2010. There were also indications of single additional packs in the Blue Mountains and North Cascades National Park, which are likely trans-boundary packs with Oregon and British Columbia, respectively. At least a few solitary wolves also likely occur in other scattered locations of Washington.

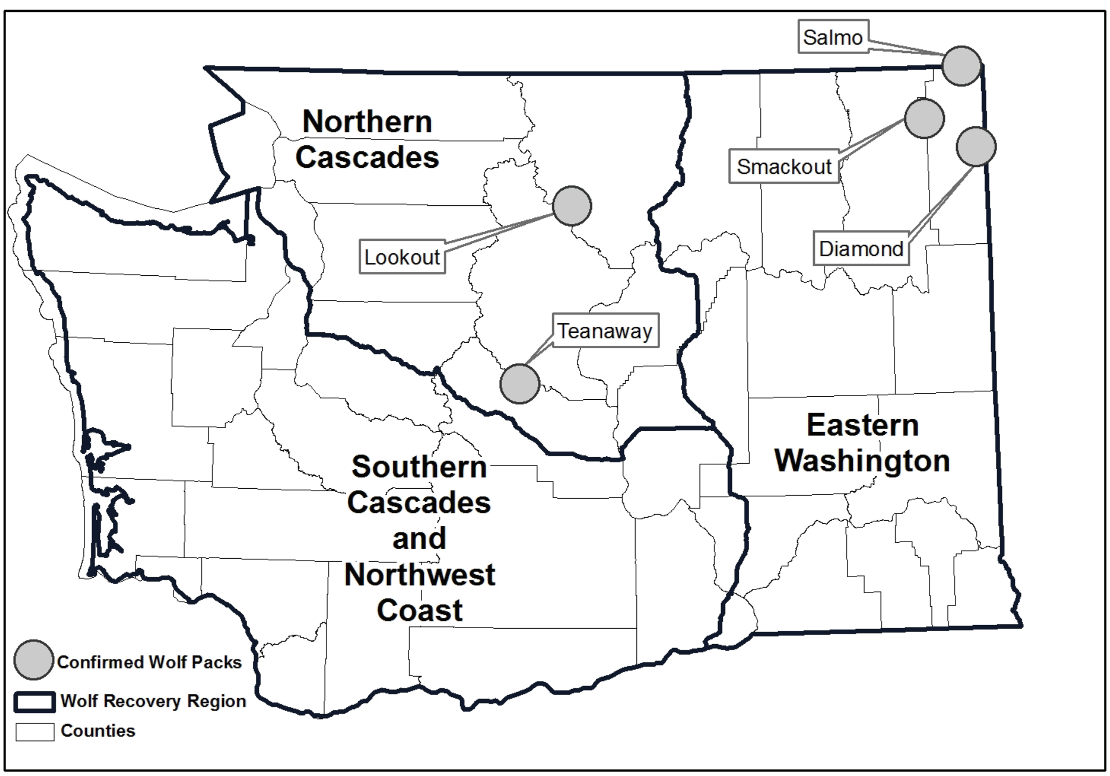


Figure 2. Distribution of confirmed wolf packs within recovery regions in Washington as of July 2011.

WDFW and others have also continued to document the presence of released or escaped hybrid wolves and pet wolves in the wild in Washington (Martino 1997, Palmquist 2002; WDFW, unpublished data).

Neighboring States and British Columbia

Wolf numbers in Montana, Idaho, and Wyoming have grown steadily since the mid-1980s and totaled at least 1,614 animals in 240 recognized packs and 108 breeding pairs in 2010 (USFWS et al. 2011). Natural recolonization of these states began in 1979, when wolves reentered the area near Glacier National Park in northwestern Montana from Alberta. Breeding in this area was first detected in 1986. Dispersers from the park and neighboring areas of Canada gradually recolonized other parts of northwestern Montana over the next decade. In 1995 and 1996, wolves were reintroduced into Yellowstone National Park and central Idaho by the U.S. Fish and Wildlife Service (Bangs et al. 1998), and have also contributed to expanding populations in the three states. This growth allowed the wolf population in the northern Rocky Mountain states to meet the biological recovery levels set by the U.S. Fish and Wildlife Service by the end of 2002 (MFWP 2003). At the close of 2010, wolf numbers totaled 705 in Idaho, 566 in Montana, and 343 in Wyoming (USFWS et al. 2011). Wolves are currently distributed primarily in western Montana, central and northern Idaho, and northwestern Wyoming. Several packs in northern Idaho occur within about 30 miles of Washington (USFWS et al. 2011).

Regulated hunting seasons for wolves were held in Idaho and Montana in 2009-2010 while wolves were federally delisted (USFWS et al. 2010, 2011). Hunter take totaled 186 animals in Idaho and 72 animals in Montana. Both states intend to resume public hunting of wolves upon federal delisting. As of April 2011, it is unknown what wolf population sizes that Idaho, Montana, and Wyoming will manage for after federal delisting.

Oregon's wolf population is in the early stages of development, much like the one in Washington. Between 1999 and early 2008, verified reports of wolves in Oregon totaled five solitary animals and one pair, all of which occurred in the northeastern corner of the state (Jacoby 2007, Cockle 2008, ODFW 2010). At least four of these animals were immigrants from Idaho and either died from human-related causes or were caught and returned to their original source. Four packs have been documented in this region since 2008, with breeding confirmed in two packs (USFWS et al. 2010, 2011). As of early 2011, one pack with 15 wolves was located in eastern Wallowa County, while two other packs with 6 wolves and 3-4 wolves were confirmed in areas of the Blue Mountains adjacent to Washington (R. Morgan, pers. comm.). An additional pack comprised of a yearling male and yearling female was lethally removed in September 2009 after multiple livestock depredations in Baker County. Northeastern Oregon also holds a small number of lone wolves (R. Morgan, pers. comm.). In addition to these records, unconfirmed reports of wolves are regularly made in Oregon (e.g., 204 were received by the Oregon Department of Fish and Wildlife in 2008) and come primarily from several northeastern counties. Under current Oregon state law, wolves are listed as endangered and are fully protected in the state.

Population estimates of wolves are not available for southern British Columbia, but anecdotal evidence suggests that much of the southwestern mainland has experienced a recent increase in wolf abundance (Pynn 2008; D. Reynolds, pers. comm.). Wolves in this region occur south to the Washington border, with some breeding known in or near Skagit Valley Provincial Park. Wolves remain largely absent in the zone along the Washington border from Manning Provincial Park eastward to Creston, although a few animals are sporadically detected (B. Harris, pers. comm.; G. Mowat, pers. comm.). Numbers appear to be growing north of Kelowna (B. Harris, pers. comm.). Wolf recovery has continued in southeastern British Columbia, with harvest numbers suggesting increased abundance since the mid-1990s (Mowat 2007). However, wolves remain quite scarce in the West Kootenay region, including along the border of northeastern Washington (Mowat 2007; G. Mowat, pers. comm.). Wolves are considered common on Vancouver Island (D. Reynolds, per. comm.). Recent research indicates that wolves located along and near the coast of British Columbia are genetically differentiated from those occurring in the interior of the province (Muñoz-Fuentes et al. 2009).

Current wolf management in southern British Columbia allows a 9- to 12-month hunting season in the Kootenay region (including along the borders of Stevens and Pend Oreille counties of Washington), with an annual bag limit of four animals or no bag limit at all. There are also 5.5- and 12-month trapping seasons with no bag limit. The province has a policy of removing wolf packs that threaten the recovery of mountain caribou. Wolves were killed for this reason at several locations in 2008, including east of Creston near the Idaho border, but there are no plans to do so near the Washington border (G. Mowat, pers. comm.). Wolves are currently protected from hunting and trapping in the Okanagan region, but a hunting season may be proposed (B. Harris, pers. comm.). Wolves are also protected from both types of harvest in the southern portion of the management region covering the southwestern mainland.

C. Biology

Physical Characteristics

In Montana, typical weights of adult gray wolves are 90-110 pounds for males and 80-100 pounds for females. Wolves in the greater Yellowstone area are somewhat heavier, with winter-captured adult females averaging 108 pounds, immature females averaging 96 pounds, and immature males averaging 107 pounds (Smith et al. 2000). Smith and Ferguson (2005) reported a maximum weight of about 130 pounds among males at Yellowstone. About half of the wolves in Montana are black, most of the remainder are gray, and a few are white. Both black and gray color phases can be found in a pack or in one litter of pups. Animals with dark pelage sometimes progressively change to white over time, perhaps due to old age, physiological stress, or genetic factors (Gipson et al. 2002).

Observers sometimes mistake coyotes for wolves, but a number of physical features separate the two (Figure 3). Wolf tracks are typically 4.0-4.5 to 5.0-5.5 inches long (Harris and Ream 1983) and are noticeably larger than those of coyotes (2.0-2.5 inches long).

Some large domestic dog breeds and wolf-dog hybrids may also be misidentified as wolves. Wolves can be distinguished from dogs by their longer legs, larger feet, wider head and snout, narrow body, and straight tail. Other identifying characteristics require closer examination than is possible in field settings with live animals. Some wolf-dog hybrids are indistinguishable in appearance from wild wolves, but characteristics that can be used to distinguish them from wolves include a curled tail, broader chest, shorter legs, and a distinct husky mask. In many instances, behavior distinguishes wild wolves from hybrids and dogs (Boyd et al. 2001, Duman 2001).

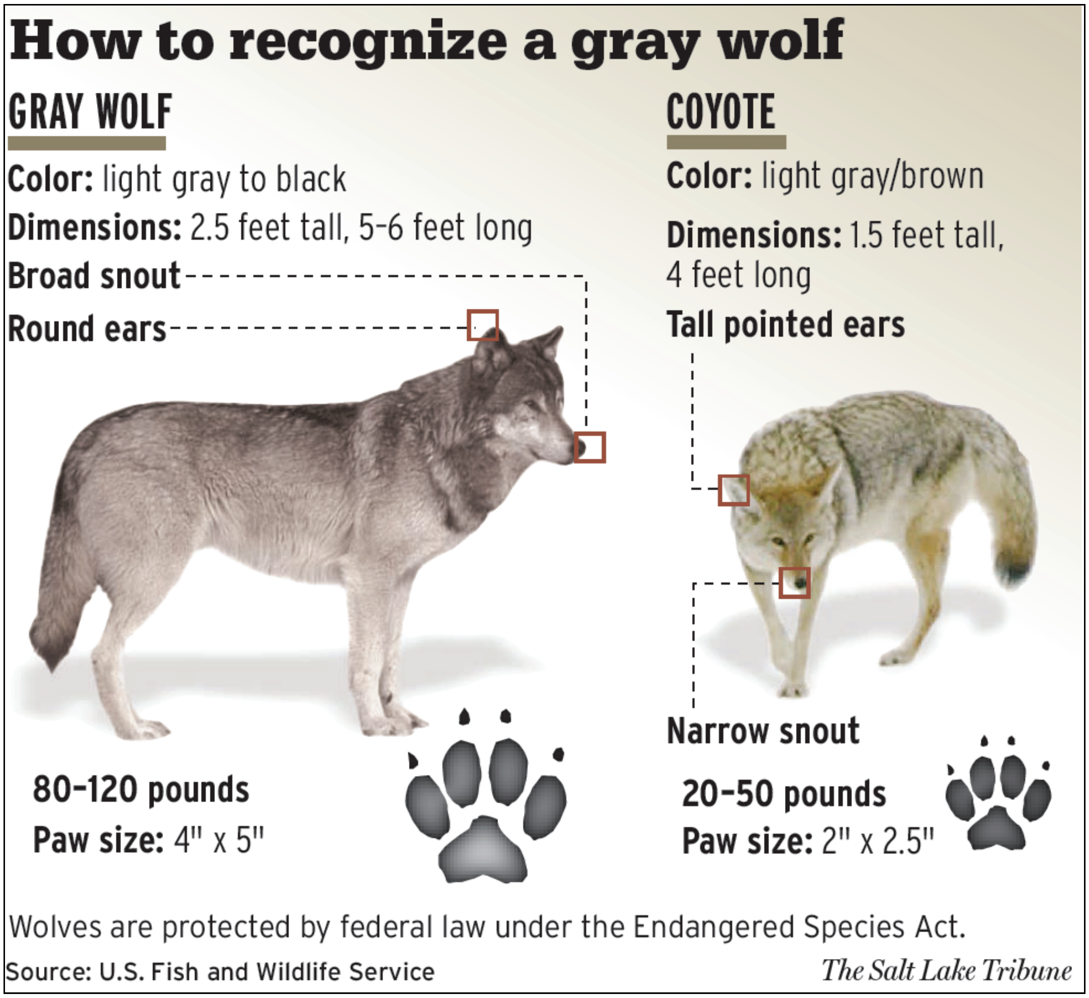


Figure 3. Identification characteristics used to distinguish wolves from coyotes.

Behavior

Gray wolves are highly social and live in packs (Mech and Boitani 2003a). Packs are formed when male and female wolves develop a pair bond, breed, and produce pups. The pack typically consists of a socially dominant breeding pair, their offspring from the previous year, and new pups. Other breeding-aged adults may be present, but they may or may not be related to the others (Mech and Boitani 2003a). The pack hunts, feeds, travels, and rests together. Maintaining the pack social unit is important for acquiring food (Sand et al. 2006, Stahler et al. 2006) and enhancing pup survival (Brainerd et al. 2008). The pack also shares pup-rearing responsibilities, including hunting and tending pups at the den or at a series of rendezvous sites.

Pack size is highly variable (Mech and Boitani 2003a). Populations that are rapidly growing and expanding often consist of smaller packs, whereas those that are well established and have slow growth rates tend to have larger packs if adequate food is available (Mitchell et al. 2008). Pack size may also be related to prey size. Packs feeding primarily on deer tend to be smaller than those preying on elk, while those feeding mainly on moose or bison are often the largest (Smith and

Ferguson 2005). In six regions of Idaho, Montana, and Wyoming, average pack size ranged from 5.1 ± 1.1 (SD) to 9.9 ± 2.6 wolves from the time of population reestablishment to 2005, with the highest average occurring in Yellowstone National Park (YNP) (Mitchell et al. 2008). Smith and Ferguson (2005) reported a maximum pack size of 37 animals at YNP. Packs in these states are often dynamic and commonly fail to persist from one year to the next (Smith and Ferguson 2005, USFWS et al. 2011). This can be due to a number of reasons, including mortalities to key pack members, poor pup production, and lethal control actions.

Pack membership typifies the predominant manner in which wolves exist in the wild. The pack is the mechanism by which wolves reproduce and populations grow. However, in most wolf populations, some lone nomadic individuals exist as dispersers. These animals spend time looking for vacant habitat, waiting to be found by a member of the opposite sex within a new home range, or searching for an existing pack to join. Lone wolves typically comprise up to 10-15% of a population (Fuller et al. 2003). This is a temporary transition. Lone animals in northwestern Montana usually found other wolves in an average of 66 days (range 2-202 days) (Boyd and Pletscher 1999).

Wolves display a number of behaviors that help populations maintain genetic diversity through avoidance of inbreeding. These include a strong avoidance for mating with related pack members, dispersal by males to established packs where mating can occur with unrelated individuals, females remaining in their birth packs to become subordinate breeders, and females dispersing to form new packs and becoming dominant breeders (vonHoldt et al. 2008).

Reproduction

Wolves normally do not breed until at least two years of age (Fuller et al. 2003). Breeding usually occurs only between the dominant male and female in a pack. In the northern Rockies, mating peaks in mid- to late February (Boyd et al. 1993). Wolves localize their movements around a den site and give birth in late April after a 63-day gestation period. Dens are usually underground burrows, but can occur in a variety of other situations, including abandoned beaver lodges, hollow trees, and shallow rock caves. Dens are commonly located near the central core of territories in on hillsides or in other elevated dry areas with loose soils near freshwater and greater vegetation cover (Trapp et al. 2008, Person and Russell 2009, Unger et al. 2009). Wolves often tolerate some limited human disturbance of dens, especially when pups are younger than six weeks of age, and regularly continue using disturbed den sites in subsequent years (Thiel et al. 1998, Frame et al. 2007, Person and Russell 2009). However, wolves sometimes respond to human disturbance near active dens by abandoning the location and moving their pups to other sites. Pups are moved to a series of rendezvous sites after reaching about eight weeks of age, which is about the time that weaning occurs.

Litters usually average four to six pups (Fuller et al. 2003, USFWS et al. 2009). Average litter sizes of 5.3 (range 1-9) pups and 5.1 pups were reported from northwestern Montana in 1982-1994 (Pletscher et al. 1997) and from central Idaho in 1996-1998 (Mack and Laudon 1998), respectively. Litter size averaged at least 3.5-4.5 pups in Idaho from 2005 to 2010 (USFWS et al. 2006-2011).

Most packs produce only one litter annually, but occasionally more than one female in a pack may breed, resulting in multiple litters (Fuller et al. 2003). This phenomenon has been documented in Yellowstone National Park, where for example 13 packs had 16 litters in 2000 (USFWS et al. 2001).

In most cases, non-dominant females breed with males from other packs (Smith and Ferguson 2005). Presence of more than one litter can occasionally lead to the formation of new packs (Boyd et al. 1995). VonHoldt et al. (2008) documented an average generation time (i.e., average age at which females give birth to their offspring) of 4.16 years among wolves at Yellowstone National Park.

Pup survival is highly variable and is largely influenced by disease, predation, and nutrition (Johnson et al. 1994, Fuller et al. 2003, Mech et al. 2008). In northwestern Montana, wolf pup survival from mid-summer to December averaged 85% (range 60 to 100%) over a 12-year period (Pletscher et al. 1997). In the northern Rocky Mountain states from 1982 to 2004, annual pup survival was lower in northwestern Montana (40%) than in central Idaho (89%) and the greater Yellowstone area (76%) (Smith et al. 2010). In Yellowstone National Park, pup survival varied between 73 and 81% from 1996 to 1998, declined to 45% in 1999 because of a likely outbreak of canine distemper, and rebounded to 77% the following year (Smith et al. 2000, Smith and Almberg 2007). Pup survival again dipped to low levels in 2005 (32%) and 2008 (29%) due to canine distemper (Smith et al. 2006, Smith et al. 2009). Wolf pup survival from birth to midwinter averaged 29% (range 14 to 58%) in Wisconsin over a 28-year period (Wydeven et al. 2009a). In this population, lowest pup survival occurred in years coincident with an outbreak of parvovirus (Wydeven et al. 1995).

Pack size is another important factor in determining whether or not a pack is successful in breeding and raising pups. Recent analyses by Mitchell et al. (2008) reveal that larger packs of 10 or more wolves in Idaho, Montana, and Wyoming have a 90% or greater chance of successfully rearing two or more pups through December of a given year, whereas smaller packs are much less likely to do so. For example, depending on location within these states, packs of 4-5 animals had only a 20-73% chance of successfully raising at least two pups to year's end. Reduced reproductive output in wolf populations can therefore result as a consequence of high levels of human-caused mortality leading to smaller pack sizes (Brainerd et al. 2008, Mitchell et al. 2008).

Food Habits

Gray wolves are opportunistic carnivores that are keenly adapted to hunt large prey species, such as deer, elk, and moose. Ungulate species comprise different proportions of wolf diets, depending on their relative abundance and distribution within territories. In the central and northern Rocky Mountains of the United States and Canada, elk are often the primary prey of wolves, but deer and moose are more important in some areas (Table 2). In coastal Alaska and British Columbia, black-tailed deer are the major prey (Darimont et al. 2004, 2009, Person et al. 1996). Moose are the major prey in much of British Columbia, including southern areas (G. Mowat, pers. comm.).

Wolves also prey on smaller animals, scavenge carrion, and even eat fish and vegetation. In addition to ungulates, wolf scat collected in Yellowstone National Park in 1998 contained the remains of voles, ground squirrels, snowshoe hares, coyotes, bears, insects, and plant matter (Smith 1998). Research in northwestern Montana has also documented non-ungulate prey such as tree squirrels, other small mammals, ruffed grouse, ravens, striped skunks, beavers, coyotes, porcupines, and golden eagles (Boyd et al. 1994, Arjo et al. 2002). In coastal Alaska and British Columbia, wolves include salmon and marine mammals in their diet (Person et al. 1996, Darimont et al. 2003, 2008,

Table 2. Prey selection by wolves at various locations in the central and northern Rocky Mountains of the United States and Canada and other areas of British Columbia.

		Prey species (% of diet[1])								
Location	Season[2]	Elk	White-tailed deer	Mule deer	Black-tailed deer	Moose	Bison	Bighorn sheep	Other[3]	Source[4]
Glacier Natl Park	w	30	60	3	-	7	-	-	-	1
Glacier Natl Park area (Camas pack)	w	14	83	-	-	3	-	-	-	2
Glacier Natl Park area (Spruce pack)	w	35	4	-	-	61	-	-	-	2
Northwest Montana	y	23	49[5]	-	-	12	-	-	15	3
Madison Range, sw Montana	w, sp	70	26	4	-	-	-	-	-	4
Idaho	su	53	42[5]	-[5]	-	-	-	-	5	5
Salmon River Mtns, Idaho	w	77	-	23	-	-	-	-	-	6
Yellowstone Natl Park	w	92	2[5]	-[5]	-	3	3	-	-	7
Yellowstone Natl Park	y	83	3[5]	-[5]	-	<1	5	<1	7	8
Banff Natl Park	w, su	78	7[5]	-[5]	-	10	-	2	3	9
N. Columbia Mtns, se British Columbia	sp, su, f	-	3[5]	-[5]	-	95	-	-	2	10
Vancouver Island	y	28	-	-	71	-	-	-	1	11
Vancouver Island	w, su	38	-	-	56	-	-	-	7	12
Central coastal British Columbia	sp, su, f	-	-	-	70				30	13

[1] Results reported as percent of total kills, frequency of occurrence in feces, or frequency of occurrence based on stable isotope analysis of hair.
[2] Season: w, winter; y, year-round; sp, spring; su, summer; f, fall.
[3] Includes other wildlife, such as mountain goats, beaver, pronghorn, mountain caribou, smaller mammals, birds, and unknown species. For central coastal British Columbia, salmon and harbor seals comprised 10% and 6% of the diet, respectively, during the non-winter seasons combined (Darimont et al. 2008).
[4] Source: 1, Boyd et al. (1994); 2, Kunkel et al. (2004); 3, Arjo et al. (2002); 4, Atwood et al. (2007); 5, Mack and Laudon (1998); 6, Husseman et al. (2003); 7, Smith et al. (2004); 8, USFWS et al. (2007, 2008, 2009, 2010; results presented as the mean of these studies); 9, Huggard (1993); 10, Stotyn (2008); 11, Scott and Shackleton (1980); 12, Milne et al. (1989); 13, Darimont et al. (2008).
[5] Use of white-tailed deer and mule deer combined.

Watts et al. 2010), with greater use of these prey groups on islands compared to mainland sites (Darimont et al. 2009).

Wolves scavenge opportunistically on vehicle- and train-killed ungulates, winterkills, and on kills made by other carnivores, particularly cougars. Wolves in northwestern Montana scavenge the butchered remains of domestic livestock at rural bone yards and big game animals at carcass disposal sites. Wolves also kill and feed on domestic livestock such as cattle, sheep, llamas, horses, and goats.

Territories

A pack establishes an annual home range or territory and defends it from trespassing wolves. From mid-April to early May until September or early October, pack activity is centered at or near the den or rendezvous sites, as adults hunt and bring food back to the pups. Rendezvous sites are specific resting and gathering areas that are used by wolf packs after pups emerge from the den. These sites are often in wet meadows (Ausband et al. 2010) or forest openings near the den, but sometimes are several miles away. Adults will carry small pups to a rendezvous site. Breeding females make regular use of den or rendezvous sites, whereas use by nonbreeders in the pack is more variable (Demma and Mech 2009). By September, pups travel and hunt with the pack. The pack hunts throughout its territory until the following spring.

Wolves use different areas of their territory daily, which suggests rotational use that may improve hunting success (Demma and Mech 2009), and territory boundaries and sizes may vary from year to year. Similarly, a wolf pack may travel in its territory differently from one year to the next because of changes in prey availability or distribution, conflicts with neighboring packs, or the establishment of a new neighboring pack. Other attributes such as elevation, land use, land ownership patterns, prey species present, and relative prey abundance make each pack's territory unique. Rich (2010) reported that territory size in general increases with greater terrain ruggedness (which tends to reduce prey availability and vulnerability), higher human densities, and higher levels of lethal control, but decreases with larger numbers of neighboring packs.

During the mid- to late 1980s, the earliest colonizing wolf packs in northwestern Montana had territories averaging 382 square miles in size (Ream et al. 1991). Average territory size in this region fell to 185 square miles (range = 24-614 square miles) by the late 1990s (USFWS et al. 2000), probably as new territories filled in suitable unoccupied habitat. In western Montana, territory size currently averages about 230 square miles per pack (Rich 2010) but can reach 300 square miles or larger (USFWS et al. 2011). In 1999, Idaho wolf packs had average territory sizes of 360 square miles, with individual pack territories ranging from 141 to 703 square miles (USFWS et al. 2000). In Washington, territory sizes for two radio-tracked packs averaged about 350 square miles.

<u>Habitat Use</u>

As with other aspects of their ecology, wolves are generalists in their habitat use. Within their historical geographic distribution, wolves occurred in every habitat with large ungulates, including forests, deserts, prairies, swamps, tundra, and coasts (Fuller et al. 2003). Elevations ranging from sea level to mountains were occupied. Wolves are adaptable enough that they will also enter and forage in towns and farms, cross highways and open environments, and den near sites heavily disturbed by people such as logging sites and military firing ranges (Fuller et al. 2003). Surviving wolf populations in much of western North America, including the northern Rocky Mountain states and British Columbia, predominantly inhabit forests and nearby open habitats, with prey availability and extent of human tolerance strongly influencing occupancy.

Wolves in the northern Rocky Mountain states have demonstrated a greater tolerance of human presence and disturbance than previously thought characteristic of the species. It previously was believed that higher elevation public lands would comprise the primary occupied habitats (Fritts et al. 1994), but most wolves in this region prefer lower elevations and gentle terrain where prey are more abundant, particularly in winter (Boyd-Heger 1997, USFWS 2007a).

The majority (77-93%) of habitat used to date by two packs in Washington has been on public land (federal and state), primarily U.S. Forest Service. Use of public and private land by wolves has differed in Montana and Idaho. Of the 94 documented packs in Idaho that survived during 2009, nearly all territories were wholly or predominantly on U.S. Forest Service (USFS) lands (USFWS et al. 2011). In contrast, most packs in Montana exist on lands with a diversity of property owners and uses. These packs move through a complex matrix of public, private, and corporate-owned lands, with the average territory in northwestern Montana comprised of about 30% private land (USFWS et al. 2011).

Landowner acceptance of wolf presence and use of private lands is highly variable in space and time. Given the mobility of the species and the extent to which these lands are intermingled, it is not unusual for wolves to traverse each of these ownerships in a single day. Land uses range from dispersed outdoor recreation, timber production, or livestock grazing to home sites within the rural-wildland interface, hobby farming/livestock, or full-scale resort developments with golf courses.

Private lands may offer habitat features that are attractive to wolves, so some packs may use those lands disproportionately more than other parts of their territories. In some settings, geography dictates that wolf packs use or travel through private lands and co-exist in close proximity with people and livestock. Land uses may predispose a pack to conflict with people or livestock, although the presence of livestock does not make it a foregone conclusion that a pack will routinely depredate (Bangs and Shivik 2001, Sime et al. 2007).

Dispersal

Upon reaching sexual maturity, most wolves leave their natal pack, looking for a mate to start a new pack of their own (Mech and Boitani 2003a, Treves et al. 2009). Dispersal may be to unoccupied habitat near their natal pack's territory or it may entail traveling much longer distances before locating vacant habitat, a mate, or joining another pack. Wolves appear to disperse preferentially to areas occupied by other wolves, using scent marking and howling to locate other animals (Ray et al. 1991). Boyd and Pletscher (1999) indicated that dispersers in their study moved toward areas with higher wolf densities than found in their natal areas.

In northwestern Montana from 1985 to 1997, 53% of tagged wolves (30 of 58) dispersed from their natal territories to establish new territories or join other existing packs; 59% of males (10 of 17) and 49% of females (20 of 41) dispersed (Boyd and Pletscher 1999). Males dispersed at an average age of 28.7 months and traveled an average of 70 miles, whereas females averaged 38.4 months old at dispersal and moved an average of 48 miles. Males and females combined traveled an average of 60 miles (range 10-158 miles), with 17% of dispersing individuals moving more than 100 miles. At Yellowstone National Park from 1995 to 1999, dispersal distances averaged 54 miles in males and 40 miles in females (Smith et al. 2000). Dispersals can occur in any month, but are somewhat more frequent in January-February (courtship and breeding season) and May-June (Boyd and Pletscher 1999). Maximum dispersal distances of more than 680 miles have been recorded (USFWS et al. 2011). Wolves are capable of traveling such distances over periods of a few weeks or months. Dispersing individuals typically have lower survival rates than non-dispersing wolves (Pletscher et al. 1997).

Dispersal has been regularly documented among and between populations in Montana, Idaho, Wyoming, and bordering areas of British Columbia, thereby increasing genetic exchange across the region (Bangs et al. 1998, Mack and Laudon 1998, Smith et al. 2000). Dispersal paths crossed international boundaries, state boundaries, public and private land boundaries, different land uses, and agency jurisdictions.

Mortality

Few wolves in the wild live more than 4-5 years (Fuller et al. 2003), although maximum age can reach 15 years (Ausband et al. 2009a). Wolves die from a variety of causes, which are usually classified as either natural or human-caused. Natural deaths result from territorial conflicts between packs, injuries while hunting prey, old age, disease, starvation, or accidents. In populations protected from human-caused mortality, most wolves die from being killed by other wolves usually belonging to neighboring packs, disease, or starvation (Mech et al. 1998, Peterson et al. 1998, USFWS et al. 2011). However, natural mortality probably does not regulate most populations in Idaho, Montana, and Wyoming. Humans are the largest cause of wolf mortality in this region as a whole and are the only cause that can significantly affect populations at recovery levels (USFWS 2000, Mitchell et al. 2008, Murray et al. 2010, Smith et al. 2010). Mitchell et al. (2008) reported that humans were responsible for 71-87% of wolf deaths in five of six regions of Idaho, Montana, and Wyoming from 1979 through 2005, whereas only 23% of mortalities in Yellowstone National Park were human-related. Human-caused mortality includes control actions to resolve conflicts, illegal killings, legal harvest, and car and train collisions.

Annual survival rates averaged 75% among wolves in Idaho, Montana, and Wyoming during 1982-2004 (Smith et al. 2010). Prior to the legal hunting seasons in 2009-2010, on average, an estimated 10% of the wolves in these states died annually from control actions, 10% from illegal killing, 3% from human-related accidents, and 3% from natural causes (USFWS 2009). In 2010, human-caused mortality removed 179 wolves in Montana (24% of the state's wolf population), 142 (17%) in Idaho, and 56 (13%) in Wyoming (USFWS et al. 2011). Mortality is higher among younger wolves, dispersers, members of small packs, and wolves occurring in regions with reduced amounts of public lands (Smith et al. 2010).

Wolves are susceptible to a number of viral and bacterial diseases, including rabies, canine parvovirus, canine distemper, canine adenovirus (canine hepatitis), canine herpesvirus, and leptospirosis (Kreeger 2003, USFWS et al. 2007, Mech et al. 2008, Almberg et al. 2009, ODFW 2010). None of these appear to threaten the long-term population viability of wolves in the northern Rocky Mountain states, although periodic outbreaks of canine distemper have been linked to poor pup survival and population decline in some years (USFWS et al. 2007, 2010, 2011, Almberg et al. 2009). Wolves at Yellowstone National Park have shown high and relatively constant levels of exposure to canine parvovirus and canine adenovirus since their reintroduction in 1995, but each disease has produced little or no wolf mortality (Almberg et al. 2009). Canine parvovirus is suspected to have caused a decline in the wolf population at Isle Royale National Park, Michigan (Kreeger 2003), and in Wisconsin during the early 1980s when its wolf population was <30 animals (Wydeven et al. 1995). In Minnesota, canine parvovirus limited population growth and expansion of the wolf population through reductions in pup survival (Mech et al. 2008). Rabies may limit population growth in some situations (Kreeger 2003).

Wolves host various parasites, but most produce little pathology and do not regulate populations (ODFW 2010). Sarcoptic mange has been documented in wolves in Montana and Wyoming, but not Idaho (Jimenez et al. 2010). Occurrence of this disease increased noticeably among wolves at Yellowstone National Park in 2008 and 2009 (USFWS et al. 2009, 2010). Mange outbreaks can be locally severe and persistent in wolves, and commonly can result in mortalities, but are not considered a serious threat to population persistence (USFWS et al. 2006, 2009, Jimenez et al. 2010a). Dog lice have been recorded on wolves in the northern Rocky Mountain states and are perhaps a minor source of mortality in cases of severe infestation (Jimenez et al. 2010b). Wolves in the northern Rocky Mountain states have recently been identified as carriers of the tapeworm *Echinococcus granulosus* (see Chapter 7, Section F; Foreyt et al. 2009) and the protozoan *Neospora caninum* (Almberg et al. 2009).

Rates of Population Change

In the absence of human-caused mortality, wolf populations primarily increase or decrease through the combination and interaction of wolf densities and prey densities (Keith 1983, Fuller 1989), although other factors (e.g., disease) may sometimes play a role. Actual rates of change depend on whether the wolf population is pioneering vacant habitat or whether the population is well established. Degree and type of legal protection, agency control actions, and regulated harvest also influence population trends. At higher densities, wolf populations are considered self regulated (i.e., abundance is density dependent) and possibly limited through territoriality or social strife rather than by prey biomass (Cariappa et al. 2011).

Once established, wolf populations can withstand high mortality rates provided that reproductive rates are also high and immigration continues (Fuller et al. 2003). Previous research suggests that mortality rates of about 30-50% should be sustainable and that human-caused mortality is largely compensatory (Mech 2001, Fuller et al. 2003, Adams et al. 2008). However, a study that modeled population growth as a function of human harvest for northern Rocky Mountain (NRM) wolves and other populations found that the maximum human offtake for stable or increasing wolf populations was 22% for NRM wolves and 24% for other wolf populations (Creel and Rotella 2010). These estimates were consistent with observed declines in NRM wolves when human harvests were 23-24%. Creel and Rotella (2010) also reported that human-caused mortality was not compensatory but highly additive. This is supported by the findings of Murray et al. (2010) and Adams et al. (2008).

Low-density wolf populations can increase rapidly if protected and prey is abundant. Wolf populations in the greater Yellowstone area and Idaho areas exceeded all expectations for reproduction and survival after their initial reintroductions (Bangs et al. 1998). Populations became reestablished in both areas within two years, rather than the predicted three to five years, and pup production and survival were high. However, once densities become high enough, social interactions among packs intensify, causing intraspecific conflict and increased competition for food. These factors eventually cause populations to level off or decline (Keith 1983, Fuller 1989).

Wolf populations in six regions of Idaho, Montana, and Wyoming increased at mean annual rates of 16-56% through 2005 (Mitchell et al. 2008). Some of the packs that formed in this region persisted, but others did not due to illegal killing, control actions where livestock depredation was repeated, and unknown reasons. Total wolf numbers in Montana increased from 8 to 497 wolves during the 26-year period from 1982 to 2008 before Montana's first wolf hunting season (USFWS et al. 2009) for an average annual rate of increase of about 17%. The population remained fairly small (fewer than 20) until 1989, then began a period of rapid increase that continued through 2008 when numbers grew in 13 of 19 years. Prey abundance has influenced wolf population dynamics in northwestern Montana. Expanding white-tailed deer populations during the late 1970s through the mid-1990s were partly responsible for increasing wolf numbers and distribution. However, the wolf population there declined after the severe winter of 1996-1997, when smaller prey populations resulted in greater predation on livestock in 1997 and 1998, forcing an increase in the lethal control of wolves (C. Sime, unpubl. data).

Idaho's wolf population grew from fewer than 20 animals in 1995, when reintroductions first occurred, to an estimated 856 wolves in 2008 (USFWS et al. 2009), which corresponds to a mean annual growth rate of about 33%. Eighty-eight packs were documented in 2008 and had expanded across much of the state from the Canadian border, south to the fringes of the Snake River plain, and east to the Montana and Wyoming borders. Wolf numbers declined substantially from 843 in 2009 to 705 in 2010 due in large part to the state's first wolf hunt and continuing lethal control (USFWS et al. 2011).

The population at Yellowstone National Park quickly expanded from no wolves at the time of reintroduction in 1995 to a peak of 174 wolves in 2003, then fell 31% to 118 animals in 2005 (USFWS et al. 2006). Numbers grew 45% to 171 wolves in 2007 (USFWS et al. 2008), but then decreased by about 60% to 97 wolves in 2010 (USFWS et al. 2011). The declines in 2008 and 2009 likely resulted from food stress, intraspecific stress, and disease (USFWS et al. 2010, 2011).

Wolf populations in the Great Lakes region have experienced variable growth rates. Annual population growth rate in the 1990s was 37.4% in Michigan, 22.1% in Wisconsin, and 4.6% in Minnesota with slowing growth in the 2000s to 12.3%, 11.1%, and 3.6%, respectively (Wydeven et al. 2009b). Slowing growth rates suggest that wolves were beginning to saturate most areas of suitable habitat.

Role in Ecosystems

Trophic Cascades

The wolf is a top-level or apex predator in the ecosystems in which it occurs, where it has few, if any significant competitors or predators. Some ecosystems may have more than one apex predator, such as wolves and grizzly bears in the greater Yellowstone ecosystem. Despite the generally small number of apex predator species, they typically influence the abundance and behavior of subordinate predator species, referred to as mesopredators (Soulé et al. 1988, Prugh et al. 2009). Coyotes, raccoons, and foxes are common examples of mesopredators. In the absence of an apex predator, the role of mesopredators can change as they become more abundant, select different prey, or take over the functional status of apex predator, a phenomenon known as mesopredator release. Conversely, the return or colonization of an apex predator to an ecosystem can result in mesopredator suppression, in which the apex predator directly or indirectly reduces the abundance or affects the ecology of mesopredators through predation, behavioral avoidance of the predator, or other interactions.

Alteration of predator-prey dynamics can produce significant changes across the trophic levels in a food web, which are referred to as a trophic cascade (Hairston et al. 1960, Beschta and Ripple 2009). One example of a trophic cascade caused by the removal of an apex predator is that the behavior or abundance of mesopredators is no longer constrained, which in turn changes the behavior or abundance of herbivores, resulting in further changes in the abundance of the plants eaten by the herbivores (Rosenheim 2004). Alternatively, removal of an apex predator can directly impact its herbivore prey, which may then affect the food plants of these species. In both examples, the trophic cascade can extend to many other plants and animals living in the ecosystem. The existence of trophic cascades has been well documented in many ecosystems, including terrestrial and marine systems (e.g., Estes and Duggins, 1995, Anthony et al. 2008).

Ecosystem Responses to Wolf Presence

As indicated above, wolves can affect many species in an ecosystem through predation, trophic cascades, and other processes. These impacts include: (1) limitation of herbivore prey abundance and changes in prey behavior, (2) removal of inferior prey individuals and stimulation of prey productivity, (3) increasing food availability for scavengers and small carnivores, and (4) enhancement or limitation of some non-prey abundance (Mech and Boitani 2003b). However, the ecological effects of wolf predation on food webs are complex and interact with other biotic and abiotic factors, especially at lower trophic levels, and therefore generally remain poorly understood and difficult to predict (Berger and Smith 2005, Hebblewhite and Smith 2010).

Regulation of large herbivore abundance and behavior by wolves can result in alterations to vegetation patterns (structure, succession, productivity, species composition, and species diversity), thereby potentially affecting many wildlife species residing in an ecosystem (Berger and Smith 2005). Research at Yellowstone and Banff national parks has linked wolf predation on elk and associated changes in elk density and behavior to the localized resurgence of woody browse species such as willows and aspen (Smith et al. 2003, Ripple and Beschta 2004, 2007, Beschta 2005, Beschta and Ripple 2010, Hebblewhite and Smith 2010). However, two recent studies dispute some of the reported findings from Yellowstone. Kauffman et al. (2010) stated that aspen are in fact not recovering in the park and that further reductions in elk abundance are needed for this to occur. Both Tercek et al. (2010) and Kauffman et al. (2010) found that abiotic factors such as soil moisture, soil mineral content, and snow depths were just as important in explaining the variable patterns in willow and aspen regrowth as elk browsing pressure. Hebblewhite and Smith (2010) concluded that only willow is recovering at Yellowstone due to reduced elk browsing.

Willow resurgence at Yellowstone has allowed beaver numbers to increase and will probably result in greater amounts of foraging and nesting habitat for various birds and other species (Hebblewhite and Smith 2010). Tree and shrub recovery in riparian areas may also decrease stream temperatures and erosion, thereby potentially benefiting trout, salmon, and other fish. At Grand Teton National Park, Berger et al. (2001) hypothesized that overbrowsing of riparian zones by moose following the eradication of wolves and grizzly bears had produced changes in vegetation structure resulting in pronounced reductions or elimination of a number of neotropical migrant bird species (e.g., calliope hummingbird, willow flycatcher, gray catbird, yellow warbler, MacGillivray's warbler, fox sparrow, and black-headed grosbeak).

Eradication of wolves has possibly produced a number of important ecological changes in Olympic National Park in northwestern Washington. Initial research by Beschta and Ripple (2008, 2009) suggests that overbrowsing by elk during the past century or so has caused substantial changes in riparian plant communities, including severe declines in the recruitment of black cottonwood and bigleaf maple. This in turn may have caused increased riverbank erosion and channel widening. Probable reductions in the amount of large woody debris in river channels during this period have likely reduced rearing habitat for salmon, steelhead, and resident fish. These changes in river ecology have probably also lowered the amount of aquatic invertebrate prey (including emerging adult insects) available for fish, birds, and bats. Confirmation of these impacts is needed through additional research (P. Happe, pers. comm.).

Wolf-related reductions in coyote abundance may result in population changes among other medium-sized and small carnivores, either directly through reduced predation by coyotes or indirectly through adjustments in prey availability. For example, reduced interference competition with coyotes may increase the abundance of red foxes (Mech and Boitani 2003b). Similarly, wolf-related reductions in coyotes or exclusion of coyotes from certain areas may result in increased survival for some prey species consumed by coyotes (e.g., pronghorn; Berger et al. 2008, Berger and Conner 2008, Barnowe-Meyer et al. 2010).

It should be noted that most research on wolf-related trophic cascades has been conducted in national parks or other protected areas. It remains unclear whether the beneficial ecological impacts of wolves are as extensive in less pristine landscapes that have been influenced by livestock grazing or other human activities (L. D. Mech, pers. comm.). Climate and habitat productivity are other factors that also may affect the strength of ecological changes resulting from wolves (Rooney and Anderson 2009).

Removal of younger, older, and debilitated prey animals by wolves (Mech 1970, 2007, Kunkel et al. 1999, Mech and Peterson 2003, Smith et al. 2004) can leave prey herds comprised of a greater proportion of animals of prime age and in good health, which may in turn result in higher productivity in prey populations (Mech and Boitani 2003b). Preliminary evidence suggests that wolf predation can also change the occurrence of some diseases in prey populations, causing either reduced prevalence through the removal of infected individuals or increased prevalence where greater herding behavior enhances transmission (Wild et al. 2005, 2011, Barber-Meyer et al. 2007, Cross et al. 2010).

D. Legal Status

In Washington, gray wolves are subject to both the federal Endangered Species Act (ESA) and Washington state law (RCW 77.15.120, WAC 232-12-014; Appendix A). These laws are independent but somewhat parallel. As long as wolves remain federally listed in all or part of Washington, both federal and state law must be consulted to understand the protections that pertain to wolves in Washington.

Federal

Wolves were listed as endangered in 1973 under the federal ESA, which is intended to conserve and recover endangered and threatened species to levels where protection is no longer necessary. The ESA prohibits the take of endangered and threatened animals. The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Penalties for violations of the ESA include fines of up to $100,000, with the maximum prison term of one year in jail.

In 1980, the U.S. Fish and Wildlife Service completed the Northern Rocky Mountain Wolf Recovery Plan, which was revised in 1987 (USFWS 1987). The plan specified a recovery criterion of 10 breeding pairs (defined as two adults of opposite sex capable of producing offspring) of wolves for three or more consecutive years in each of three distinct recovery areas: (1) northwestern Montana, (2) central Idaho, and (3) the Yellowstone National Park area. The plan stated that if two recovery areas maintained 10 successful breeding pairs for three successive years, the population could be reclassified to threatened; and if all three recovery areas maintained 10 successful breeding pairs for three consecutive years, the wolf population could be considered fully recovered and considered for delisting. Washington is not included in this recovery plan.

This recovery goal was modified in 1994 to better meet the needs for reestablishing a wolf population with long-term viability. The goal now requires a total of 30 or more breeding pairs (defined as an adult male and adult female that raise at least 2 pups until December 31) comprising 300 or more wolves in a metapopulation (USFWS 1994). A metapopulation can be thought of as a group of partially isolated populations that interbreed and are able to recolonize sites of extirpated population. The goal also requires that at least 10 breeding pairs and 100 wolves be maintained per state (i.e., Idaho, Montana, and Wyoming) rather than per specified recovery area. As a safety margin against relisting, all three states have committed to managing for 15 breeding pairs and 150 wolves in mid-winter (E. Bangs, pers. comm.). The requirement for 10 breeding pairs and 100 wolves per state for three successive years was met in 2002.

Based on scientific reviews and updated information, the U.S. Fish and Wildlife Service began using entire states, in addition to recovery areas, to measure progress toward recovery goals. Wolves reintroduced into Yellowstone National Park and central Idaho in 1995 and 1996 were designated as "non-essential experimental populations" under the federal ESA within a combined zone covering all of Idaho south of Interstate 90, southwestern Montana, and all of Wyoming. Elsewhere (i.e., northwestern Montana and northernmost Idaho), wolves remained listed as endangered. In addition to population objectives in the three states, the U.S. Fish and Wildlife Service required approved state management plans to ensure the conservation of the species into the future as a condition of delisting the wolf in Idaho, Montana, and Wyoming. Washington was not required to have a state wolf conservation plan as a prerequisite for federal delisting because it was not part of the original Northern Rocky Mountain Wolf Recovery Plan (USFWS 1987). State wolf management plans were approved by the U.S. Fish and Wildlife Service for Montana and Idaho in 2004 and Wyoming in 2007.

In 2007, the U.S. Fish and Wildlife Service proposed the formation of a Northern Rocky Mountain distinct population segment (DPS) of the gray wolf and delisting of this DPS (USFWS 2007a). The proposed DPS encompassed all of Montana, Idaho, and Wyoming, as well as the eastern one-third of Washington and Oregon and a small part of north-central Utah (Figure 4), and became effective on March 28, 2008 (USFWS 2008a). Under this rule, wolves were federally delisted in Washington east of Highway 97 from the British Columbia border south to Monse, Highway 17 from Monse south to Mesa, and Highway 395 from Mesa south to the Oregon border, but remained federally listed west of these highways (Figure 4). However, the delisting rule was challenged in court; a preliminary injunction was granted in July 2008, which restored federal protection under the ESA. The rule was vacated by the judge at the request of the Service and was released in October 2008 for public comment (USFWS 2008b). On January 14, 2009, the U.S. Fish and Wildlife Service announced its intention to delist the DPS except in Wyoming, which no longer had an accepted management plan. The Service withdrew this action on January 20, 2009, pending further review, but announced its decision to proceed with delisting on March 6, 2009 (USFWS 2009). Delisting became effective on May 4, 2009, except in Wyoming.

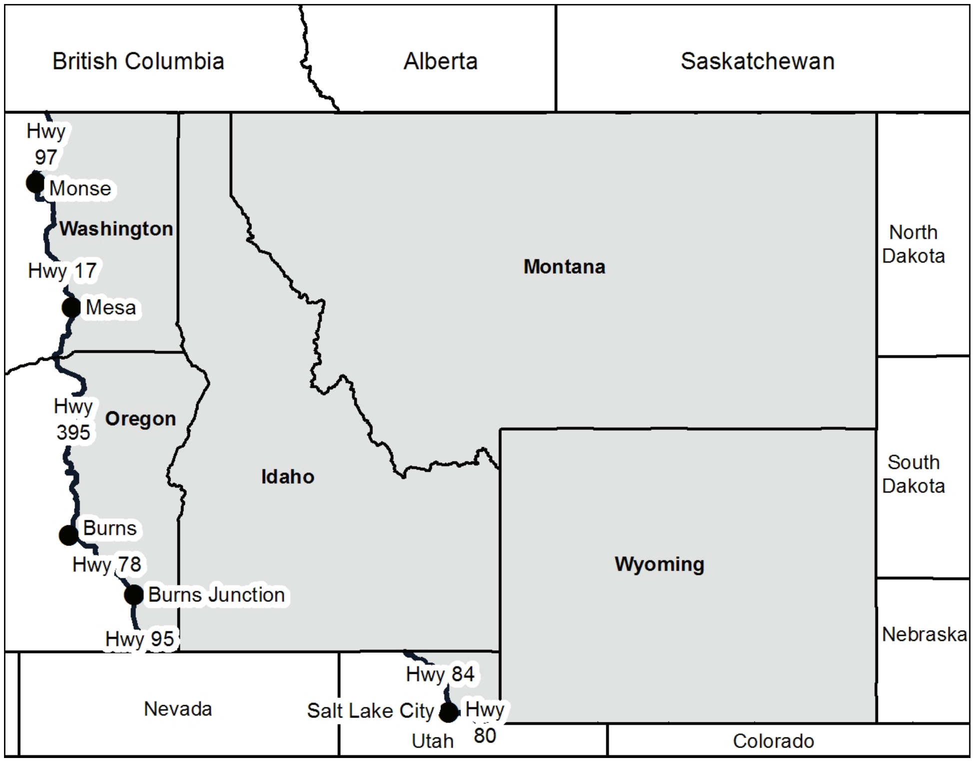


Figure 4. Map of the area (gray shading) designated by the U.S. Fish and Wildlife Service as the Northern Rocky Mountain distinct population segment of gray wolves.

In June 2009, two lawsuits were filed by conservation groups opposing delisting, while two others were filed by the state of Wyoming and a coalition of livestock groups and others seeking the delisting of wolves in that state. On August 5, 2010, a U.S. district judge vacated the U.S. Fish and Wildlife Service's 2009 delisting rule on the basis that the delisting of a portion of a DPS was not legal under the ESA. This reinstated the federal protections for wolves in the DPS that were in place prior to the 2009 delisting (USFWS 2010a).

On May 5, 2011, wolves in the Northern Rocky Mountain DPS, except Wyoming, were delisted as a result of a rider attached to the 2011 federal budget bill. Judicial review of the delisting was prohibited by the budget rider (USFWS 2011b). Following delisting, the U.S. Fish and Wildlife Service is required under the federal ESA to continue monitoring delisted populations for at least five years to ensure that abundance remains above a threshold for relisting.

Also on May 5, 2011, the U.S. Fish and Wildlife Service initiated a 5-year status review of wolves in the Pacific Northwest (USFWS 2011a). This will determine whether a separate DPS should be designated for wolves in western Washington, western Oregon, northern California, and western Nevada.

State of Washington

Wolves were first listed as endangered by the Washington Department of Game in 1980 because of their historical occurrence in the state and subsequent near-extirpation, and because of their existing status as endangered under the federal Endangered Species Act. State law RCW 77.15.120 protects endangered species from hunting, possession, malicious harassment, and killing; and penalties for illegally killing a state endangered species range up to $5,000 and/or one year in jail (Appendix F). State listing and delisting procedures for endangered, threatened, and sensitive species in Washington are specified in WAC 232-12-297 (Appendix A).

Tribal

In the mid-1800s, eight treaties (known as the "Stevens Treaties") were negotiated with tribes in what would become Washington State. The treaties established reservations for the exclusive use of the tribes. Federally recognized tribes with reservations generally have authority to manage fish and wildlife within their reservation. Not all of the state's tribes signed treaties with the federal government. Several of these tribes have reservations designated by executive order. These include the Colville, Spokane, and Kalispel reservations in eastern Washington, and the Chehalis and Shoalwater reservations in western Washington.

Wolf Management

Wolf management may vary among tribes in Washington. WDFW has established a Wolf Interagency Committee composed of WDFW, tribes, federal and state land managers, and the U.S. Fish and Wildlife Service to foster coordination and collaboration on wolf management in the state. Individual tribes in Washington may choose to develop their own wolf management plans, as several tribes in other states have done (Shoshone and Arapaho Tribal Fish and Game Department 2007, Blackfeet Tribal Business Council 2008, Confederated Salish and Kootenai Tribes Tribal Wildlife Management Program 2009). In areas where wolves are federally listed as endangered, tribes are subject to federal Endangered Species Act regulations. However, in areas of Washington where wolves become federally delisted, there is the potential for tribes to develop their own management plans and regulations regarding wolves. These may or may not be consistent with the state wolf plan. If issues were to arise over inconsistencies, they would be discussed in government-to-government consultations between WDFW and the tribes. With regard to hunting, treaties generally preempt state regulation of tribal treaty hunting. However, the courts have created a narrow exception to the general rule, which applies to situations where the state regulates the hunting of a particular species in order to conserve that species. Below is some additional detail describing off-reservation hunting rights in Washington.

Off-Reservation Hunting

In addition to the authority to manage on reservation lands, the Stevens Treaty tribes reserved their rights to continue traditional activities on lands beyond these reserved areas. The treaties all contain substantially similar language reserving the right to hunt, fish, and conduct other traditional activities on lands off reservations. There are 24 tribes with off-reservation hunting rights in Washington. Two of the tribes, the Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe, are located outside of the state, but have reserved hunting rights within Washington.

Tribal hunting rights for non-treaty tribes are typically limited to areas on the reservation, although the Colville Confederated Tribes' hunting rights extend to an area that was formerly part of the reservation known as the "North Half." The Colvilles' hunting rights to the North Half were upheld by the U.S. Supreme Court's decision in *Antoine v. Washington* in 1975.

There are additional tribes that are recognized by the federal government, but have no specific off-reservation hunting rights. Members of those tribes are subject to state hunting regulations.

As federal law, treaties preempt inconsistent state law under the Supremacy Clause of the Federal Constitution. The courts have ruled that state regulation of tribal exercise of off-reservation hunting rights on open and unclaimed land is preempted by the Stevens Treaties, except where state regulation is necessary for conservation purposes.

The treaties do not expressly specify the geographical extent of the hunting right. In *State v. Buchanan* (1999), the Washington State Supreme Court ruled that this right extends to (1) the lands formally ceded by the tribes to the United States as those lands are described in the Treaties; and (2) may include other areas where it can be shown that those areas were "actually used for hunting and occupied [by the tribe] over an extended period of time." The court did not provide a formal mechanism to evaluate and determine traditional hunting areas.

Federal and state courts have ruled that public land is "open and unclaimed" unless it is being put to a use that is inconsistent with tribal hunting. For example, in *U.S. v. Hicks*, a federal district court ruled that the Olympic National Park was not "open and unclaimed" because one of its purposes is the preservation of native wildlife and because hunting is generally prohibited in the park. In contrast, national forests have been held to be "open and unclaimed." In *State v. Chambers* (1973), the Washington Supreme Court stated that private property is not "open and unclaimed," but such private property must have outward indications of private ownership recognizable by a reasonable person.

E. Social, Cultural, and Economic Values

Many aspects of the wolf-human relationship are based on long-held cultural perceptions. Modern viewpoints on wolves also illustrate the fundamental differences in the ways that urban and rural people view nature (Wicker 1996). As noted in the Montana Gray Wolf Conservation and Management Plan Draft EIS (MFWP 2003), "the differences in attitudes towards wolves might be summed up as the perceived chance of personal benefit or loss resulting from the presence of wolves. Those who feel they will benefit either directly or vicariously tend to favor wolf recovery and those who perceive the threat of personal loss oppose recovery."

Decidedly negative views of wolves prevailed during the period of eradication in the United States and continue today among some portions of the population, especially those who may be economically impacted by wolf restoration (Wilmot and Clark 2005). Hunter groups also worry that wolves may reduce harvestable game populations. Additionally, some citizens view wolves as highly problematic in the greater context of preserving private property rights and achieving broader uses of public lands.

By contrast, many studies of human attitudes towards wolves in the United States have documented strong public support for wolves in recent decades, even in the West (Fritts et al. 2003). These attitudes are fostered by the fear of extinction and a desire to restore natural ecosystems to their former function. Urban people and members of environmental organizations tend to hold the most positive and protectionist views toward wolves (Fritts et al. 2003). Favorable attitudes towards wolves also increase with geographic distance from occupied wolf range (Karlsson and Sjöström

2007). Wolf-related tourism has become an economic benefit in some areas, especially at Yellowstone National Park, where wolves are plentiful, easily located, and viewed from park roads (see Chapter 14, Section D). Nie (2002) cautioned that the debate over wolf recovery and management in the U.S. is a value-based political conflict that needs to go beyond economic or scientific framing. He suggested that an inclusive, participatory framework of multiple stakeholders holding diverse values may be a constructive way to address the socio-political dimensions of wolf recovery (Nie 2002).

Views of Native Americans in Washington towards Wolves

Perspectives regarding wolves vary amongst Native American tribes in Washington. A number of tribes in the state have traditional and cultural ties with wolves; and there are also concerns in some tribes regarding potential impacts on opportunities for subsistence harvest of elk, deer, and moose.

There are several summaries on the strong cultural and spiritual ties of Native American tribes in Washington to wolves (Laufer and Jenkins 1989, Ratti et al. 1999). Wolves are respected for their intelligence, hunting ability, and devotion to other pack members (Ratti et al. 1999). These and other values have been taught to generations of Native Americans through the telling of stories and legends. Wolves play an important role in the creation stories and other legends of many tribes, such as the Quinault, Quileute, Makah, and S'Klallam of the Olympic Peninsula (see Ratti et al. 1999). Wolves also have significant parts in the spiritual life of some tribes. For example, they serve as spirit guides for tribal members and provide spiritual power to warriors and hunters (see Ratti et al. 1999). Wolves are also featured in vision-quest stories, rituals, and ceremonial practices. Thus, for many tribes, there is a general regard that wolves "help" humans to prosper both physically and socially (Laufer and Jenkins 1989).

Although some tribes had taboos against killing wolves (Laufer and Jenkins 1989), others such as the Salish and Quinault are known to have hunted them (Ratti et al. 1999). The Sanpoil and Nespelem of northeastern Washington caught wolves and used their skins for robes or blankets (Ray 1933). Wolves were also sometimes kept as pets.

Survey Results of Public Attitudes in Washington

Four recent studies in Washington provide information on citizen attitudes statewide on a variety of questions pertaining to hunting and wildlife management, including wolves. The first of these (Duda et al. 2008a) was conducted by Responsive Management, a professional public opinion and attitude survey research firm specializing in natural resource and outdoor recreation issues. This study examined overall public opinion and entailed a telephone survey of 805 Washington residents 18 years old and older in January 2008. The survey asked six questions about wolves and related issues. Specific information on the survey and its findings can be found at http://wdfw.wa.gov/publications/pub.php?id=00433. The following summary of results is reprinted from the survey's final report:

- "The large majority of Washington residents (75%) support allowing wolves to recover in Washington; meanwhile, 17% oppose it.

- "A cross tabulation found that those who live in urban and suburban areas are more likely to support wolf recovery; while those residing in small city/town or rural areas are more likely to oppose. Note that those living on ranches or farms are the most likely to *strongly* oppose.

- "When the stipulation is put on wolf recovery that it could result in localized declines in elk and deer populations, support declines slightly: 61% support wolf recovery if it will result in some localized declines in elk and deer populations, and 28% oppose.

- "Most Washington residents (61%) support some level of lethal wolf control to protect at-risk livestock; however, 31% oppose. Additionally, a majority of residents (56%) support having the state pay compensation out of the General Fund to ranchers who have documented losses to livestock from wolves, but 35% oppose.

- "When asked how worried, while recreating outdoors, they would be about wolves, respondents most commonly say that they would not be worried at all (39%), and 26% would be only a little worried; in sum, 65% would be only a little worried or not worried at all. On the other hand, 33% would be very or moderately worried, with 11% *very* worried.

- "In a question tangentially related to wolf management, the survey found that wildlife viewing specifically of wild wolves would appear to be popular, as 54% of residents say that they would travel to see or hear wild wolves in Washington. (Note that 2% of respondents say that they would not need to travel, as they have wild wolves nearby already.)"

The second survey (Duda et al. 2008b), also conducted by Responsive Management, assessed hunter opinions and was conducted via telephone interviews with 931 Washington hunters 12 years old and older from December 2007 to February 2008. Interviewees in this study were exclusive from those contacted by Duda et al. (2008a). The survey asked three questions about wolves and related issues. Specific information on the survey and its findings can be found at http://wdfw.wa.gov/publications/pub.php?id=00433. The following summary of results is reprinted from the survey's final report:

- "After being informed that wolves are highly likely to re-colonize Washington over the next 10 years, hunters were asked if they support or oppose having the Department manage wolves to be a self-sustaining population. Support exceeds opposition among every type of hunter except [those in a category combined for] sheep/moose/goat hunters.

- "Common reasons for supporting include that the hunter likes wolves/that all wildlife deserves a chance to flourish, that wolves should be managed and controlled anyway, or that wolves should be managed so that they do not overpopulate.

- "Common reasons for opposing include concerns about potential damage to livestock and/or game and wildlife, that the respondent does not want wolves in the area, or that wolves are not manageable."

The third survey (Dietsch et al. 2011) was conducted by Colorado State University in collaboration with WDFW and examined overall public opinion on different wildlife management issues based on

4,183 mail-in responses from Washington residents in the fall of 2009. The survey asked eight questions about wolves and related issues. Specific information on the survey and its findings can be found at http://wdfw.wa.gov/publications/pub.php?id=01190. The following summary of results is reprinted from the survey's final report:

- "Washington residents generally found natural recolonization of the state by wolves to be acceptable (74.5%).
- "Residents also supported translocation of wolves by WDFW from one area in Washington where they have reached a certain population size to another area in the state to reestablish new wolf populations (73.7%).
- "There was also a high level of support among residents for wolf control measures. Specifically, residents were accepting of lethal removal of wolves that have caused loss of livestock (65.9%), limiting the number of wolves in certain areas if they are contributing to localized declines in deer or elk (69.8%), and a limited hunting season on wolves once they have exceeded WDFW recovery goals (63.5%).
- "Residents were less accepting of landowner compensation schemes for wolf-related livestock losses (44.8%), but were slightly more accepting of these strategies if the funds for compensation came from the sale of hunting and fishing licenses (46.1%) rather than from state tax dollars (40.3%).
- "Current hunters were highly supportive of limiting wolf numbers, both in terms of lethal removal of damage-causing animals and recreational hunting……Non-hunters were significantly more supportive of wolf recolonization than were past or current hunters."

The fourth survey (Callahan 2011) was conducted as part of a Master's thesis focused entirely on public opinion about wolves and wolf management in Washington. The survey asked Washington residents 51 questions pertaining to wolves in March 2009, with results based on 325 mail-in responses. The following summary of results comes from a preliminary report on the study's findings:

- More Washington residents are in favor of having wolves in Washington (48.3% strongly or somewhat approved) than opposed to having them (18.1% strongly or somewhat disapproved).
- Among respondents living in western Washington (i.e., west of the Cascade crest), most preferred a situation in which wolves become reestablished in many, most, or all western Washington counties (59.0%) vs. in no or few western Washington counties (38.8%). Among respondents living in eastern Washington (i.e., east of the Cascade crest), most preferred a situation in which wolves become reestablished in many, most, or all eastern Washington counties (68.4%) vs. in no or few eastern Washington counties (27.8%).

- Most Washington residents thought that conservation groups and ranchers should work together to develop proactive and non-lethal methods for managing wolves (55.7% strongly or somewhat favored this vs. 13.6% who strongly or somewhat opposed this).

- Most Washington residents thought that the threat of a wolf hurting or killing a person is so low that it should not be an important factor in determining the total number of wolves allowed to live in the state (52.0% strongly or somewhat favored this vs. 16.9% who strongly or somewhat opposed this).

- Most Washington residents thought that wolf populations provide ecological benefits (51.1% strongly or somewhat favored this vs. 15.7% who strongly or somewhat opposed this).

- More Washington residents thought that the most effective method for managing wolves is to educate the public about how to live with wolves (48.3% strongly or somewhat favored this vs. 19.4% who strongly or somewhat opposed this).

- More Washington residents thought that the state's wolf population should not be allowed to impact deer and elk numbers to the point that hunting of these species becomes more restricted (38.5% strongly or somewhat agreed with this vs. 25.2% who strongly or somewhat disagreed with this).

- Somewhat more Washington residents believed that wolves should be managed by hunting (36.9% strongly or somewhat favored this), as is done with cougars and bears, than not (29.2% strongly or somewhat opposed this).

- Somewhat more Washington residents opposed adjusting hunting limits to allow for more prey for wolves (32.3% strongly or somewhat opposed this) than supported this (25.2% strongly or somewhat favored this).

- Washington residents were split on whether wolves should be trapped and relocated to suitable regions of Washington where natural migration is difficult or impossible (31.4% strongly or somewhat favored this vs. 32.0% who strongly or somewhat opposed this).

- Most Washington residents favored using state tax funds to manage wolves for the following purposes: 1) to preserve wolves as a wildlife species (56.9% strongly or somewhat supported this vs. 15.1% who strongly or somewhat opposed this), 2) to keep wolves away from residential areas (54.1% strongly or somewhat supported this vs. 10.5% who strongly or somewhat opposed this), and 3) to encourage collaboration between conservation groups and ranchers to develop, use, and monitor proactive non-lethal wolf management tools (50.5% strongly or somewhat supported this vs. 17.2% who strongly or somewhat opposed this).

- Most Washington residents supported having private conservation organizations help fund implementation of the Wolf Conservation and Management Plan (56.3% of respondents strongly or somewhat supported this vs. 10.7% who strongly or somewhat opposed this).

> There was lower support or opposition for the use of fees or tax dollars from the following sources for this purpose: 1) increased hunting and fishing license fees (39.1% supported this vs. 30.5% who opposed it), 2) the federal government (36.4% supported this vs. 25.0% who opposed it), 3) a state wildlife tax (32.3% supported this vs. 33.8% who opposed it), and 4) Washington's general fund (27.4% supported this vs. 36.3% who opposed it).

In addition to the four public attitude surveys, Mazur (2011) used a different type of methodology to provide structure to analyzing public attitudes and preferred management strategies for wolves in Washington. Thirty-two people representing a range of values about wolf recovery participated in the process. Mazur (2011) identified three dominant perspectives among the stakeholders: scientific, incompatibility, and precautionary perspectives. The scientific perspective promotes the use of best science, public education, and outreach to achieve ecosystem restoration. The incompatibility perspective holds that wolves do not have a place in Washington and urges that proactive measures be taken to mitigate ungulate decline and hunting traditions. The precautionary perspective cautions about impacts that wolves will have on livestock producers and urges fairness in management. Explicit areas of consensus and contention were identified. Mazur (2011) suggested these could be used to develop management approaches that are more likely to be acceptable across all stakeholder groups involved in wolf recovery in Washington.

3. WOLF CONSERVATION

The conservation portion of this plan identifies the strategies to reestablish a naturally reproducing and viable population of gray wolves distributed in a significant portion of the species' former range in Washington. WAC 232-12-297 (Endangered, threatened and sensitive wildlife species classification; Appendix A) defines the process by which "listing, management, recovery, and delisting of a species can be achieved." The process requires the preparation of a recovery plan for species listed as endangered or threatened. At a minimum, recovery plans must include target population objectives, criteria for reclassification, and an implementation plan for reaching population objectives. The Wolf Conservation and Management Plan for Washington is designed to meet the requirements under WAC 232-12-297 for a state gray wolf recovery plan.

This chapter of the plan provides:

- background on the scientific basis of conservation planning for wolves (Section A)
- recovery objectives for wolves in Washington (Section B)
- a discussion of wolf management after delisting (Section C)

A. Scientific Basis for Conservation Planning

State wildlife agencies have employed several approaches for setting recovery objectives for wolves that are intended to ensure long-term viability. WDNR (1999) determined that the objectives for Wisconsin had to achieve four standards. They needed to:

- meet or exceed federal recovery criteria,
- be compatible with existing information on wolf population viability analysis,
- represent a population level that could be supported by the available habitat, and
- be socially tolerated to avoid development of strong negative attitudes toward wolves.

These standards provide guidance for a scientific basis for setting wolf recovery objectives for Washington.

Consideration of Federal Recovery Objectives

When the states of Minnesota, Michigan, Wisconsin, Idaho, Montana, and Wyoming developed state wolf plans, they had to meet or exceed the federal population goals established by the U.S. Fish and Wildlife Service in federal recovery plans (USFWS 2009, Wydeven et al. 2009b). In the Great Lakes region, states established minimum population goals that were 100-200 wolves higher than the minimum federal goals; these goals were derived after conducting population viability analyses (Wydeven et al. 2009b).

In Washington and Oregon, there were no federal population objectives to consider in developing state objectives because the two states were not included in the Northern Rocky Mountain Wolf Recovery Plan (USFWS 1987). As a result, there are no minimum federal population objectives that must be met or exceeded in developing Washington's wolf recovery objectives.

Population Viability

Recovery objectives for downlisting and delisting a species need to be set at sufficient numbers of individuals and levels of geographic distribution to ensure that a permanently viable population is reestablished. For the purposes of this document, a "viable" population is one that is able to sustain its size, distribution, and genetic variation in the long term without requiring human intervention and conservation actions. Such populations must also be able to withstand fluctuations in abundance and recruitment associated with variation in food supplies, predation, disease, and habitat quality. For wolves, long-term persistence of a population in Washington will depend on other factors as well, including proximity and connectivity (e.g., vonHoldt et al. 2008) to source populations (outside and potentially within the state), competing carnivore populations, the extent of conflicts with livestock production, and overall social tolerance by people.

Federal Population Viability Analyses for the Northern Rocky Mountain Wolf Recovery Plan

The number of individuals needed to maintain the long-term viability of wolf populations is widely debated. In 1994, the U.S. Fish and Wildlife Service (2008a) concluded that 30 or more breeding pairs comprising 300 or more wolves in a metapopulation (a population made up of partially isolated sets of subpopulations that are able to exchange individuals and recolonize sites in which the species has recently become extirpated) should have a high probability of long-term persistence because:

> "… such a population would contain enough individuals in successfully reproducing packs distributed over distinct but somewhat connected large areas to be viable for the long-term (USFWS 1994). A population at or above this size would contain at least 30 successfully reproducing packs and ample individuals to ensure long-term population viability. In addition, the metapopulation configuration and distribution throughout secure suitable habitat would ensure that each core recovery area would include a recovered population distributed over a large enough area to provide resilience to natural or human-caused events that may temporarily affect one core recovery area. No wolf population of this size and distribution has gone extinct in recent history unless it was deliberately eradicated by humans (Boitani 2003)" (USFWS 2008a).

In the mid-1990s, Fritts and Carbyn (1995) provided a synthesis of information for insight into minimum population size and area requirements for wolf conservation. They reviewed the scientific literature on minimum viable population size, examined case histories of wolf populations, and surveyed biologists familiar with wolves. They were skeptical of results from population viability analyses because they were based on insufficient theoretical models to account for the high resilience of small wolf populations. In their survey of biologists about whether recovery goals in the Northern Rocky Mountain Wolf Recovery Plan would equate to a viable wolf population, 61% of respondents believed that 10 breeding pairs (about 100 wolves) met the minimum standard of a viable population, whereas 70% agreed that three groups of 10 breeding pairs and 100 wolves in a metapopulation (about 300 wolves) for three consecutive years met the definition of viable (Fritts and Carbyn 1995). Based on this assessment, Fritts and Carbyn (1995) concluded that 100 or more wolves might be needed to maintain viability in isolation.

Haight et al. (1998) modeled the long-term population survival (50 years) of a hypothetical, isolated wolf population of about 100 wolves. In their analysis, the landscape was capable of supporting a maximum of 16 territories, representing a disjunct population of 96 wolves (6 wolves per pack). Different human-caused mortality rates were simulated in the model by varying the number of territories in core (lower mortality rates) or peripheral (higher mortality rates) range. For a small initial population occupying 2 of the 16 territories, immigration was crucial in maintaining growth of the small population; with no immigration, mean territory occupancy in year 50 was less than 80% with fewer than 8 territories in core habitat. For a large initial population in which 14 of the 16 available territories were occupied, mean occupancy remained high at year 50 regardless of immigration, provided that pup and dispersal mortality were low and consistent with a legally protected population. For a large initial population, with higher pup and dispersal mortality, two or more immigrants per year were necessary to maintain high site occupancy (≥80%) provided that four or more territories were in core habitat. Adding environmental variation to the model to account for short-term prey fluctuations exacerbated the effect of little or no immigration on population persistence, especially when pup or dispersal mortality was high; under these scenarios populations were more likely to decline or go extinct. Results of these simulations and empirical evidence from isolated or semi-isolated wolf populations (Fritts and Carbyn 1995) indicate that disjunct populations of wolves may persist provided that adequate immigration is maintained, human-caused mortality is not excessive, and prey is abundant.

In 2001-2002, the U.S. Fish and Wildlife Service reevaluated recovery criteria for the Northern Rocky Mountain distinct population segment in an effort to update their 1994 analysis and conclusions of Fritts and Carbyn (1995). The assessment of the recovery goals included a review of the scientific literature and a survey of wolf experts on population viability. Most reviewers (78%) strongly supported the 1994 conclusion that a metapopulation of at least 30 breeding pairs and at least 300 wolves would provide a viable wolf population (USFWS 2008a). However, the experts also concluded that viability would be "enhanced by higher (500 or more wolves) rather than lower population levels (300) and longer (more than 3 years) rather than shorter (3 years) demonstrated time frames [because the] more numerous and widely distributed a species is, the higher its probability of population viability will be" (USFWS 2008a). Based on this reevaluation, the U.S. Fish and Wildlife Service retained its 1994 wolf recovery goals for the Northern Rocky Mountain distinct population segment (USFWS 2008a).

Recent studies that reviewed minimum viable population (MVP) size requirements for many species, including wolves (Reed et al. 2003, Brooks et al. 2006, Traill et al. 2007, 2010). Reed et al. (2003) estimated MVP for 102 vertebrate species and found the overall median estimate was 5,816 adults. Traill et al. (2007) conducted a meta-analysis of MVP for 212 species, including the gray wolf, and reported a median MVP of 4,160 individuals. Brook et al. (2006) estimated MVP for 1,198 species, including the gray wolf, and reported a median MVP of 1,377 individuals. These studies suggest that populations of several thousand individuals may be needed to ensure long-term persistence (>90% probability for 100 years). Species with populations of several hundred individuals may only ensure 50% probability of persistence on a long-term time scale.

Flather et al. (2011) identified some shortcomings in the methods used in these studies, citing a lack of data and theory to support their general applicability. Using supplementary data from Traill et al. (2007), they demonstrated high variability in standardized MVPs within species, such as the wolf. In this case, MVP varied from 248 to 6,332 individuals and had a strong dependence on environmental context. Although Flather et al. (2011) discounted the applicability of a universal threshold for MVP, they supported using population viability analysis modeling based on data specific to the focal population at risk.

State Population Viability Analyses for Wisconsin and Michigan

Both Wisconsin and Michigan conducted population viability analyses on an isolated population to provide a conservative estimate of wolf numbers needed for viability if exchange of wolves among the Great Lakes population declined in the future (WDNR 1999, Beyer et al. 2009). In Wisconsin, population viability analysis suggested that an isolated population of 300-500 wolves would have a high probability of persisting for 100 years under most of the scenarios tested (WDNR 1999). However, simulations employing moderate to high levels of environmental variation and catastrophic events resulted in substantially greater likelihood of extinction or the need to relist the population. Criteria for downlisting wolves in Wisconsin to state threatened status were set at 80 or more wolves for 3 years, with state delisting set at 250 or more wolves for 1 year (outside tribal reservations) (Wydeven et al. 2009a). In Michigan, population viability analysis suggested that 200 wolves "reasonably approximated a viable population" (Beyer et al. 2009:76).

Genetic Diversity and Gene Flow

An underlying tenet of endangered species recovery is that populations need to be functionally connected so that genetic material can be exchanged. In isolation, no population of wolves less than several thousand is expected to maintain its genetic viability (Fritts and Carbyn 1995, vonHoldt et al. 2008). Loss of genetic variation can pose a conservation threat to wolves by causing decreased reproductive rates, reduced disease resistance, and other problems. These can, in turn, hinder the long-term recovery of populations regardless of other factors such as habitat and prey availability. Inbreeding depression has been suggested as the cause of reproductive problems (e.g., reduced sperm quality, decreased litter size, reduced pup survival) and other problems (e.g., congenital backbone deformities) noted in several small wolf populations (Wayne and Vilà 2003, Liberg et al. 2005, Asa et al. 2007, Fredrickson et al. 2007, Räikkönen et al. 2009). Nevertheless, many existing wolf populations have persisted for decades or centuries with low genetic diversity (Fritts and Carbyn 1995, Boitani 2003). As a result, wolf populations are broadly considered to be more threatened by issues relating to excessive human-caused mortality than by genetic concerns (Boitani 2003).

Although wolves display several behaviors that help them avoid inbreeding (see Chapter 2, Section C), isolated populations that remain small in size can experience reductions in genetic diversity because members have few opportunities for mating with unrelated individuals. Wolf populations feature effective population sizes (i.e., the average number of individuals in a population that breed and successfully pass their genes to succeeding generations; N_e) that are much smaller than the total size of populations (N_c) (Aspi et al. 2006). This means that retaining adequate numbers of successfully breeding adults is particularly important in preserving the long-term genetic viability of wolf populations. Analyses by vonHoldt et al. (2008) suggested that isolated populations maintaining 10 breeding pairs and 100 wolves will lose genetic variation and become inbred over the long term. Bensch et al. (2006) reported that an isolated wolf population in Scandinavia that grew from a founding breeding pair and one subsequent immigrant to about 140 wolves during a 21-year period lost genetic diversity at a rate of 2% per generation (i.e., about every 4 years). Other small wolf populations also possess reduced levels of genetic variability (Peterson et al. 1998, Wayne and Vilà 2003, Fredrickson et al. 2007). Based on the genetic traits of wolves at Yellowstone National Park, vonHoldt et al. (2008) predicted that without immigration, inbreeding depression would cause the park's population of about 170 animals to experience an increase in pup mortality from an average of 23 to 40% within 60 years.

To preserve the genetic diversity of isolated wolf populations, vonHoldt et al. (2008) suggested that conservation efforts should discourage actions that interfere with pack formation and retention. For example, intense control actions that result in the frequent removal of breeding pairs or severe disruption of pack stability may lead to high breeder turnover and the possibility of reduced genetic exchange through fewer mating choices with unrelated individuals. High levels of lethal removal associated with livestock depredation and hunting could also significantly reduce genetic connectivity and effective population size of wolves in a metapopulation (vonHoldt et al. 2010). Genetic concerns in wolf populations can be alleviated by management actions such as increased protection, restoration of habitat, and augmentation of populations through translocation (vonHoldt et al. 2008, Kojola et al. 2009, USFWS 2009). The addition of even a single breeding immigrant can dramatically increase the genetic variability of isolated populations (Vilà et al. 2003, Adams et al. 2011). Translocations reestablishing new populations should emphasize adequate numbers of founders so that these populations start with significant genetic diversity.

Current wolf populations in the northern Rocky Mountain states are characterized by high levels of genetic variability and substantial gene flow (Forbes and Boyd 1996, 1997, vonHoldt et al. 2008, 2010, Hebblewhite et al. 2010), meaning that wolves arriving in Washington from this source should be genetically healthy. In addition to wolves dispersing into Washington from the Rocky Mountain states, the genetic makeup of wolves in the state would be further diversified by breeding with wolves dispersing into the state from British Columbia.

Potential Suitable Habitat and Biological Carrying Capacity

Potential Suitable Habitat in Washington

As a habitat generalist, wolves are capable of living in a variety of ecosystems having adequate prey and sufficient human tolerance. Oakleaf et al. (2006) looked at potential wolf habitat in Idaho, Montana, and Wyoming, using the following GIS data layers: roads accessible to two-wheel and four-wheel vehicles, topography (slope and elevation), land ownership, relative ungulate density (based on State harvest statistics), cattle and sheep density, vegetation characteristics, and human density. From that analysis, they concluded, and the U.S. Fish and Wildlife Service (USFWS 2008a) concurred, that the four primary factors related to wolf occupancy and persistence were: 1) forest cover, 2) human population density, 3) elk density, and 4) domestic sheep density. Higher forest cover and elk density increased the probability of occupancy and persistence, whereas higher human and sheep densities decreased the probability of occupancy and persistence.

Wolves are expected to persist in habitats with similar characteristics in Washington. Areas with abundant deer, elk, and moose, lower livestock use, and few potential human conflicts offer the best chance for recovery success. These locations include national forests, national parks, wilderness areas, national recreation areas, designated roadless areas on public lands, and areas with low densities of open roads. In some areas, wolves are expected to follow their prey to lower elevations during the winter.

Historically, wolf distribution in Washington included much of the state. During the 70 or so years that wolves have been essentially absent from Washington, humans have significantly altered the landscape. Habitat once occupied by wolves has been reduced by development and land conversion, with many suitable areas now existing as fragments rather than as large contiguous blocks. Road densities have increased dramatically and the human population has grown to more than six million people. Although these changes have reduced the amount of habitat now available to wolves, large areas of Washington still have low human densities and are potentially suitable for the species.

There have been five recent modeling studies that have estimated potentially suitable wolf habitat in Washington. They vary in approach, data layers that were used, and in predictions of amounts of potentially suitable wolf habitat in the state, but most were consistent in predicting suitable habitat in northeastern Washington, the Blue Mountains, the Cascade Mountains, and the Olympic Peninsula (Figures 5-8). The five studies include:

(1) B. Maletzke (unpubl. data) used the four parameters (i.e., elk density, forest cover, human density, and presence of sheep allotments) found by Oakleaf et al. (2006) to be the most important predictors of wolf occupancy and persistence in Montana, Idaho and Wyoming. Methods for calculating these parameters appear in the methods section of Appendix G. Maletzke determined that nearly all potentially suitable wolf habitat (≥ 50% probability of occupancy) occurs in northeastern Washington, the Blue Mountains, the Cascade Mountains, southwestern Washington, and the Olympic Peninsula (Figure 5).

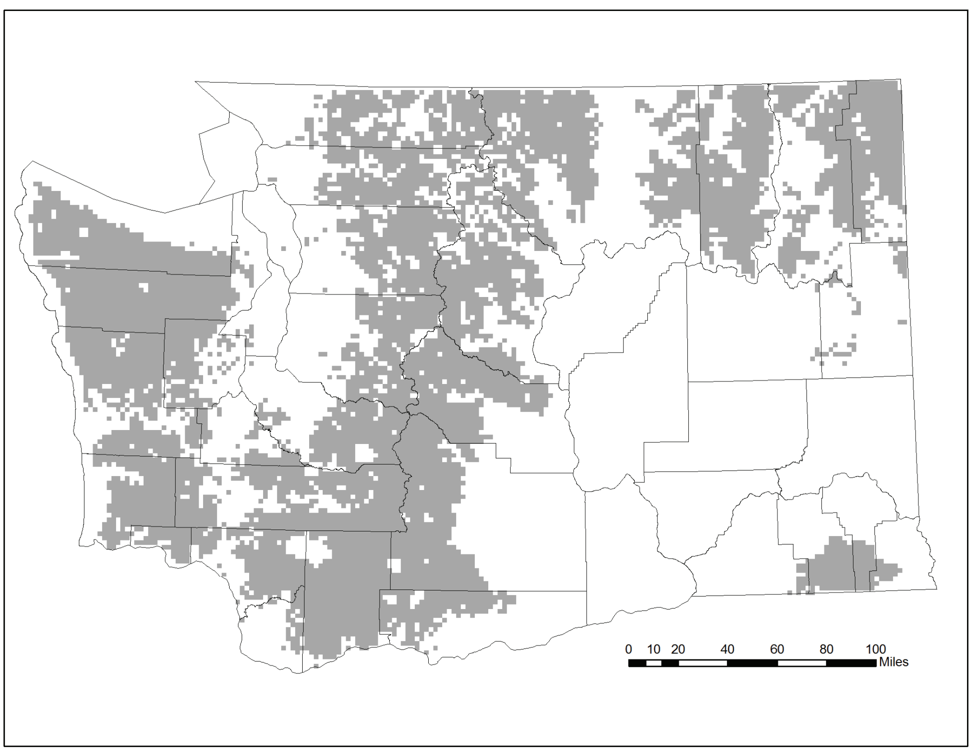


Figure 5. Estimated suitable wolf habitat likely (≥ 50% probability) to be occupied in Washington (gray shading), using the parameters of Oakleaf et al. (2006). Analyses were conducted by B. Maletzke.

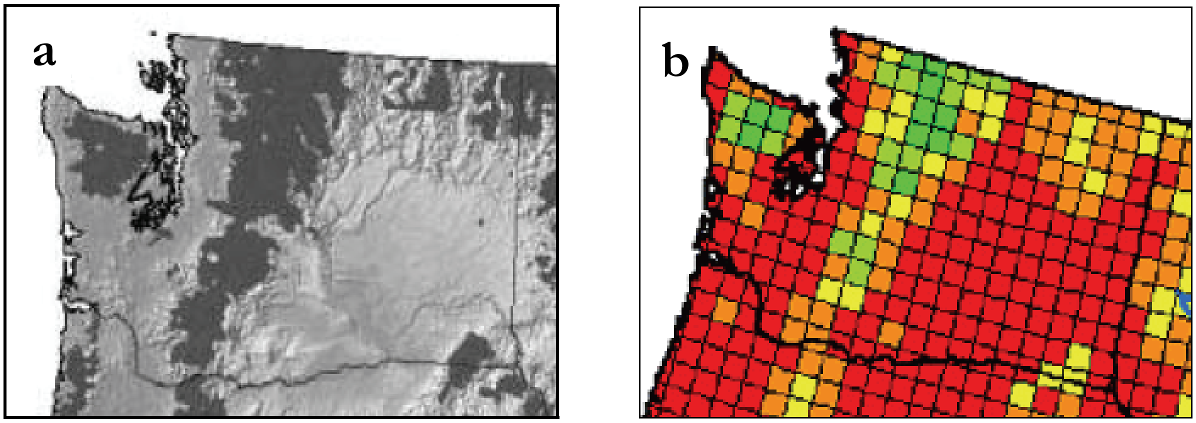


Figure 6. Estimated suitable wolf habitat in Washington depicted in two studies: (a) suitability was defined as those lands with a 50% or more probability of occurrence (dark gray shading; Larsen and Ripple 2006); and b) suitability was represented by values greater than 0.5 (Houts 2003). Colors represent different probabilities of occupancy from 0.0-0.69 (green = predicted suitable wolf habitat ≥ 0.5).

(2) Larsen and Ripple (2006) used prey density and the extent of human presence, forest cover, and public lands as parameters. They defined wolf habitat suitability as those lands that predicted a ≥ 50% probability of wolf occurrence (Figure 6a). Their results projected more suitable habitat in the northern Cascades than the Maletzke model (Figure 5), but none in southwestern Washington.

(3) Houts (2003) used logistic regression to model suitable wolf habitat in Washington (Figure 6b), the northern Rocky Mountain states, and Oregon based on road density and land cover data, using a 30 x 30 km grid to approximate an average wolf pack territory size. Houts (1999) found that most wolves in Idaho, Montana, and Wyoming were in areas with a mean road density less than 0.54 km per sq km, and in coniferous or mixed conifer/deciduous forests.

(4) Carroll et al. (2006) conducted a series of analyses of suitable wolf habitat in the western U.S., including Washington. The first analysis mapped much of western and northeastern Washington as suitable habitat based on vegetation type (used as a measure of prey abundance) and terrain (Figure 7a).

A second analysis predicted potential distribution and demography of wolves in the western U.S. using the spatially-explicit PATCH model (Schumaker et al. 2004) under five different landscape scenarios portraying current and future conditions. In this analysis, Washington was considered isolated from British Columbia and adjacent states. The PATCH model predicted low probability of occupancy and persistence in Washington under current conditions, except in the Olympic Peninsula and the Blue Mountains (Figure 7b). Using this projection, USFWS (2008a, 2009) reported that the Washington portion of the Northern Rocky Mountain distinct population segment (i.e., eastern one-third of Washington) contained only an estimated 297 square miles of potential wolf habitat. This projection has already proven to be a poor representation of suitable wolf habitat in the state, as evidenced by the five wolf packs all currently living in northeastern Washington and the Cascades in areas of low predicted occupancy.

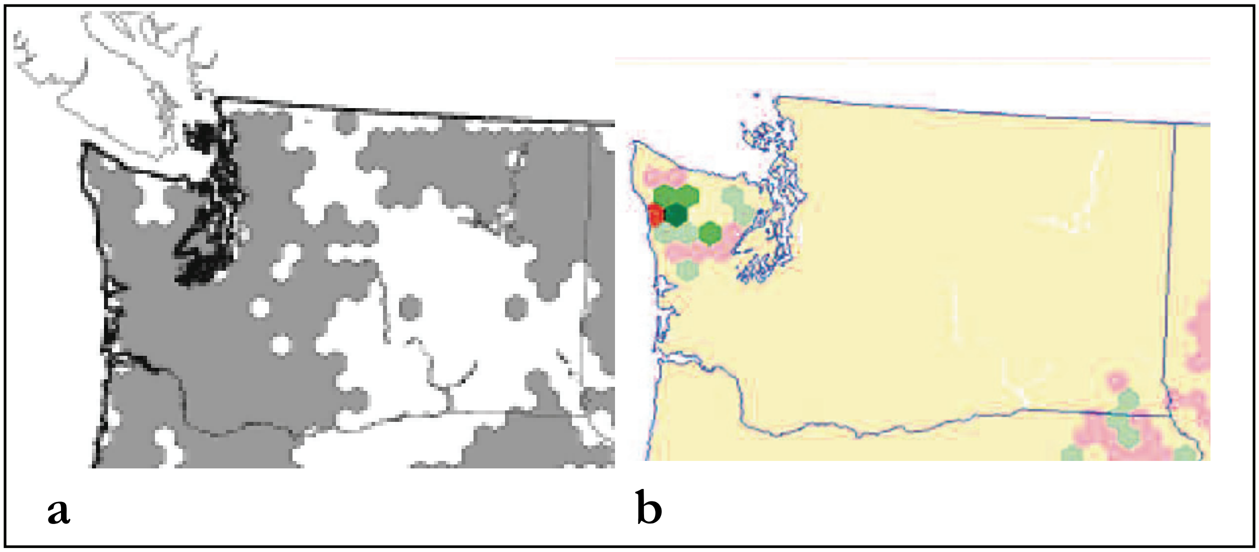


Figure 7. The estimates of Carroll et al. (2006) of (a) suitable wolf habitat in Washington (gray shading) based on vegetation parameters, and (b) potential wolf distribution predicted by the PATCH model under current habitat conditions. In (b), areas with predicted negative population growth rates are shown in pink and red, and are considered “sink” habitats. Those shown in shades of green have predicted positive growth rates and are considered “source” habitats. Areas in pale yellow are predicted to have low potential occupancy (less than 25%).

(5) In response to questions from the Wolf Working Group, Carroll (2007, unpubl. data) subsequently expanded his PATCH model analysis of suitable wolf habitat in Washington by considering the influence of linkages with habitat in British Columbia and adjacent states on predicted wolf distribution and demography. GIS data layers used were: (1) vegetative productivity; (2) road density and type together with human population density and distribution, which were used as a measure of wolf mortality (livestock density was not incorporated); and (3) habitat linkages with neighboring states and British Columbia.

The results identified areas of potential wolf habitat similar to those indicated by Maletzke (unpubl. data) and Larsen and Ripple (2006), including the Cascades, northeastern Washington, the Olympic Peninsula, and the Blue Mountains (Figure 8). However, most of the habitat within these areas, especially in the northern Cascades and northeastern Washington, was considered to be lesser quality “sink” habitat, where resident wolf populations would have difficulty persisting without ongoing immigration from neighboring “source” populations. Sink habitat is nonetheless considered vital in enhancing regional population viability by facilitating dispersal between source populations. In comparison, source habitats are higher quality habitats that support growing populations (source populations) and produce dispersing young. Source habitats therefore play a pivotal role in sustaining viable populations.

Models of suitable wolf habitat are most useful for understanding the relative proportions and distributions of various habitat characteristics related to wolf survival and shouldn’t be interpreted as absolute predictors of areas that will be occupied by wolves (USFWS 2008a). Estimates of suitable habitat calculated from four of the model results (estimates from Houts 2003 not available) range from a low of about 16,900 square miles (Carroll 2007) to a high of about 41,500 square miles

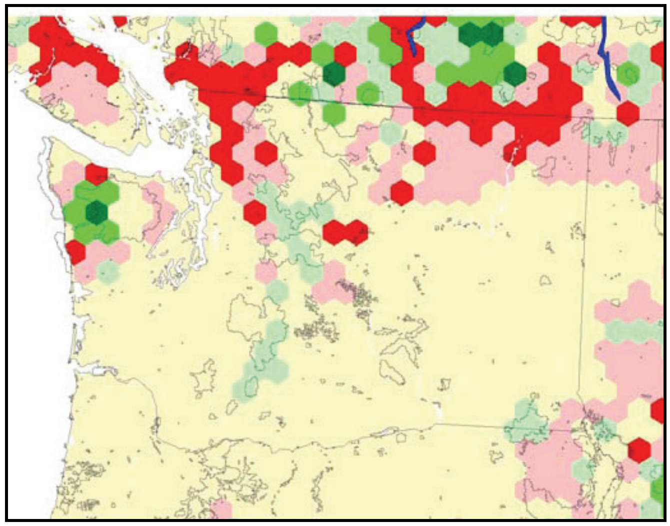


Figure 8. Potential wolf distribution in Washington and surrounding areas as predicted by Carroll (2007). Areas with predicted negative population growth rates are shown in pink and red, and are considered "sink" habitats. Those shown in shades of green have predicted positive growth rates and are considered "source" habitats. Areas in pale yellow are predicted to have low potential occupancy (less than 25%).

(Carroll et al. 2006). Maletzke's (unpubl. data) results were about 26,700 square miles and Larsen and Ripple (2006) results were about 19,000 square miles. The average of the four models was about 26,025 square miles. Maletzke's (unpubl. data) projection may be the most realistic because it used the parameters identified by Oakleaf et al. (2006) as the most important predictors of suitable wolf habitat, and it was able to use current WDFW GIS data layers for elk densities in the state. Both Larsen and Ripple (2006) and Carroll (2007) projected lower amounts of total suitable habitat because their results did not portray southwestern Washington as potential wolf habitat. The Carroll et al. (2006) model results were highest because they projected the Puget Sound lowlands as potential habitat. These differences in the models are likely artifacts of the parameters and GIS data layers used.

Models and observations from Idaho, Montana, and Wyoming during the past 20 years (Bangs et al. 2004, USFWS et al. 2011) indicate the types of habitat not suitable for wolves. These include non-forested rangeland and croplands associated with intensive agricultural use (Carroll et al. 2003, 2006, Larsen and Ripple 2006, Oakleaf et al. 2006, Carroll 2007, unpubl. data; B. Maletzke, unpubl. data). This unsuitability is due to high rates of wolf mortality, high densities of livestock compared to wild ungulates, repeated conflict with livestock, local cultural intolerance of large predators, and wolf behavioral characteristics that make them vulnerable to human-caused mortality in open landscapes (USFWS 2008a). Consequently, although a few wolves could potentially occupy the Columbia Basin in Washington, the likelihood of them persisting and establishing a viable breeding population is low. Lowland areas of the Puget Sound region are similarly not expected to support wolves because of the high human and road densities, lack of available prey, and reduced forest cover found there.

Road Density

Several studies in the Great Lakes states have found road density to be an important predictor of wolf occupancy. Mladenoff et al. (1995) assessed various landscape-scale factors in defining suitable wolf habitat in the region and determined that road density was the most important predictor. Their model had a road density threshold of 0.72 mi/mi^2 that best classified areas with and without packs; areas containing packs usually had road densities <0.72 mi/mi^2. This parameter allowed the amount and distribution of suitable wolf habitat to be mapped for the three-state region (Mladenoff et al. 1995) and the size of the potential wolf population to be estimated for northern Wisconsin and upper Michigan (Mladenoff et al. 1997). The habitat model and road density threshold of 0.72 mi/mi^2 successfully predicted the location of recolonizing wolves in Wisconsin from 1993 to 1997 (Mladenoff et al. 1999).

Road density was a key secondary variable, although with a higher threshold value (<0.72 mi/mi^2), in a more recent model of wolf occupancy based on the locations of Wisconsin packs in 2007 (Mladenoff et al. 2009). The authors suggested that results of earlier models reflected the dynamics of a small, recolonizing wolf population in Wisconsin, whereas results from the newer model reflected wolf occupancy under a source-sink dynamic.

Potvin et al. (2005) found the probability of wolf occupancy was positively related to deer density as well as road density in upper Michigan. They identified threshold values of about 0.9-2.2 deer/mi^2 and 1.13 mi of road/mi^2 for predicting suitable wolf habitat. Nevertheless, most wolf territories occurred in areas with road densities lower than 0.72 mi/mi^2. Wolves will use roads for travel, but road density is an index to human contact and roads contribute to wolf mortality through increased intentional or accidental killing.

Biological Carrying Capacity

Another factor considered for establishing wolf recovery goals in Wisconsin and upper Michigan was an assessment of their "biological carrying capacity" for wolves. The amount and distribution of available wolf habitat in the two states was estimated using data on landscape use by radio-collared wolves (Mladenoff et al. 1997). Potential wolf numbers were then estimated using two approaches: (1) a habitat area model, using available wolf habitat in combination with wolf pack territory size; and (2) a prey-based model, using wolf-prey biomass relationships. Potential wolf numbers based on habitat area and prey-based models were 380 (90% CI 324-461) and 462 (90% CI 262-662), respectively for Wisconsin, and 751 (90% CI 641-911) and 969 (90% CI 581-1357) for Michigan. Using this information, Wisconsin used a population of 500 wolves as the estimated potential biological carrying capacity of the state (Wydeven et al. 2009a).

Using the first of these approaches, WDFW estimated potential biological carrying capacity for wolves in Washington by overlaying a circle representing a pack territory size of 360 sq mi (933 km^2) on a map of potential wolf habitat. Territory size used was based on the mean size of territories in Idaho and two packs in Washington. Amount of potential habitat was determined by the Maletzke model (≥50% probability of occupancy, using the parameters of Oakleaf et al. 2006; Figure 5) described in the previous section. The analysis resulted in an estimate of 76 circles for the state. As wolf recovery continues, WDFW will use Washington-specific data to refine estimates of biological carrying capacity in the state.

Landscape Connectivity and Dispersal

Some landscape features allow easy passage by wildlife species, whereas others such as unsuitable natural habitats, rugged topography, human development, and major highways may act as barriers that constrain, prevent, or redirect movements (Singleton et al. 2002). Landscape features can therefore influence: (1) levels of gene flow among populations; (2) rates of dispersal to unoccupied areas with suitable habitat, which can affect the establishment of new populations; and (3) rates of immigration into existing populations, which can affect the viability of populations, especially those with low survival or productivity and those occupying fragmented habitats.

Wolves are capable of dispersing long distances rapidly through a variety of habitats and select mates to maximize genetic diversity (USFWS 2008a). The recovery objectives established in this plan for wolves in Washington (see Section B of this chapter) recognize that the long-term viability of the state's wolf population will, in part, be dependent on maintaining its connectivity (e.g., vonHoldt et al. 2008) to the broader regional wolf metapopulation in Idaho, Montana, British Columbia, and Oregon. Additionally, maintaining connectivity between blocks of potentially suitable habitat within Washington is important to wolf conservation because of the fragmented condition of habitats in the state. Managing landscape permeability for the benefit of wolves will speed recolonization and progress toward recovery goals and will reduce the need for costly translocation efforts.

Singleton et al. (2002) analyzed landscape permeability for wolves in Washington and adjoining areas of Idaho and British Columbia (the Blue Mountains and Oregon were excluded). They reported that landscapes in the Cascades, north-central and northeastern Washington, and parts of the interior lowlands of British Columbia were broadly conducive for travel by wolves. However, five zones within the region were identified as impediments to movement, with the upper Columbia (Lake Roosevelt)-Pend Oreille valleys being the least permeable of these, followed by Snoqualmie Pass, Stevens Pass-Lake Chelan, the Fraser-Coquihalla region of British Columbia, and the Okanogan Valley. These zones generally represent developed valley bottoms with discontinuous forest cover, sizeable human populations, and high road densities, or reservoirs. Singleton et al. (2002) also showed a broad band of south-central British Columbia extending north from a line between about Osoyoos and Grand Forks as being of lower permeability for wolves, meaning that wolves attempting to move between eastern Washington and the Washington Cascades could find better travel conditions in the northern tier of Washington than in a sizeable portion of southernmost British Columbia.

Singleton et al.'s (2002) conclusions are generally supported by the work of others who have modeled potential wolf habitat in Washington (Carroll et al. 2006, Larsen and Ripple 2006; Carroll 2007, unpubl. data; B. Maletzke, unpubl. data). These studies variously showed the Okanogan, upper Columbia, and Pend Oreille valleys, Snoqualmie Pass, and high elevation areas of the North Cascades as being potential gaps in the distribution of wolves in eastern Washington (Figures 5-8) that would have to be crossed by individuals dispersing between major blocks of suitable habitat. Two additional areas, the I-5 corridor through Lewis and Cowlitz counties and the Chehalis River valley through Grays Harbor County, represent potential barriers to dispersal in western Washington. In contrast to Singleton et al. (2002), Carroll's (2007, unpubl. data) results suggested that southernmost British Columbia may hold better dispersal habitat (as indicated by the presence of "source" habitat) for wolves than northern Washington (Figure 8).

Maintaining cross-border habitat linkages between Washington and Idaho, British Columbia, and Oregon is vital to the reestablishment and long-term viability of a wolf population in Washington (Carroll 2007). Proximity to wolf populations in Idaho and Montana, which numbered a combined 1,271 animals in 2010 (USFWS et al. 2011), and good habitat connectivity along the northeastern Washington-northwestern Idaho border (Singleton et al. 2002; Carroll et al. 2006; Oakleaf et al. 2006; Carroll 2007, unpubl. data) provides a high probability that dispersing wolves will regularly enter Washington as long as this source population remains large.

Important cross-boundary habitat linkages also exist with British Columbia and Oregon and will benefit wolf recolonization in Washington. However, both of these jurisdictions currently have much smaller wolf populations in areas bordering Washington and therefore will likely be the source of fewer animals entering the state. Any management programs that significantly reduce wolf numbers in Idaho, Montana, British Columbia, and Oregon through regulated public hunting or other large-scale control actions will likely reduce rates of dispersal into Washington. Such activities would create vacancies within existing packs as well as areas of suitable habitat devoid of resident wolf packs, which will probably become occupied by some dispersing wolves before they travel to more distant areas such as Washington. The eventual formation of a source population of wolves in Washington will reduce the dependence on wolf dispersal into the state from outside. Over time, better knowledge of dispersal and immigration rates into Washington will emerge.

The Washington Connected Landscapes Project (WHCWH 2010) begins to address habitat connectivity issues through scientific analyses conducted at different spatial scales of current and future landscape conditions, and coordinates with transboundary partners to maintain connectivity across Washington's borders. A recently completed statewide analysis identifies important linkage areas between areas of suitable habitat using both a focal species and landscape integrity approach. While the focal species approach did not include the wolf, the analysis did address connectivity issues for elk and mule deer, two important prey species. The landscape integrity approach of the analysis identified large, contiguous areas of low human impact and linkage zones between these core areas that avoid areas of high human activity (e.g., urban, residential and industrial zones), which also is applicable to connectivity of wolf habitat. Future work will explore connectivity issues at the ecoregional and local levels.

Management tasks for maintaining and improving habitat connectivity for wolves in Washington are presented in Chapter 12, Task 7.

<u>Comparisons between the Northern Rocky Mountain States and Washington for Wolves</u>

During scientific peer review of this plan, several knowledgeable experts on wolves in the northern Rocky Mountain states commented that wolf restoration in Washington may resemble that which occurred in northwestern Montana from 1979 until well into the 1990s. In contrast to central Idaho and the greater Yellowstone area, both northwestern Montana and Washington lack large core refugia of secure habitat with large numbers of overwintering wild prey and few livestock (USFWS 2009). Instead, northwestern Montana and Washington feature much more fragmented habitat and a mix of public and private ownership; northwestern Montana also has large holdings of livestock, a natural prey base comprised mainly of deer, and less overall public support for wolf recovery. Because of this combination of characteristics, the wolf population in northwestern Montana grew relatively slowly in numbers and distribution (Bangs et al. 1998). After the first two wolves were recorded in 1979, the first documented breeding pair did not occur until 1986 and six successful breeding pairs did not become established until 1995.

Wolf numbers were dampened during this period by wolf-livestock conflicts resulting in significant lethal control, deaths from cars and trains, illegal human-caused mortality, declining ungulate density due to severe winter weather, disease, and an apparently slow rate of immigration from adjacent areas of Alberta and British Columbia, where management appeared to be aggressive enough that fewer wolves than expected dispersed into Montana (Bangs et al. 1998, Sime et al. 2007, Murray et al. 2010, Smith et al. 2010; C. Sime, pers. comm.). Additionally, Glacier National Park and large adjoining wilderness areas to the south did not function as core secure habitat for wolves because their high elevations and harsh winters do not allow significant numbers of ungulates to overwinter (Smith et al. 2010; D. Smith, pers. comm.). Wolves in northwestern Montana had among the lowest average pack sizes and population growth rates in the northern Rocky Mountain states through 2005 (Mitchell et al. 2008). Despite these characteristics, the population showed stronger growth during the 1990s and 2000s, with immigration from central Idaho helping supplement the population after 2002. Because of the proportionally greater level of conflicts with humans, management of wolves in northwestern Montana has required greater agency intervention and cost than wolf restoration efforts in the greater Yellowstone area, central Idaho, and the Great Lakes states (E. Bangs, pers. comm.).

B. Recovery Objectives for Washington

The plan sets recovery objectives to downlist wolves from endangered to threatened, threatened to sensitive, and to delist from sensitive status per WAC 232-12-297. The objectives were developed from a combination of current scientific knowledge about wolves in other locations and in Washington, wildlife conservation and population viability principles, and discussions with the Wolf Working Group, with input from WDFW, scientific peer review, and an analysis of assumptions and risks.

Definition of Recovery Terms

Recovery objectives are defined as numbers of successful breeding pairs that are maintained on the landscape for 3 consecutive years, with a set geographic distribution within 3 specified recovery regions.

Successful Breeding Pairs

Consistent with the recovery objectives for the Northern Rocky Mountain distinct population segment, the recovery objectives in this plan are based on numbers of successful breeding pairs rather than packs or individuals. "Successful breeding pair" is used as the unit of measurement because it provides a higher level of certainty in assessing population status and documenting reproduction. A successful breeding pair of wolves is defined as an adult male and an adult female with at least two pups surviving to December 31 in a given year. (This term was formerly known simply as "breeding pair," but Mitchell et al. [2008] recommended use of "successful breeding pair" as a more precise term to indicate that successful rearing of young had occurred.) The U.S. Fish and Wildlife Service used successful breeding pair as their recovery measure "because wolf populations are maintained by packs that successfully raise pups" (USFWS 1994, Mitchell et al. 2008). Success of breeding pairs is measured in winter because most wolf mortality occurs from spring through fall, and winter is the beginning of the annual courtship and breeding season (USFWS 2008a). In Washington, verification of successful breeding pairs will be done by WDFW using established protocols.

Consistent with protocols used in the northern Rocky Mountain states, and to avoid double-counting successful breeding pairs of wolves, packs with territories straddling recovery region or state boundaries will be counted in the area where the den site is located. If the den location is not known with certainty, then other criteria such as amount of time, percent of territory, or number of wolf reports will be used to determine pack residency. Thus, a pack will not be counted in more than one recovery region in the state.

Time Requirement

Also consistent with the Northern Rocky Mountain objectives and state recovery plans for other listed species in Washington, the objectives in this plan must be maintained for 3 consecutive years. This requirement adds greater certainty that reproductive success (as reflected in breeding pair numbers) and total population size will be maintained over time. If a year occurred where there were 18 successful breeding pairs of wolves and the distribution criteria for delisting were met, then WDFW could begin the process to write a status review to prepare a delisting recommendation at that time.

Distribution within Recovery Regions

One of the criteria for removing a species from state listed status in Washington is that it must occupy a significant portion of its original geographic range. A "significant portion of the species' historical range" is defined under WAC 232-12-297, section 2.9, as that portion of a species' range likely to be essential to the long-term survival of the population in Washington. To achieve distribution across a significant portion of the species' historical range in the state, recovery regions with their own population objectives are typically established.

Three recovery regions are designated to achieve wolf recovery in a significant portion of the range in Washington and are identified as the Eastern Washington region, Northern Cascades region, and Southern Cascades and Northwest Coast region (Figure 9). Wolves do not need to be distributed throughout the Southern Cascades and Northwest Coast recovery region to achieve the recovery objectives. If they occur in the Olympic Peninsula or southwest Washington, they will count, but they are not required to be there in order to delist.

The western boundary of the Eastern Washington region follows Highways 97 (British Columbia border south to Monse), 17, and 395 (Mesa south to the Oregon border) and matches the line used by the U.S. Fish and Wildlife Service to demarcate the western edge of the Northern Rocky Mountain distinct population segment for gray wolves in Washington (USFWS 2009). The boundary between the Northern Cascades region and the Southern Cascades and Northwest Coast region is Interstate 90 and the county borders.

Although wolves historically occurred throughout Washington, they do not need to reoccupy all of their former range to meet the recovery objectives of this plan. The northern and southern Cascade

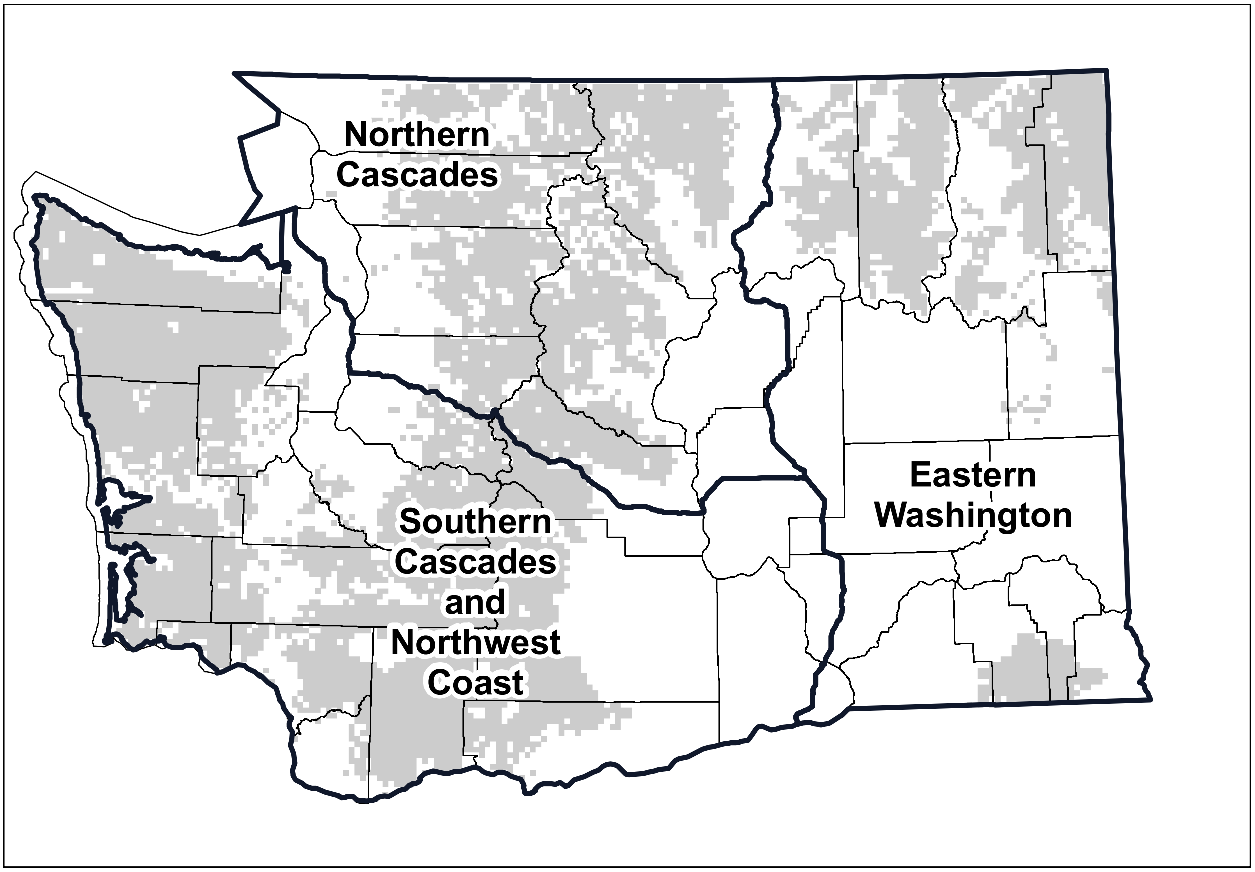


Figure 9. Washington's three gray wolf recovery regions (Eastern Washington, Northern Cascades, and Southern Cascades and Northwest Coast) superimposed on the estimated suitable habitat for wolves (≥50% probability of occupancy, modeled by B. Maletzke, using Oakleaf et al. 2006).

Mountains contain much of the "significant portion of the historical range" that would ensure the long-term survival of the population. However, despite the presence of considerable high quality habitat for wolves on the Olympic Peninsula and in southwestern Washington (Figure 10), wolves would not need to occupy these areas to achieve recovery if they were present in both halves of the Cascades and eastern Washington in sufficient numbers to satisfy the recovery objectives for each of the three recovery regions. Eastern Washington is currently being recolonized from adjacent populations in neighboring states and British Columbia, whereas the Olympic Peninsula and southwestern Washington are distant from colonizing sources and separated by additional potential barriers inhibiting natural dispersal. Recovery is therefore likely to happen more quickly through the reoccupation of eastern Washington than waiting for wolves to reach far western Washington.

In particular, the southern Cascade Mountains contain a large amount of high quality habitat (Figure 10). This area contains abundant natural prey for wolves, including nearly half of Washington's elk population, and large contiguous blocks of forested public and private lands, where low levels of conflict with livestock are expected. As a result, the southern Cascades have the potential to support a source population of wolves, a factor of importance with regard to the long-term survival of the wolf population in Washington.

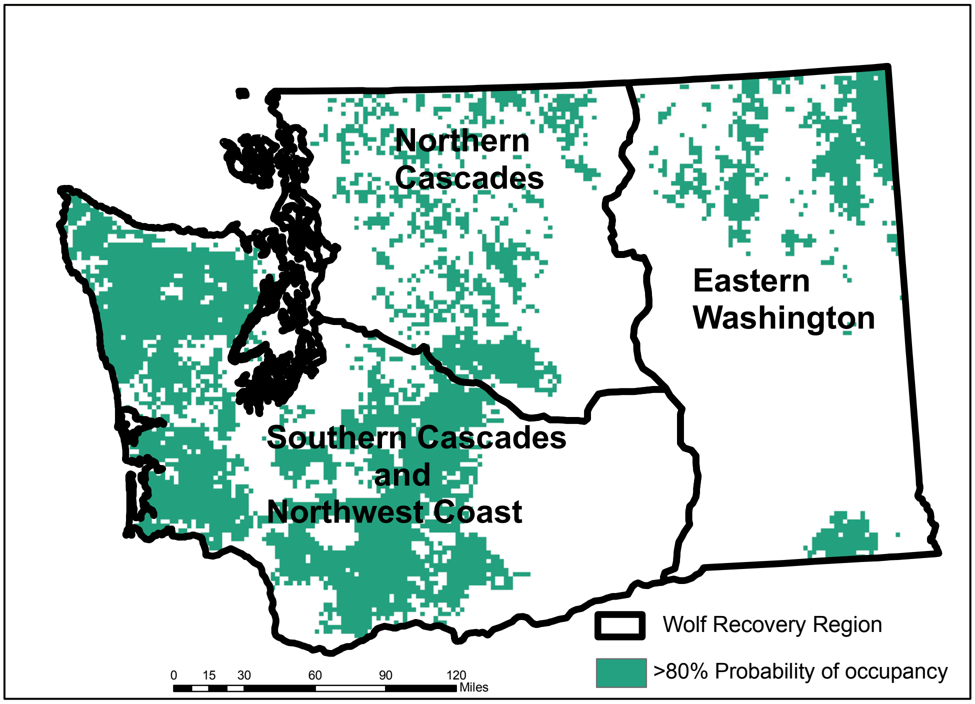


Figure 10. Modeled high quality habitat for wolves in Washington (i.e., >80% probability of occupancy), as determined by B. Maletzke using the parameters of Oakleaf et al. (2006).

Land Ownership of Potentially Suitable Wolf Habitat in Washington

Land ownership of potentially suitable wolf habitat (≥50% probability of occupancy, modeled by B. Maletzke, using Oakleaf et al. 2006) was determined for each of the wolf recovery regions in Washington (Figure 11, Table 3). The majority (64%) of this habitat is on public land, varying from 53-87% per region. The U.S. Forest Service is the primary administrator of these lands, both statewide and in each recovery region (Table 3). The National Park Service and Washington Department of Natural Resources are other significant public landowners supporting extensive amounts of potential wolf habitat, especially in the Northern Cascades and Southern Cascades and Northwest Coast recovery regions. Private lands (particularly those owned by private timber companies) comprise 27% of the state's potential wolf habitat, with the most extensive area occurring in the Southern Cascades and Northwest Coast recovery region. Tribal lands comprise 9% of potential wolf habitat statewide and are especially significant in the Eastern Washington recovery region.

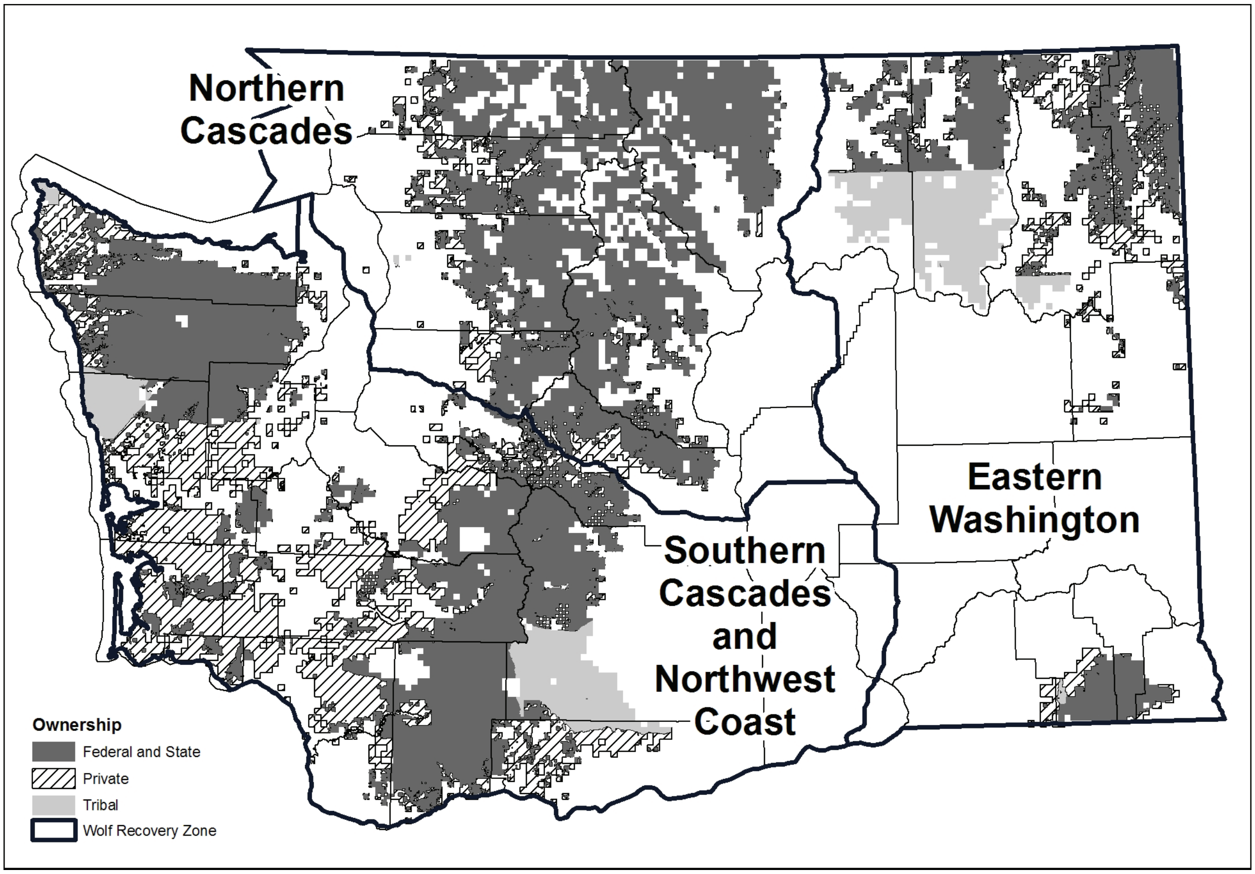


Figure 11. Public (federal and state), private and tribal landownership of potentially suitable wolf habitat (≥50% probability of occupancy, modeled by B. Maletzke, using Oakleaf et al. 2006) in the three recovery regions in Washington.

Table 3. Land ownership of potentially suitable wolf habitat (≥50% probability of occupancy, modeled by B. Maletzke, using Oakleaf et al. 2006) within the three recovery regions in Washington.

	Recovery Region							
	Eastern Washington		Northern Cascades		Southern Cascades & Northwest Coast		Total	
Land ownership	Acres	%	Acres	%	Acres	%	Acres	%
Federal								
US Forest Service	1,543,547	45	3,566,440	70	2,583,831	28	7,693,819	43
National Park Service	148	<1	357,166	7	1,128,258	12	1,485,572	8
US Dept of Defense	453	<1	2,173	<1	54,698	<1	57,325	<1
US Fish and Wildlife Service	44,869	1	1,111	<1	5,982	<1	51,961	<1
US Bureau of Land Management	1,305	<1	5	<1	0		1,310	<1
US Bureau of Reclamation	22,921	<1	2,984	<1	3,817	<1	29,721	<1
Total	**1,613,244**	**47**	**3,929,879**	**77**	**3,776,586**	**41**	**9,319,708**	**52**
State								
Dept of Natural Resources	140,562	4	491,318	10	1,064,209	11	1,696,089	10
Dept of Fish and Wildlife	8,710	<1	29,324	<1	70,782	<1	108,816	<1
State Parks	14,218	<1	6,778	<1	11,121	<1	32,116	<1
Universities	0		0		994	<1	994	<1
Other	0		0		1,418	<1	1,418	<1
Total	**163,490**	**5**	**527,420**	**10**	**1,148,524**	**12**	**1,839,433**	**10**
City	**1,183**	**<1**	**12,221**	**<1**	**100,704**	**1**	**114,108**	**<1**
County	**375**	**<1**	**3,708**	**<1**	**33,273**	**<1**	**37,355**	**<1**
Private	**763,094**	**22**	**614,681**	**12**	**3,480,552**	**37**	**4,858,327**	**27**
Tribal	**857,610**	**25**	**5,770**	**<1**	**745,261**	**8**	**1,608,642**	**9**
Total	**3,398,996**		**5,093,679**		**9,284,899**		**17,777,574**	

Recovery Objectives

The following recovery objectives have been identified to transition from one listed status to the next:

1. The gray wolf will be considered for downlisting from state endangered to threatened when 6 successful breeding pairs are present for 3 consecutive years, with:

- 2 successful breeding pairs in the Eastern Washington region,
- 2 successful breeding pairs in the Northern Cascades region, and
- 2 successful breeding pairs distributed in the Southern Cascades and Northwest Coast region.

2. The gray wolf will be considered for downlisting from state threatened to sensitive when 12 successful breeding pairs are present for 3 consecutive years, with:

- 4 successful breeding pairs in the Eastern Washington region,
- 4 successful breeding pairs in the Northern Cascades region, and
- 4 successful breeding pairs distributed in the Southern Cascades and Northwest Coast region.

3. The gray wolf will be considered for delisting from state sensitive when:

15 successful breeding pairs are present for 3 consecutive years, with:

- 4 successful breeding pairs in the Eastern Washington region,
- 4 successful breeding pairs in the Northern Cascades region,
- 4 successful breeding pairs distributed in the Southern Cascades and Northwest Coast region, and
- 3 successful breeding pairs anywhere in the state.

Or:

In addition to the delisting objective of 15 successful breeding pairs distributed in the three geographic regions for 3 consecutive years, an alternative delisting objective is also established whereby the gray wolf will be considered for delisting when:

18 successful breeding pairs are present with the following distribution:

- 4 successful breeding pairs in the Eastern Washington region,
- 4 successful breeding pairs in the Northern Cascades region, and
- 4 successful breeding pairs distributed in the Southern Cascades and Northwest Coast region, and
- 6 anywhere in the state.

There is no requirement that wolves must go through each listed stage before downlisting or delisting if they meet the recovery objectives. If the wolf population increased rapidly in numbers and distribution, then it may be eligible for skipping a listing stage. For example, if 12 or more successful breeding pairs became reestablished in the state in the first few years of the plan's implementation and met the distribution objectives for 3 consecutive years, then WDFW could move ahead with downlisting from endangered to sensitive status.

Assumptions and Rationale

Estimated Numbers of Wolves Represented by Successful Breeding Pairs

Table 4 provides estimates of the numbers of packs and individuals that the recovery objectives might represent. The estimates are made using two methods. The first determines the number of packs equivalent to a specified number of successful breeding pairs using the lowest and highest probabilities of a pack containing a successful breeding pair, as determined for five regions of Idaho, Montana, and Wyoming (excluding Yellowstone National Park) from 1979-2005 (Mitchell et al. 2008). Successful breeding pair numbers are typically smaller than pack numbers because not all packs breed or successfully rear pups, and because logistical difficulties may prevent the confirmation of breeding in some packs, especially as pack numbers become larger (USFWS et al. 2008). Estimates of the number of wolves present in packs are based on averages varying from a minimum of 5.1 ± 1.1 (SD) to a maximum of 7.3 ± 2.3 wolves per pack in the same regions of Idaho, Montana, and Wyoming from 1979-2005 (Mitchell et al. 2008). Estimates of the number of lone wolves are based on lone wolves comprising 10-15% of most populations (Fuller et al. 2003). Estimates of the total number of wolves in the population are the sum of the estimated numbers in packs and lone wolves.

Table 4. Range of numbers of packs, lone wolves, and total number of wolves that might correspond to numbers of successful breeding pairs at different recovery stages in Washington.

	Endangered to threatened	Threatened to sensitive	Sensitive to delisted
No. of successful breeding pairs	6	12	15
Estimated equivalent no. of packs	7-17	14-33	17-42
Estimated no. of wolves in all packs combined	36-124	71-241	87-307
Estimated no. of lone wolves	4-22	8-43	10-54
Total estimated no. of wolves present	40-146	79-284	97-361
Total estimated no. of wolves present, using 14 wolves per successful breeding pair[e]	84	168	210

Using this method, 6 successful breeding pairs would correspond to a range of 40-146 total wolves, 12 successful breeding pairs with a range of 79 to 284 wolves, and 15 successful breeding pairs with a range of 97 to 361 wolves (Table 4). Data from Idaho and Montana indicate that the number of successful breeding pairs and packs are usually similar early in recovery (USFWS et al. 2009; C. Sime, unpubl. data), when closer monitoring of each pack can be performed. Thus, expected numbers of packs and wolves in Washington during the endangered and threatened stages are likely to be on the lower end of the range of estimates presented here.

The second method uses long-term data collected in Idaho, Montana, and Wyoming that indicate that each successful breeding pair corresponds to about 14 wolves in the overall wolf population in mid-winter (USFWS 2009). Based on this estimate, 6 successful breeding pairs would correspond to 84 wolves in the overall mid-winter population, 12 successful breeding pairs with 168 wolves in the overall population, and 15 successful breeding pairs with 210 wolves in the population (Table 4). These estimates fall within the range of estimates using the first method.

Analysis of the Adequacy of the Recovery Objectives

Using either method to estimate numbers of wolves, the delisting objective of 15 successful breeding pairs may represent a range of 97 to 361 wolves, and may be expected to be on the lower end of the range of estimates (Table 4). As such, the recovery objectives for Washington are likely to be below those thought to be needed for long-term persistence of an isolated wolf population (i.e., 30 or more successful breeding pairs containing 300 or more animals in a metapopulation (WDNR 1999, USFWS 2008a; see Section A of this chapter), and well below the 2001-2002 conclusions of wolf experts queried by the U.S. Fish and Wildlife Service that 500 or more wolves would be more likely to result in a viable wolf population than the Service's original objective of 300 wolves.

In the blind peer review process, two of the three blind peer reviewers stated that the recovery objectives in WDFW's draft wolf plan were inadequate with respect to wolf recovery objectives. Both believed that the number of successful breeding pairs needed to achieve delisting should be higher and that the plan fell below current scientific standards for sustainability and genetic viability. Both recommended that a population viability analysis be conducted to determine appropriate recovery criteria for wolves in Washington. The third reviewer considered the plan's recovery objectives reasonable for achieving a recovered and self-sustaining wolf population.

However, Washington's delisting objective of 15 successful breeding pairs distributed across three recovery regions and maintained for 3 consecutive years is believed to be sufficient to result in the reestablishment of a self-sustaining recovered wolf population because of the distribution and time requirements included in the objectives, and assumptions that the population would be allowed to continue to grow. These criteria, plus connectivity (e.g., vonHoldt et al. 2008) with populations in Idaho, Montana, British Columbia, and Oregon, are assumptions essential to the 15 successful breeding pairs being considered an adequate, though minimal, objective to achieve recovery.

Long-Term Persistence Modeling of Recovery Objectives

WDFW evaluated whether available data support the objective of 15 successful breeding pairs as a reasonable level to delist a growing wolf population by using spatially explicit population model RAMAS software (Akcakaya 2002) to model future colonization and persistence of wolf populations in Washington. The results of this exercise are not considered definitive, and vary widely depending on the assumptions used, especially about wolf survival and immigration. A word of caution is advised in interpreting model results. Models are a useful tool, but rarely provide perfect predictions of population growth.

RAMAS links spatial habitat information with demographic data using packs as subpopulations of a metapopulation. The metapopulation model was developed by the Carnivore Lab at Washington

State University under contract to WDFW, and was validated by comparison with observed populations in Idaho and northwestern Montana (Appendix G). Population model parameters were based on information available from wolf populations in Idaho and Montana (Mitchell et al. 2008, Smith et al. 2010). Conservative assumptions were used to evaluate persistence and extinction risks. These included territory size, mortality rates (including mortality from lethal control and illegal killing), immigration, and available habitat and its potential to support wolf packs. Circles representing hypothetical wolf territories of 360 mi^2 (933 km^2) were systematically placed across a map of potential wolf habitat in Washington, which was determined using the parameters of Oakleaf et al. (2006) and a 0-100% probability of occupancy. Territory size was based on data from Idaho (n = 13; USFWS 2000) and Washington (n = 2). Only those circles that averaged greater than 40% probability of occupancy were included in the analysis. Predicted wolf population projections for 50 years were done using 100 repeated simulations based on the modeled habitat and selected set of assumptions. Additional model assumptions are listed in Appendix H, including presence and absence of immigration.

The persistence of a metapopulation of 15 successful breeding pairs for 50 years, arranged within recovery regions as proposed in the delisting objectives, was evaluated under five different scenarios (Appendix H). Because 30% of packs do not successfully reproduce in any particular year (Mitchell et al. 2008), a minimum of 23 packs (i.e., territories) was used to represent a population level at or above the delisting objective of 15 successful breeding pairs. The 23 packs were distributed in the Eastern Washington (7), Northern Cascades (7), and Southern Cascades and Northwest Coast (9) recovery regions to represent the recovery objective distribution of 5, 4, and 6 successful breeding pairs in the three recovery zones, respectively. The hypothetical territories used were those with the highest predicted probability of occupancy and did not include the Olympic Peninsula or southwestern Washington.

Scenarios 1-3 assumed that the population was allowed to grow and wolves colonized additional areas. Under these assumptions, the scenarios suggested that 15 successful breeding pairs was an adequate recovery objective for delisting and managing wolves as a non-listed species, with little or no probability (0-2%) of the population falling below the delisting goal of 15 pairs during the 50 years, even without immigration into the population (Appendix H).

This was not the case if the wolf population was assumed to be capped at 15 successful breeding pairs (i.e., 23 occupied territories). In this situation (scenarios 4, 5), the model suggested a 93% probability of the wolf population falling below the delisting goal of 15 successful breeding pairs during the 50 years and requiring relisting even when immigration occurred; with no immigration, the probability rose to 97%.

Currently, there is little empirical data from wolves in Washington to include in population persistence modeling. The population will be monitored as wolves recolonize the state to determine trends in abundance, demographic parameters, habitat use, prey relationships, outcomes of interactions with humans, and other factors pertaining to population growth. In addition, the permeability of habitat and frequency of successful dispersal between isolated populations of wolves both within the state and between Washington and adjacent populations in British Columbia, Idaho, and Oregon will be monitored. The expectation is that over time, as wolves recolonize Washington, WDFW will be able to collect data from within the state to determine whether the model assumptions are appropriate.

If future data reveal that the population dynamics of wolves in Washington are significantly different from those used in the model, these conclusions will need to be reevaluated. Incorporating wolf demographic data specific to Washington will allow WDFW to update predictions of population persistence during wolf recovery phases and to revise the recovery objectives, if needed.

Delisting

The plan's recovery objectives represent the numbers needed to achieve the downlisting and delisting of wolves in Washington and do not carry implications for ultimate numbers of wolves that will exist in the state. The delisting objectives of 15 successful breeding pairs with adequate geographic distribution for 3 consecutive years, or 18 successful breeding pairs with adequate distribution, are not a population "cap" at which the population will be limited. The plan does not place a limit on the numbers of wolves that will be allowed to live in Washington.

When Washington's wolf population reaches the delisting objective of 15 breeding pairs for 3 consecutive years in appropriate distribution, WDFW will begin the process of proposing delisting of the species. This process, described in WAC 232-12-297 (Appendix A), requires the preparation of a status review that examines all pertinent information on abundance, the achievement of recovery objectives, and ongoing threats. WDFW can initiate a status review prior to achieving the 3-year requirement for the recovery objectives. Review under the State Environmental Policy Act (SEPA) and public review are also required as part of the delisting process. Delisting is based only on the biological status of the species in Washington. Information from the status review is then presented to the Washington Fish and Wildlife Commission to make the final determination on delisting. The Commission would not consider final action until after achieving the recovery objectives.

If a year occurred where there were 18 successful breeding pairs of wolves and the distribution criteria for delisting were met, then WDFW could begin the process to write a status review to prepare a delisting recommendation at that time

Conservation and Management Tools

A variety of conservation strategies and management tools will be considered to meet recovery objectives while wolves remain state listed in Washington. These are outlined in Chapter 12, with strategies and tasks identified. They include (1) protection and monitoring of wolves as they disperse into Washington and establish breeding packs; (2) translocation (discussed below); (3) prevention of illegal killing; (4) measures to assist livestock producers in reducing wolf-livestock conflicts, including proactive deterrents, compensation programs for wolf-related livestock losses and proactive methods, and various harassment options and forms of limited lethal control (see Chapter 4); (5) management of prey populations and their habitat; (6) management of human safety concerns and wolf-pet conflicts; (7) preservation and enhancement of habitat connectivity for wolves; (8) implementation of a comprehensive outreach and education program; and (9) research.

Translocation

Wolves will naturally disperse into unoccupied suitable habitat across ownerships and administrative designations, resulting in the recolonization of new areas of Washington. Singleton et al. (2002) evaluated landscape permeability for wolves in Washington and suggested that even the two areas likely representing the greatest impediments to wolf dispersal (i.e., the upper Columbia-Pend Oreille Rivers and Snoqualmie Pass) were nevertheless probably permeable for wolves. It is recognized, however, that there may be barriers inhibiting natural dispersal and establishment of wolf packs, particularly for wolves attempting to disperse across the existing mix of private and public lands between northeastern Washington and the northern Cascades and from the southern Cascades to the Northwest Coast due to distance, human-caused mortality, or other potential bottlenecks to natural dispersal.

The overall timeframe for wolves to reach recovery objectives for downlisting and delisting in Washington is difficult to predict, but it may be slow (Carroll 2007) and could take years to several decades. Based on the proximity of wolf packs in neighboring states and British Columbia and the current locations of the few packs present in Washington, the northeastern and southeastern corners of the state and the northern Cascades and Pasayten Wilderness will be the most likely areas to be initially occupied through natural dispersal. The southern Cascades and western Washington will take longer to recolonize.

Translocation (moving animals from one area of Washington to another to establish a new population) is an important conservation tool (Appendix I). This tool may be needed to establish populations in recovery regions that wolves have failed to reach through natural dispersal. Potential benefits of translocation are that it could:

- Address impediments to natural dispersal such as extensive areas of private lands and unsuitable habitat, or excessive mortality from illegal killing, lethal control, vehicle collisions, or other human-related causes.
- Reduce wolf numbers in some regions where they may increase to carrying capacity prior to downlisting and delisting objectives being met in other recovery regions,
- Hasten establishment of breeding pairs in areas that are potentially capable of supporting a source population, thereby helping to ensure and maintain viable populations in a significant portion of the state's historical range, as required to meet state recovery objectives.
- Help lower the overall costs of recovery by achieving population target levels more quickly, thereby allowing downlisting and delisting to begin earlier. Costs would be reduced by replacing the more expensive monitoring of breeding pairs that is needed while wolves are listed with the less expensive monitoring of packs following delisting.
- Facilitate achieving recovery goals more quickly, thereby leading to greater management flexibility in addressing conflicts.

Evaluation of translocation efforts could begin when one recovery region had exceeded its delisting requirements by at least one breeding pair, while another recovery region remained unoccupied. Wolves would only be translocated out of a recovery region if that region exceeded delisting objectives and removal would not cause the region's population to fall below its delisting objectives.

If translocation were to be considered, a feasibility assessment would be needed to determine if sufficient suitable habitat and prey were available to support wolves at potential translocation sites in the recipient region, and to ensure that removal of wolves from the source region would not cause it to fall below delisting objectives. If these conditions are met, an implementation plan would be prepared, which would provide detailed information on translocation methods and the selection of a release site(s). This would include consideration of genetics in selecting the source population.

A public review process would then be conducted to evaluate the translocation proposal. If the proposed translocation site were on federal land, the review process would be conducted under the National Environmental Policy Act (NEPA); if it were proposed on non-federal land, the State Environmental Policy Act (SEPA) process would be used. WDFW biologists would coordinate with other land management agencies to determine a suitable location to release wolves. Coordination with federal and other state agencies, tribal governments, landowners, and non-governmental organizations would also take place throughout the process. It is recognized that if wolves are still federally listed in portions of Washington when translocation is proposed, collaborative discussions with the U.S. Fish and Wildlife Service will be needed for approval to implement translocations (E. Bangs, pers. comm.).

If the translocation proposal were approved following the NEPA/SEPA process, the translocation would then occur followed by post-release monitoring to evaluate success of the project. Some areas that were identified where recolonization may be slow or difficult were the southern Cascade Mountain range and the Northwest Coast region.

C. Management after Delisting

Reclassification upon Delisting

All classification of wildlife is under the authority of the Washington Fish and Wildlife Commission. After the recovery objectives for delisting are met, wolves could be reclassified as a game animal through the Commission's public process. If reclassified to a game species, statewide management goals would be established to preserve, protect, perpetuate, and manage wolves and their habitats to ensure a healthy, productive population with long-term stability (D. Ware, pers. comm.). It would not be a population "cap" intended to keep numbers beneath a specific level. Placing a numerical cap on the wolf population is undesirable for several reasons, including 1) that the population should be managed at a biologically and socially acceptable size (which is currently undetermined), as is done with all other carnivore species in the state, 2) WDFW would need to devote considerable resources to monitoring wolves in perpetuity to ensure that numbers don't exceed the cap, and 3) as suggested by WDFW's population modeling (Appendix H, scenarios 4 and 5), a cap set at or near the delisting objective would very likely result in the long-term decline of the population below 15 successful breeding pairs, requiring relisting.

After state delisting, WDFW intends to develop a new plan for managing wolves.

Hunting

This plan addresses wolf conservation and management while it is state listed. After delisting, it is anticipated that the WDFW would recommend listing as a game species. Proposals to hunt wolves following delisting would go through a public process with the Fish and Wildlife Commission. This process would address the diverse public values regarding hunting of wolves. If hunting of wolves were approved while population numbers were relatively low, it is likely that conservative approaches would be used initially. These approaches may include a mix of no hunting, hunting on a limited permit-only basis as is done for moose, bighorn sheep, and mountain goats in Washington, or a statewide hunting quota.

With regard to hunting, Mitchell et al. (2008) recommended that consideration should be given to protecting wolves in some core habitat areas (e.g., in large blocks of public lands) to maintain pack size and structure, thereby potentially retaining successful breeding pairs and reproductive output. Hunting may also target areas of conflict to reduce the need for agency management and compensation, as is done for other species in Washington such as elk and geese.

Montana and Idaho initiated hunting seasons immediately following delisting, when wolf population levels far exceeded the state recovery objectives. Minnesota adopted a phased approach, where wolves would not be hunted for five years after delisting to ensure that adequate population numbers were being maintained following delisting (MDNR 2001). In Wisconsin's plan, hunting could be considered once the population exceeded 350 wolves outside of Indian reservations and would require legislative approval (Wydeven et al. 2009b).

Relisting

As with all wildlife species, the state takes whatever management steps are necessary to safeguard the species from a population decline that would necessitate relisting. Upon delisting, the wolf population will be expected to increase across the landscape where suitable habitat and prey exist. However, it will continue to be affected by natural and human-caused mortality factors.

WDFW will continue to monitor population status and trends after delisting. If the population were to start declining, WDFW would assess the population's size, distribution, health, reproductive status, and potential causal factors. If there are mortality factors causing the decline that can be controlled, such as poaching, lethal control actions, or legal hunting, actions will be taken to reduce these sources of mortality. A decline due to changing habitat conditions, low prey numbers, or disease could constitute underlying warning signs of a more serious situation that could warrant relisting.

In the event of a decline approaching the minimum population objectives for delisting (including numbers and distribution), WDFW may immediately initiate a status review to determine whether relisting is appropriate. WDFW's listing procedures (WAC 232-12-297) also provide for emergency listing.

4. WOLF-LIVESTOCK CONFLICTS

Addressing gray wolf-livestock conflicts is an essential part of this plan. Based on experiences in other western states with wolf populations, the return of wolves to Washington is expected to result in conflicts with livestock. The ranching and farming industry is a vital component of the Washington economy and provides important open space and habitats that support a wide variety of wildlife, including deer and elk. In some areas of the state, concerns have been raised regarding the effect that wolves will have on the livestock industry and a number of comments received at the initial public scoping meetings in 2007 and the public review period in 2009-2010 involved concerns about conflicts with livestock and how they are addressed.

The reestablishment of wolves in Washington will affect some livestock producers through wolf-related depredation and/or changes in husbandry and management methods needed for adapting to the presence of wolves. Projections of wolf-caused losses of livestock and related economic impacts in the state are described in Chapter 14, Section B. During the endangered and threatened phases of recovery, wolves should pose little detriment to the state's livestock industry as a whole. At the population levels associated with the early stages of recovery, a few individual producers will likely experience some livestock losses. Some of these costs would likely be offset by compensation from state or federal programs. As wolf populations become larger and more widely distributed, financial impacts to more producers are likely. Where and when depredations occur will depend on different factors, including the abundance and distribution of wolves and the husbandry methods and locations of livestock in areas occupied by wolves.

This chapter of the plan provides:

- background on wolf depredation on livestock (Section A)
- background on management measures available for reducing wolf depredation (Section B)
- background on wolf compensation programs in other states (Section C)
- predicted losses of ranch animals in Washington due to wolves (Section D)
- a description of the management tools to be used for managing wolf-livestock conflicts in Washington (Section E)
- steps for expanding the use of proactive measures for reducing conflicts in Washington (Section F)
- a recommended wolf compensation program to address livestock losses in Washington (Section G)

A. Wolf Depredation on Livestock

The recovery of wolves in other states has resulted in depredations on cattle, sheep, other livestock, and guarding/herding dogs. However, despite significant increases in wolf populations, confirmed losses to wolves have remained small to date relative to livestock numbers (Bangs et al. 2005b, USFWS 2008a). Bangs et al. (2006) noted that while wolf depredations on livestock were unimportant to the regional livestock industry, they could affect the economic viability of some ranchers. Many factors influence depredation rates on livestock, including the proximity of livestock to wolf home ranges, dens, and rendezvous sites; pack size; abundance of natural prey and livestock;

amount and type of vegetative cover; time of year; livestock husbandry methods in both the area of concern and adjacent areas; the use of non-lethal deterrents and lethal take; pasture size; and proximity to roads, dwellings, and other human presence (Mech et al. 2000, Fritts et al. 2003, Treves et al. 2004, Bradley and Pletscher 2005). These factors also make it difficult to predict where and when depredations by wolves will occur.

USFWS et al. (2011) reported that on average 10-38% of all wolf packs in Montana were confirmed to have killed livestock in any given year from 1999 to 2010. In comparison, 33-85% of the packs in Wyoming outside of Yellowstone National Park were involved in depredations annually from 2005 to 2010 (USFWS et al. 2006-2011). In contrast, predation risk is usually lower in areas where livestock herds are fenced (e.g., in Wisconsin, where only about 7% of wolf packs annually depredated livestock; Wydeven et al. 2004). Wolves don't necessarily attack livestock whenever livestock are encountered, but most wolf packs that regularly encounter livestock are likely to depredate at some point (Bangs and Shivik 2001, Wydeven et al. 2004). Some packs show increasingly frequent depredation behavior, while others may do so once or twice a year, every other year, or even less frequently (USFWS et al. 2011).

Sime et al. (2007) reported that among the 162 livestock producers suffering confirmed wolf depredation in Montana between 1987 and 2006, 62% experienced a single incident, 20% experienced two incidents, and 17% experienced three or more incidents. A similar percentage (59%) of livestock owners with wolf depredation in Wisconsin experienced a single incident between 1976 and 2000 (Treves et al. 2002); these affected livestock owners represented 0.4% of the 7,424 full-time livestock producers in the state's 19 counties with verified wolf depredations. In Minnesota, the number of livestock farms with verified wolf depredations on livestock was 0.3% annually during the period when there were 1,200-1,416 wolves (Ruid et al. 2009).

In the northern United States, wolf depredation on livestock occurs more frequently from March to October when livestock spend more time under open-grazing conditions, calving is taking place, and wolf litters are being raised (Fritts et al. 2003, Musiani et al. 2005, Sime et al. 2007, Edge et al. 2011). Untended livestock, particularly young calves, appear to be more vulnerable, and the presence of livestock carcasses on a property may increase risk as well (Fritts et al. 2003, Edge et al. 2011). Depredations occur on both open grazing sites and inside fenced pastures.

In the northern Rocky Mountain and Great Lakes states, calves are more commonly killed than other age groups of cattle because of their greater vulnerability (Fritts et al. 2003, Bangs et al. 2005a, Unsworth et al. 2005, Sime et al. 2007, Stone et al. 2008, Ruid et al. 2009, Edge et al. 2011; J. Timberlake, pers. comm.). Oakleaf et al. (2003) found that wolves tend to choose the smallest calves and there is evidence that some depredated calves are in poorer physical condition (Bradley and Pletscher 2005). In parts of Canada, wolves sometimes kill yearling cattle more often than calves (Stone et al. 2008). In contrast, adult sheep appear to be taken more frequently than lambs (Fritts et al. 2003). Depredations commonly involve multiple sheep per incident, whereas only 1-2 cattle are usually killed per incident (Muhly and Musiani 2009).

Among northern Rocky Mountain and Great Lakes states, significant variation exists in the number of cattle and sheep killed by wolves, and sometimes variation exists between years (Tables 5, 6). It is important to note that the numbers presented in Tables 5 and 6 represent minimum estimates of the livestock actually killed by wolves. Probable losses, in which officials are unable to verify the cause

Table 5. Confirmed livestock and dog losses from wolf predation in Idaho, Montana, and Wyoming, 1987-2010 (USFWS et al. 2011)[a,b].

	87-90	91-94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	Total
Idaho																			
Cattle			0	1	1	9	11	15	10	9	6	19	20	29	53	96	75	75	429
Sheep			0	24	29	5	64	48	54	15	118	161	184	205	170	218	324	148	1,767
Other[c]			0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	5
Dogs			0	1	4	1	7	0	2	4	5	3	9	4	8	12	13	0	73
Total wolves[d]			14	42	71	114	156	187	251	263	345	422	512	673	732	846	843	705	-
Wolves killed[e]			0	1	1	0	3	11	7	14	7	17	27	45	50	108	93	78	462
Montana																			
Cattle	14	9	3	10	19	10	20	14	12	20	24	36	23	32	75	77	97	87	582
Sheep	10	2	0	13	41	0	25	7	50	84	86	91	33	4	27	111	202	64	850
Other[c]	0	0	0	0	0	0	0	0	4	5	0	3	2	2	14	16	6	11	63
Dogs	1	0	4	1	0	1	2	5	2	5	1	4	1	4	3	2	4	2	42
Total wolves[d]	10-33	29-55	66	70	56	49	74	97	123	183	182	152	256	316	422	497	524	566	-
Wolves killed[e]	6	0	0	5	18	4	19	7	8	26	34	40	35	53	73	110	145	141	724
Wyoming																			
Cattle			0	0	2	2	2	3	18	23	34	75	54	123	55	41	20	26	478
Sheep			0	0	56	7	0	25	34	0	7	18	27	38	16	26	195	33	482
Other[c]			0	0	0	0	1	0	0	0	10	2	0	1	0	0	0	1	15
Dogs			0	0	0	3	6	6	2	0	0	2	1	0	2	0	7	0	29
Total wolves[d]			21	40	86	112	107	153	189	217	234	272	252	311	359	302	320	343	-
Wolves killed[e]			0	0	2	3	1	2	4	6	18	29	41	44	63	46	32	40	331
Totals																			
Cattle	14	9	3	11	22	21	33	32	40	52	64	130	97	184	183	214	192	188	1,489
Sheep	10	2	0	37	126	12	89	80	138	99	211	270	244	247	213	355	721	245	3,099
Other[c]	0	0	0	0	0	0	1	0	4	5	10	5	2	3	14	17	7	15	83
Dogs	1	0	4	2	4	5	15	11	6	9	6	9	11	8	13	14	24	2	144
Total wolves[d]	10-33	29-55	101	152	213	275	337	437	563	663	761	846	1,020	1,300	1,513	1,645	1,687	1,614	-
Wolves killed[e]	6	0	0	6	21	7	23	20	19	46	59	86	103	142	186	264	270	259	1,517

[a] Confirmed losses are defined as those losses verified through physical evidence to have been caused by wolves, as determined by USDA Wildlife Services or the U.S. Fish and Wildlife Service.
[b] For a variety of reasons (see text), the figures presented here represent minimum estimates of the livestock actually killed by wolves.
[c] Includes livestock other than cattle and sheep. Losses from 1987-2010 totaled 37 goats, 27 llamas,18 horses, and 1 domestic bison.
[d] Minimum number of wolves living in the state(s) during autumn.
[e] Includes wolves killed by government control actions and those legally killed by ranchers.

Table 6. Confirmed livestock and dog losses from wolf predation in Minnesota, Wisconsin, and Michigan during even-numbered years from 1980-2008 (Erb 2008, Hart 2008, Wydeven et al. 2008, 2009b, 2009d, 2009e, Ruid et al. 2009)[a].

	80	82	84	86	88	90	92	94	96	98	00	02	04	06	08	Total[b]
Minnesota																
Cattle	16	24	10	26	31	37	55	82	74	118	95	97	66	85	52	1,694
Sheep	56	12	92	13	68	112	38	14	21	33	19	58	15	17	22	1,036
Horses	1	0	1	0	0	0	2	1	1	4	1	2	3	1	0	26
Dogs	1	2	6	1	3	11	5	8	10	25	17	6	4	2	2	194
Total wolves[c]	1,269	1,341	1,416	1,496	1,581	1,700	1,862	2,039	2,232	2,445	2,623	2,814	3,020	3,200	2921	
Wolves killed	21	20	36	31	59	91	118	172	154	161	148	146	105	122	143	2,932
Wisconsin																
Cattle	1	0	0	0	1	0	1	0	0	20	6	36	29	35	39	294
Sheep	0	0	0	0	1	0	8	0	0	0	0	7	5	6	1	55
Horses	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	6
Dogs	0	0	0	1	0	0	2	2	5	10	5	10	15	25	22	158
Total wolves[d]	25	23	18	15	26	34	45	54	99	178	248	327	373	467	626	
Wolves killed	0	0	0	0	0	0	0	0	0	0	0	0	24	18	39	169
Michigan																
Cattle						0	0	0	0	3	2	4	7	9	13	72
Sheep						0	0	0	0	0	1	0	3	4	0	24
Horses						0	0	0	0	0	0	0	0	0	0	0
Dogs						0	0	0	1	0	0	4	4	4	0	33
Total wolves[d]						10	21	57	116	140	216	278	360	434	520	
Wolves killed						0	0	0	0	0	0	0	6	7	8	44
Totals																
Cattle	17	24	10	26	32	37	56	82	74	141	103	137	102	129	104	2,060
Sheep	56	12	92	13	69	112	46	14	21	33	20	65	23	27	23	1,115
Horses	1	0	1	0	0	0	2	1	1	4	1	4	3	1	0	32
Dogs	1	2	6	2	3	11	7	10	16	35	22	20	23	31	24	385
Total wolves	1,294	1,364	1,434	1,511	1,607	1,744	1,928	2,150	2,447	2,763	3,087	3,419	3,753	4,101	4,067	
Wolves killed	21	20	36	31	59	91	118	172	154	161	148	146	135	147	190	3,145

[a] Excludes poultry losses.
[b] Total loses for all years from 1976 to 2008.
[c] Interpolated population estimates based on average population growth between actual population estimations in mid- to late winter.
[d] Minimum number of wolves in mid to late winter based on actual counts or population estimations.

of death, are not included. Additionally, ranchers sometimes fail to locate carcasses or are unable to notify authorities soon enough to obtain confirmation because of the rugged and vast terrain where livestock graze, the extent of carcass consumption by predators and scavengers, or carcass decomposition. In some instances, ranchers may choose not to report their losses.

Determination of the ratio of estimated total losses to confirmed kills continues to be debated (Kroeger et al. 2006) and some wolf experts believe it is premature to set such ratios (C. Sime, pers. comm.). Loss ratios probably vary considerably according to the characteristics of each grazing site, extent of rancher supervision, and type, age, and number of livestock. Loss ratios of 8:1 and 6.3:1 have been reported for cattle in two studies conducted on large allotments with forested and mountainous terrain (one with range riders and one without) (Oakleaf et al. 2003, Sommers et al. 2010). However, Oakleaf et al. (2003) suggested that a ratio of about 2:1 was more realistic under less timbered or less rugged conditions. Loss ratios closer to 1:1 probably occur for many smaller operations using private lands, where livestock are more closely supervised. Morehouse and Boyce (2011) described three wolf packs that depredated cattle more often than recognized by their owners at a site in Alberta.

Livestock losses to other causes

While the number of livestock killed by wolves in Idaho, Montana, and Wyoming has generally increased over time as wolf numbers have grown, these are small compared to losses caused by coyotes, cougars, bobcats, dogs, bears, foxes, eagles, and other predators. Coyotes and other predators were responsible for almost all of the losses in which the predator was identified (98.8% of the cattle losses and 99.4% of the sheep losses) during 2004 and 2005; wolves were responsible for 1.8% and 0.6% of the losses (Figure 12). Most of these predators, such as coyotes, cougars, bobcats, black bears, and foxes, can be legally hunted or are subject to lethal control if depredating. Wolf depredations are also far smaller than combined non-predator losses (e.g., sickness, disease, weather, and birthing problems) in Idaho, Montana, and Wyoming, being less than 0.1% of these losses for cattle and 0.6% for sheep (Figure 12; NASS 2005, 2006). Wolves have caused minor losses of other livestock species in these states (Table 5).

B. Management Tools for Reducing Wolf Depredation

Managing wolf-livestock conflicts and wolf recovery requires an integrated approach using a variety of non-lethal and lethal methods, as described below. One of the important factors in reducing wolf-livestock conflicts in the northern Rocky Mountain states was maintaining a high level of radio-collared wolves in the population while the species was listed, which allows agencies to monitor problem situations (Bangs et al. 2006).

Proactive Measures

A variety of proactive management measures exist to help livestock producers reduce conflicts between wolves and livestock, and offer a partial alternative to lethal control of wolves (Musiani et al. 2003, Bangs et al. 2005a, 2006, Shivik 2006, Stone et al. 2008). Implementation of such measures may be costly to producers, but there have been efforts in the northern Rocky Mountain states to assist ranchers with proactive measures and to offset some costs. These measures can be especially important when wolf numbers and distribution are small and recovery objectives have not yet been achieved.

Proactive deterrents, especially when used in combination, often temporarily succeed in reducing the vulnerability of livestock to wolf depredation, but are usually not considered permanent solutions by

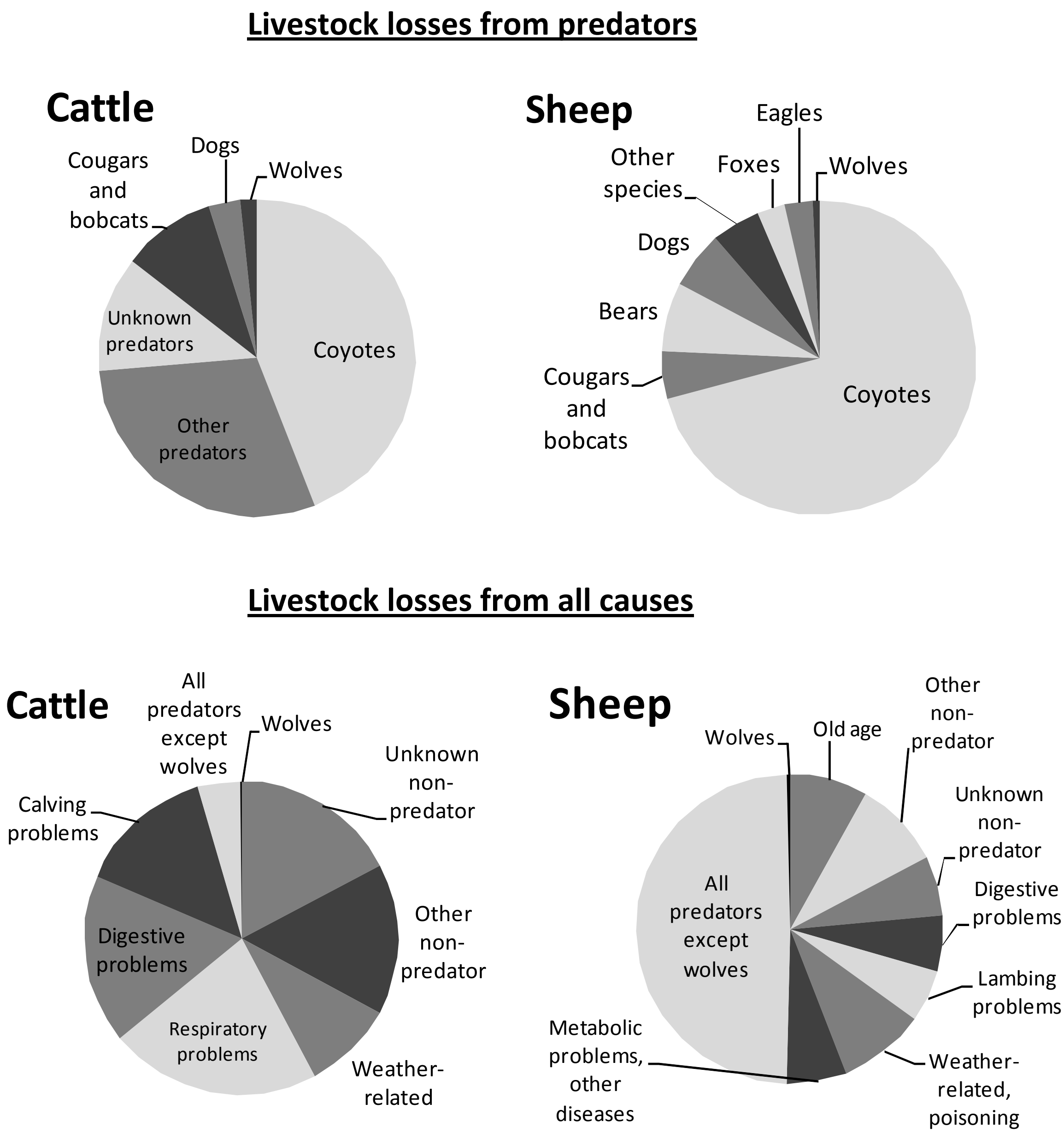


Figure 12. Percent of livestock death losses due to predators and other causes in Idaho, Montana, and Wyoming combined (adapted from NASS 2005, 2006). Data for cattle were collected in 2005 and for sheep in 2004.

themselves. However, when combined with a fair and effective compensation program, they offer the best solution for both limiting livestock losses and compensating producers for any unavoidable losses. Some producers in Washington already use proactive deterrents to protect their livestock from predators. Among producers using such measures in 2004-2005, the most frequently employed tools were exclusion fencing, guarding animals, frequent checking of stock, night penning, and use of lamb sheds (Table 7). Because the large majority of the state's cattle and sheep operations are categorized as extra small or small in the numbers of animals owned (Chapter 14, Section B), implementation of proactive deterrents to protect against wolves may be particularly effective in Washington.

Modified Husbandry Techniques

Bangs et al. (2006) and Stone et al. (2008) described a number of husbandry methods that are often useful in avoiding some wolf depredation of livestock. These include: the use of range riders to help keep cattle more concentrated on grazing sites; having herders with dogs present with sheep at night when most sheep depredation occurs; burying livestock carcasses rather than dumping them in traditional bone yards to reduce scavenging opportunities by wolves (see Morehouse and Boyce 2011); moving sick or injured livestock, which may be more vulnerable to wolves; delaying the turnout of cattle onto grazing sites until calving is finished or until young wild ungulates are born to reduce opportunities for depredation; allowing calves to reach at least 200 pounds before turning them out to grazing sites can also lower their vulnerability (Oakleaf et al. 2003); and avoiding grazing livestock near wolf territory core areas, especially dens and rendezvous sites, during the earlier portion of the grazing season. Implementation of these methods may result in higher costs to livestock producers.

One type of proactive program that has been developed and tested in Montana is the Range Riders Project. This program is a collaborative effort between ranchers, government agencies, and

Table 7. Percent use of different proactive methods among ranchers and farmers employing such techniques to prevent predation losses of livestock in Washington (NASS 2005, 2006).

Method	Cattle and calves (% of use)[a]	Sheep and lambs (% of use)[a]
Exclusion fencing	48.1	68.5
Guard animals	43.8	25.0
Frequent checks	43.1	2.5
Culling	14.1	4.0
Livestock carcass removal	13.6	1.0
Fright tactics	4.2	2.0
Night penning	0.2	36.6
Lamb shed	-	35.4
Llamas	-	16.4
Donkeys	-	6.7
Herding	-	2.4
Change bedding	-	0.1
Other methods	13.7	2.0

[a] Data for cattle and calves are from 2005, data for sheep and lambs are from 2004.

conservationists (including the Montana Fish, Wildlife & Parks, Madison Valley Ranchlands Group, Boulder Watershed Association, Turner Endangered Species Fund, USDA Forest Service, Predator Conservation Alliance, the Sun Ranch, USDA Wildlife Services, USDA Natural Resources and Conservation Service, Sweet Grass County Conservation District, and Montana State University Extension Service). The main goal of the project is to reduce predator-livestock interactions. Secondary goals are to (1) detect injured or dead livestock more rapidly, (2) preserve the evidence at potential depredation sites so that investigators can better determine whether or not predation was involved and which species was responsible, (3) improve livestock management and range conditions, (4) increase knowledge about predator-livestock interactions in space and time, and (5) build relationships among project partners. All project collaborators provide funding and in-kind contributions. In particular, significant funding has come through the USDA Natural Resources and Conservation Service's Environmental Quality Incentives Program.

In the Range Riders Project, cowhands are trained in methods to keep wolves and livestock apart. Riders stay with livestock throughout the grazing season (generally June–October) and chase away any wolves that come near the cattle. Projects were implemented beginning in 2004 on both public grazing allotments and private lands in two valleys in Montana. Protocols varied from place to place, but the underlying premise was continual human presence and immediate response to wolves interacting with livestock. The use of horses and vehicles (where applicable) allowed riders to cover as much ground as possible while checking on livestock. In 2006, areas with riders experienced no confirmed or probable depredations, although wolves were present and were seen and/or chased off. Due to high variability among sites, there is no clear evidence that these efforts have actually prevented depredations. However, when surveyed, many participating producers believed the project was helpful and indicated an interest to continue their participation. Additional range rider projects implemented in Montana are briefly described in USFWS et al. (2009).

Non-Lethal Deterrents

A number of non-lethal deterrents have been developed for discouraging wolf predation on livestock, including those developed in the northern Rocky Mountain states (Bangs et al. 2005a, 2006, Shivik 2006, Stone et al. 2008, Gehring et al. 2010a, Urbigkit and Urbigkit 2010). These deterrents are available to livestock producers and are generally most effective in small areas. The following non-lethal deterrents have been used:

- Guarding animals (primarily dogs) that are kept with livestock and alert herders when wolves and other predators are nearby.
- Light and noise scare devices that are used to frighten wolves away from confined livestock and alert ranchers and herders to the presence of wolves. These include propane cannons, light systems, and radio-activated guard (RAG) systems that emit flashing lights and loud sounds at the approach of a radio-collared wolf.
- Hazing with non-lethal munitions (e.g., cracker shells, rubber bullets, paintballs, and bean bags) to frighten wolves seen near livestock.
- Predator-resistant or electric fencing that is used as a permanent or temporary barrier to confine livestock and keep wolves away. Portable fencing can be effective as night pens under open grazing conditions.
- Fladry, which consists of numerous strips of flagging hung along a fence or rope to keep wolves out of an area occupied by livestock. Electrified fladry ("turbofladry") is similar, but

with the flagging hung from an electrified wire. Initial testing suggests that electrified fladry is more effective with wolves than regular fladry (Lance et al. 2010).

Further research and development may eventually produce other suitable techniques that can be implemented under field conditions (e.g., "biofencing" using human-distributed wolf scat and urine, Ausband 2010; shock collars, Hawley et al. 2009; and greater integration of guarding dogs, Gehring et al. 2010b, Urbigkit and Urbigkit 2010).

Moving Individual Wolves to Resolve Conflicts

Relocation was used extensively by the U.S. Fish and Wildlife Service as a non-lethal solution to mitigate livestock damage in the early phases of wolf recovery in the northern Rocky Mountain and Great Lakes states, but gradually became less practical as the number of potential release sites declined with expansion of the regions' wolf populations (Bangs et al. 1998, Bradley et al. 2005, Ruid et al. 2009). Bradley et al.'s (2005) evaluation of the technique in Idaho, Montana, and Wyoming revealed some important drawbacks with its use. These included (1) a lower average annual rate of survival among relocated wolves (60%) than non-relocated wolves (73%), (2) the failure of most (67%) relocated wolves to ever join or form a pack, (3) a strong tendency among relocated wolves to depart their release site, including 20% that returned distances of 46-197 miles to their original capture location, and (4) 18% of relocated wolves that resumed depredation of livestock near their release site. Selection of release sites strongly affected survival of relocated individuals, with survival being greatest in the high quality habitat of central Idaho and lowest in the more human-influenced landscapes of northwestern Montana. Soft releases showed some promise in reducing homing behavior among relocated wolves. Bradley et al. (2005) concluded that moving wolves was most effective during the early stages of population recovery, and that other non-lethal techniques are probably better for preventing or resolving conflicts when larger wolf populations exist.

In Minnesota, wolves involved in depredations or harassment of livestock were relocated to areas of suitable wolf habitat from 1975-1978. Survival and behavior of relocated adults and pups were comparable to resident wolves, and similar to that of naturally dispersing wolves (Fritts et al. 1985). Most relocated wolves left their release sites within a few days and were more likely to return to their original capture sites if moved less than 40 miles (Fritts et al. 1984). Resident wolves were present at release sites, which may explain the rapid departure of relocated wolves from release sites.

Lethal Removal

Lethal control of wolves may be necessary to resolve repeated wolf-livestock conflicts and is performed to remove problem animals that jeopardize public tolerance for overall wolf recovery. Large numbers of wolves have been killed in control actions in both the northern Rocky Mountain states (1,517 wolves from 1987 to 2010, with 7-16% of the population removed annually since 2002; Table 5) and Great Lakes states (3,145 wolves from 1978 to 2008, with 3-4% of the population removed annually; (Table 6) during the recovery of wolf populations. While federally listed, most lethal control of wolves in the northern Rocky Mountain states was performed by wildlife agency staff. As wolves became more common, the U.S. Fish and Wildlife Service gradually loosened restrictions on this activity to allow increased take by agency staff and private citizens with a federal permit (Fritts et al. 1992, Bangs et al. 2006). In Washington, if wolves are federally listed in any part of the state, WDFW would consult with and coordinate with the U.S. Fish and Wildlife Service prior to any lethal removal proposal to ensure consistency with federal law.

In Idaho, Montana, and Wyoming, agency decisions to lethally remove wolves have been made on a case-by-case basis, taking into account specific factors such as a pack's size and conflict history, status and distribution of natural prey in the area, season, age and class of livestock, success or failure of non-lethal tools, and potential for future losses (Sime et al. 2007). Where lethal removal is deemed necessary, incremental control is usually attempted, with one or two offending animals removed initially. If depredations continue, additional animals may be killed. Stepwise incremental control can result in the eventual elimination of entire packs if wolves repeatedly depredate livestock (Sime et al. 2007).

Lethal control of wolves by agency staff can have the advantages of being swift, effective, and tightly regulated. The benefits of allowing lethal removal by livestock producers are that offending wolves are more likely to be targeted, it can eliminate the need for agency control, shooting at wolves may teach them and other pack members to be more wary of humans and to avoid areas of high human activity, it allows producers to address their own problems, and it may reduce animosity toward government agencies and personnel (Bangs et al. 2006). Drawbacks of lethal control are that it is always controversial among a sizeable segment of the public, depredation may recur, there is uncertainty whether the wolves killed were the offending animals, wolves may respond by becoming more active at night to avoid people, it can be costly when performed by agencies, and it is open to abuse when conducted by the public, thereby requiring law enforcement follow-up (Fritts et al. 1992, Musiani et al. 2005, Treves and Naughton-Treves 2005, Bangs et al. 2006). Two recent analyses of long-term lethal control of wolves found that removals generally have limited or no effect in reducing the recurrence of depredation (Harper et al. 2008, Muhly et al. 2010a).

Although lethal control is a necessary tool for reducing wolf depredation on livestock, excessive levels of lethal removal can preclude the recovery of wolf populations, as noted with the Mexican gray wolf in New Mexico and Arizona (USFWS 2005). Wolf managers must therefore monitor and, if necessary, adjust the extent of lethal removals to meet both conservation and management objectives. Constraints on lethal control have recently been recommended by Brainerd et al. (2008) to minimize negative impacts on recolonizing wolf populations. They suggested that lethal control be limited to solitary individuals or territorial pairs whenever possible, and that removals from reproductive packs should occur when pups are more than six months old, the packs contain six or more members (including three or more adults or yearlings), neighboring packs exist nearby, and the population totals 75 or more wolves. Consideration should also be given to minimizing lethal control around or between any core recovery areas that are eventually identified, especially during denning and pup rearing periods (April to September) (E. Bangs, pers. comm.). Additionally, managers should assess the potential negative impacts of wolf removal on pack structure and persistence and the potential for creating unstable pack dynamics if sink habitats are created by depredation control, especially in recovering populations (Gehring et al. 2003).

C. Compensation Programs for Wolf-Related Losses and Deterrence in Other States

Some livestock producers experience financial losses due to wolves, particularly through depredations on livestock. Other financial hardships associated with wolves may result from livestock becoming stressed or injured, and from changes in husbandry or management methods to reduce risk of depredation (see Chapter 14, Section B). Some of these losses can be documented reliably but others cannot. Wolf compensation programs were started as a means to build greater social acceptance for wolf recovery by reimbursing producers for some of these losses while wolves were listed.

Compensation for Losses

Defenders of Wildlife devised and operated the first compensation program for wolf depredation in the western United States (Stone 2009). Known as the Bailey Wildlife Foundation Wolf Compensation Trust, it paid about $1.5 million to livestock operators in Idaho, Montana, and Wyoming from 1987 to August 2010 (S. Stone, pers. comm.), with all funding obtained from private sources. Confirmed losses of livestock and herding/guarding dogs were reimbursed at 100% of their current or projected market value up to $3,000 per animal, whereas probable losses were reimbursed at 50% of their current or projected market value up to $1,500 per animal. Producers seeking compensation were required to provide appropriate documentation of the value of their animal(s), such as a contract, previous sale record, or current market reports, and had to submit a standard investigation report. Claims were paid on average within two and a half months (Muhly and Musiani 2010). To remain eligible for compensation of future losses, livestock owners needed to demonstrate reasonable use of non-lethal control measures and animal husbandry methods that did not unnecessarily attract wolves.

The Defenders of Wildlife program ended in all states except Oregon in 2010. In 2010, much of the funding for state-operated compensation programs came from a federal grant, the 2009 Wolf Loss Demonstration Project Bill, Public Law 111-11 (USFWS et al. 2011). This law provided up to $1 million annually for five years to states (excluding Alaska) and tribes with wolves and wolf-caused livestock damage. States are required to provide a 50% match for the federal contribution with state funds or private donations. In 2010, Defenders of Wildlife and state-run programs paid out $270,263 in Idaho, $96,097 in Montana, and $82,186 in Wyoming (USFWS et al. 2011). Descriptions of various state compensation programs are provided below.

The Idaho Wolf Depredation Compensation Program is overseen by a board of county commissioners, with agency representatives acting as advisors (OSC 2011). Since its inception in 2001, Idaho's program has paid claims for some wolf damage not covered by the Defenders of Wildlife compensation program (USFWS et al. 2010). Claims for verified losses receive priority and are paid at market value. Payments for unverified losses (e.g., lower than expected weight gains by livestock) and missing livestock are allocated on a prorated basis. If funds remain, reimbursement is also given for proactive measures. The Idaho program is funded at up to $100,000/year using federal funding. If claims exceed $100,000/year, each claim is pro-rated a percentage of the available $100,000 available (USFWS et al. 2010). The state compensation program recognized claims of $220,000 in 2008, $208,000 in 2009, and $280,000 in 2010 (USFWS et al. 2009, 2010, 2011).

Montana's state compensation program was created by the state legislature in 2007. The Montana Livestock Loss Board oversees the state's compensation program consistent with the Montana wolf plan (MDOL 2011). The board makes payments for confirmed and probable livestock losses its first priority, but had insufficient funding in 2010 to cover injured livestock and costs associated with proactive efforts. A grant program for prevention costs is being initiated in 2011. Overall funding comes from federal and state appropriations and private donors (e.g., Defenders of Wildlife, Montana Cattlemen's Association, Montana Farmers Union, and online contributions by private citizens). In addition, a specialty license plate will be issued to generate additional funding. The state compensation program paid claims of $87,318 in 2008 (April 15 to December 31), $144,996 in 2009, and $96,076 in 2010 (USFWS et al. 2009, 2010, 2011).

Wyoming's compensation program was created in 2008 using state general fund dollars (USFWS et al. 2010). Under Wyoming's compensation program, damage claims are paid only in the "trophy game" area of northwestern Wyoming (USFWS et al. 2011). The program uses a multiplier for each confirmed depredation on calves and sheep to account for undocumented wolf-caused losses. Calves and sheep are compensated up to seven times the number confirmed but only up to the total number reported missing by a producer. Other kinds of livestock such as adult cattle and horses are covered at actual value for confirmed losses only. Wyoming's compensation program paid claims of $101,429 in 2008 (July through December), $67,581 in 2009, and $73,849 in 2010 (USFWS et al. 2009, 2010, 2011).

Each of the Great Lakes states with wolves operates its own wolf compensation program. Wisconsin's program is run with federal and state matching funds. The latter come in part from voluntary public contributions, which can be made through (1) the purchase of Endangered Resources vehicle license plates bearing a wolf logo), (2) a check-off on the state income tax form (Treves 2008), and (3) the Wisconsin Department of Natural Resources' webpage. The program covers livestock (including calves missing at greater than normal mortality rates), hunting and pet dogs killed or injured on public lands, and farmed deer. Payments for dogs represented slightly more than half of the $92,000 paid out in compensation in 2009 (Wydeven et al. 2010). Minnesota's program compensates only for livestock killed or injured, as confirmed by university extension agents, conservation officers, or USDA Wildlife Services (Ruid et al. 2009). Husbandry practices must not have contributed to wolf depredations. Michigan's program similarly pays only for livestock losses verified by state Department of Natural Resources personnel or USDA Wildlife Services (Ruid et al. 2009). Funding comes from the state legislature and private sources. Between 1996 and 2009, $40,270 was paid out to livestock owners in Michigan for compensation of losses that were confirmed and attributed to wolves (Edge et al. 2011).

Compensation for wolf depredation is also available in all states through the federal Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program (ELAP), which was created as part of the 2008 Farm Bill and is administered by the USDA Farm Service Agency. Payments for confirmed wolf kills (probable kills are not covered) are based on 75% of the fair market value of the animal lost. Value for each class of livestock is determined annually according to prices at the time. A single rate applies to all losses of that class of animal across the U.S., regardless of the value the producer may feel a specific animal had. Reimbursement is given only for losses beyond normal mortality, and thus is not paid until the year is over. Livestock producers are only eligible if they insure all crops they raise, including pasture, thus many may not qualify for coverage. Claims must be submitted within 30 days on an incident and verified by a competent authority (e.g., USDA Wildlife Services, state fish and wildlife agency). Claims reimbursed through other compensation programs are not eligible. ELAP is only authorized through September 30, 2011, unless Congressional action extends it until 2012. Thus far, the program has been used minimally in the northern Rocky Mountain states to compensate livestock producers for wolf damage.

Evaluations of the effectiveness of wolf compensation programs have been conducted in the U.S. and other countries. Stone (2009) reported that most (69%) recipients of compensation from the Defenders of Wildlife program in the northern Rocky Mountain states were somewhat or highly satisfied with the payments they received and most (80%) did not want to see a reimbursement program ended. Nevertheless, the majority of (60%) recipients stated that the payments did not increase their support for wolf recovery, causing Stone (2009) to conclude that the program succeeded only in preventing further loss of tolerance for wolves among livestock producers. Program evaluations elsewhere have similarly concluded that compensation generally fails to improve the attitudes of producers towards wolves (Naughton-Treves et al. 2003, Treves et al. 2009, Vynne 2009, Boitani et al. 2010). This has led to recommendations for revision of existing compensation programs, including making them more user friendly and involving stakeholders (both recipients and donors) in program development and management.

<u>Compensation for Proactive Management</u>

With the termination of its compensation fund in 2010, Defenders of Wildlife is expanding its Proactive Carnivore Conservation Fund, which encourages greater use of preventative non-lethal deterrents and appropriate husbandry methods through cost-sharing grants to ranchers. This program spent $376,000 on wolf-related projects in the northern Rocky Mountain states from 1999 to 2010 (S. Stone, pers. comm.).

D. Predicting Losses of Ranch Animals in Washington Due to Wolves

This section provides rough estimates of confirmable losses of ranch animals that might be expected to occur annually in Washington as wolves become reestablished. Hypothetical projections are given for four population size categories of 50, 100, 200, and 300 wolves (which corresponds to about 4, 7, 14, and 21 breeding packs, respectively, USFWS 2009). Predictions of this type are difficult because of the many uncertainties over where and how many wolves will eventually inhabit the state, the frequency that they will interact with livestock, problems in determining actual versus confirmed numbers of livestock killed, and ongoing improvements in the adaptive management responses of ranchers and wildlife agencies.

The estimates presented are based on analyses of depredation data from Idaho, Montana, and Wyoming for 1987 to 2007 (Table 5) and assume that interactions between livestock and wolves in Washington will be similar to those in these states. This assumption must be viewed cautiously because of differences in livestock numbers (especially the lower number of sheep in Washington) and distribution, husbandry methods, availability of natural prey, land use, and human densities. In addition, these projections represent average expected losses per year and do not demonstrate the annual variation in depredations that commonly occurs in Idaho, Montana, and Wyoming. More complete information on this analysis and the annual monetary value of these losses appear in Chapter 14, Section B.

Low and high predictions of confirmable annual losses of ranch animals for Washington are presented in Table 8. Total populations of 50 and 100 wolves are expected to depredate very small numbers of livestock. Fifty wolves may kill about 1-6 cattle and 7-16 sheep per year, with annual take perhaps doubling for 100 wolves. Larger wolf populations will likely kill greater numbers of livestock, with projections of 6-28 cattle and 20-60 sheep killed annually by 200 wolves, and 12-67

Table 8. Predicted estimates of confirmable depredations of livestock and domestic dogs for four different future population size categories of wolves in Washington. Because of the absence of biological and depredation data on wolves living in Washington, numbers presented here should be considered as very rough hypothetical estimates.

	Wolf population size category			
Future number of wolves present	50	100	200	300
Estimated no. of future confirmed cattle depredations per year[a]	1-6	2-12	6-28	12-67
Estimated no. of future confirmed sheep depredations per year[a]	7-16	14-35	20-60	22-92
Estimated no. of future confirmed horse and other livestock depredations per year[a]	0-1	0-1	0-2	0-2
Estimated no. of future confirmed dog depredations per year[a]	1-2	2	2-3	1-4

[a] Numbers represent the estimated numbers of livestock and dogs that might be confirmed as being killed annually by different sizes of wolf populations. Unconfirmed kills are excluded from these estimates.

cattle and 22-92 sheep killed annually if 300 wolves became reestablished. However, sheep losses are expected to be on the low end of these estimates because sheep numbers are much smaller in Washington than in Idaho, Montana, and Wyoming (see NASS 2004). Even at a population of 300 wolves, these levels of depredations represent 4% or less of the annual predator-caused death losses experienced by Washington cattle and sheep producers. Depredations on horses, other livestock, and guarding/herding dogs are expected to be minor for each of the four wolf population size categories.

E. Management of Wolf-Livestock Conflicts in Washington

Any wolf-livestock management program should manage conflicts in a way that gives livestock owners experiencing losses the tools to minimize losses, while at the same time not harming the recovery or long-term sustainability of wolf populations. Strategies to address wolf-livestock conflicts in Washington are described in Chapter 12, Task 4. Management approaches are based on the status of wolves, ensuring that recovery objectives are met. Non-lethal management techniques will be emphasized throughout the recovery period and beyond. Actively informing and equipping landowners, livestock producers, and the public with tools to implement proactive wolf management techniques will be an important aspect of this approach. Lethal control will be used only as needed after case-specific evaluations are made, with use becoming less restrictive as wolves progress toward delisting. Wherever wolves are federally listed in Washington, the U.S. Fish and Wildlife Service and USDA Wildlife Services are the lead agencies to respond to reports of wolf depredations. WDFW will consult with and collaborate with the U.S. Fish and Wildlife Service on management decisions and actions in these locations. In areas where wolves are federally delisted, WDFW will be the lead to respond, with potential assistance from USDA Wildlife Services and other entities (Chapter 12, Task 4.3.3).

Wolf-livestock conflicts will be managed using a range of options to prevent depredation, as presented in Table 9. Descriptions of these options are as follows:

Table 9. State management options to address depredation of livestock during wolf recovery phases in Washington. All proposed state management actions involving lethal control of wolves in areas of Washington where the species is federally listed would be contingent on consistency with federal law and consultation and approval by the U.S. Fish and Wildlife Service.

Management Option	Endangered	Threatened	Sensitive
Wolf location information to livestock owners	Provided	Provided	Provided
Non-injurious harassment	Allowed	Allowed	Allowed
Non-lethal injurious harassment	Allowed with a permit and training from WDFW. This will be reconsidered if used inappropriately or a mortality occurs under this provision.	Allowed with a permit and training from WDFW.	Allowed with a permit and training from WDFW.
Move individual wolves	May be used by state/federal agents to resolve conflicts on a case-by-case basis.	May be used by state/federal agents to resolve conflicts on a case-by-case basis.	May be used by state/federal agents to resolve conflicts on a case-by-case basis.
Lethal control by state/federal agents of wolves involved in repeated livestock depredations	Allowed during all listed statuses and after delisting, consistent with federal law. WDFW may consider issuing a permit to a livestock owner (including family members and authorized employees) to conduct lethal control if WDFW does not have the resources to address control.	Allowed during all listed statuses and after delisting, consistent with federal law. WDFW may consider issuing a permit to a livestock owner (including family members and authorized employees) to conduct lethal control if WDFW does not have the resources to address control.	Allowed during all listed statuses and after delisting, consistent with federal law. WDFW may consider issuing a permit to a livestock owner (including family members and authorized employees) to conduct lethal control if WDFW does not have the resources to address control.
Lethal control by livestock owners (including family members and authorized employees) of wolves to resolve repeated wolf-livestock conflicts	Not allowed, except as noted above.	Not allowed, except as noted above.	Allowed by livestock owners (including family members and authorized employees) with an issued permit on private lands and public grazing allotments they own or lease.

Table 9. State management options to address depredation of livestock during wolf recovery phases in Washington. All proposed state management actions involving lethal control of wolves in areas of Washington where the species is federally listed would be contingent on consistency with federal law and consultation and approval by the U.S. Fish and Wildlife Service.

Management Option	Endangered	Threatened	Sensitive
Lethal take of wolves in the act of attacking (biting, wounding, or killing) livestock, including guarding/herding animals	Allowed by livestock owners (including family members and authorized employees) on private land they own or lease and public grazing allotments, with an issued permit, after documented depredation (injury or killing) in the area. Would trigger a review by WDFW if used inappropriately or if 2 wolf mortalities occur under this provision in a year. WDFW would evaluate the circumstances of the mortalities and determine if it would continue issuing permits.	Allowed by livestock owners (including family members and authorized employees) on private land they own or lease and public grazing allotments, with an issued permit, after documented depredation (injury or killing) in the area. Would trigger a review by WDFW if used inappropriately or if 2 wolf mortalities occur under this provision in a year. WDFW would evaluate the circumstances of the mortalities and determine if it would continue issuing permits.	Allowed by livestock owners (including family members and authorized employees) on private land they own or lease and public grazing allotments, with an issued permit, after documented depredation (injury or killing) in the area. Would trigger a review by WDFW if used inappropriately or if 2 wolf mortalities occur under this provision in a year. WDFW would evaluate the circumstances of the mortalities and determine if it would continue issuing permits.
Compensation	Yes	Yes	Yes
Assistance with the use of proactive non-lethal management tools	Yes	Yes	Yes

Wolf location information: WDFW will notify livestock producers if wolves are living near their operations and will update them, as needed. This will assist livestock producers in implementing proactive precautions, if they choose, to reduce the likelihood of depredation by wolves.

Non-injurious harassment: Livestock owners and grazing allotment holders (or their designated agents) will be allowed to harass wolves with non-injurious techniques when wolves are in close proximity to livestock or livestock grazing areas on both private and public land. These techniques could include scaring off an animal(s) by firing shots or cracker shells into the air, making loud noises, or other methods of confronting the animal(s) without doing bodily harm.

Non-lethal injurious harassment: This form of harassment involves striking wolves with non-lethal projectiles, such as rubber bullets specifically designed and approved for use on wolves, paintballs, and beanbags (Bangs et al. 2006). Livestock owners and grazing allotment holders (or their designated agents) may be issued a permit to use non-lethal injurious harassment on their own land or their legally designated allotment, respectively, during all listed phases. This will require authorization from WDFW and training in the use of the above listed projectiles. Whiles wolves are listed as endangered, this management tool will be reconsidered if used inappropriately or if a wolf mortality occurs under this provision.

Move individual wolves: As described in Section B of this chapter, moving an individual wolf is a possible management tool to remove the animal from a conflict situation. This activity would be evaluated on a case-specific basis under all management phases, but would especially be considered during endangered and threatened status. Examples of when this might occur are when a wolf or wolves become involved in depredation on livestock, or are present in an area that could result in conflict with humans or harm to the wolf.

If a wolf were moved, it would be transported and released into suitable remote habitat on public land, within the same recovery region. A relocated individual would be released into an area unoccupied by an existing wolf pack; and would not be moved to an area that had livestock present on the ground. Any relocation would be conducted by WDFW or USDA Wildlife Services in consultation with the appropriate land management agency, and the U.S. Fish and Wildlife Service, if wolves are federally listed in that portion of the state. Moving an individual wolf does not require a public review process and is not used to facilitate dispersal.

Lethal control to resolve repeated livestock depredations: Lethal removal may be used to stop repeated depredation if it is documented that livestock have clearly been killed by wolves, non-lethal methods have been tried but failed to resolve the conflict, depredations are likely to continue, and there is no evidence of intentional feeding or unnatural attraction of wolves by the livestock owner. Situations will have to be evaluated on a case-specific basis, with management decisions based on pack history and size, pattern of depredations, number of livestock killed, state listed status of wolves, extent of proactive management measures being used on the property, and other considerations. If it is determined that lethal removal is necessary, it will likely be used incrementally, as has been done in other states, with one or two offending animals removed initially. If depredations continue, additional animals may be removed. Lethal removal methods may include trapping and euthanizing, or shooting.

In areas of Washington where wolves are federally listed, any proposal to lethally control wolves would have to be consistent with federal law. WDFW does not have authority to lethally remove wolves where they are federally listed. During state endangered and threatened status, lethal control would be conducted by WDFW or USDA Wildlife Services staff. If a situation were to occur where WDFW did not have the resources to address a situation of repeated depredations, WDFW may consider issuing a permit to a livestock owner (including family members and authorized employees) to conduct lethal control during a specific time period on private lands they own or lease. As wolves move to state sensitive and delisted status, WDFW may permit livestock owners (including their family members and authorized employees) to lethally control a limited number of wolves during a specific time period on private lands and public grazing allotments they own or lease. Wolves taken under a permit must be reported to WDFW within 24 hours, with additional reasonable time allowed if there is limited access to the take site.

Lethal take in the act of attacking livestock: This provision allows lethal take of wolves "in the act" of attacking livestock (defined as biting, wounding, or killing; not just chasing or pursuing) by livestock owners (including family members and authorized employees), on private land and public grazing allotments they own or lease at all listed statuses, with an issued permit, after documented depredation (injury or killing) in the area. This provision would not be available in areas of the state where wolves are federally listed as endangered. Federal law does not allow lethal take of an endangered species in the act of attacking livestock. At federal threatened status, there is more management flexibility through federal regulations. Wherever wolves are federally listed in Washington, the U.S. Fish and Wildlife Service is the lead management authority. In these areas, WDFW will consult with and collaborate with the U.S. Fish and Wildlife Service on management decisions and actions to ensure consistency with federal law.

State law (RCW 77.15.120) prohibits the killing of an endangered species unless it has been authorized by rule of the commission. Subject to limitations established by the commission, certain private citizens may kill wildlife that is threatening human safety or causing property damage. Under RCW 77.36.030, the conditions set by the commission must include "appropriate protection for threatened or endangered species." It also states that in establishing the limitations and conditions related to wolves, the commission "shall take into consideration the recommendations of the Washington state wolf conservation and management plan." Under WAC 232-36-051, it is unlawful to kill state endangered species causing damage to commercial livestock unless authorized by commission rule or WDFW permit.

Permits for this activity would be issued after WDFW has confirmed that wolves previously have wounded or killed livestock in the area and efforts to resolve the problem have been deemed ineffective. Efforts to resolve the problem may either be preventative measures (i.e., documented non-lethal actions implemented specifically to minimize or avoid wolf-livestock conflict before the initial depredation), or non-lethal control efforts (i.e., non-lethal actions implemented specifically to minimize or avoid wolf-livestock conflict after the initial depredation). The permit holder would be required to continue implementing non-lethal actions to minimize or avoid wolf-livestock conflicts during the life of the permit, with issuance of future permits being contingent upon this effort. "In the area" means the area known to be used by the depredating wolves. In some cases, the area may be specifically delineated by data (i.e., radio telemetry). Permits for this activity may be issued for protection of all types of livestock covered under this plan and to both commercial and non-commercial livestock operators.

WDFW will provide training to permit holders to ensure the appropriate use of this provision. Wolves stalking, looking at, or passing near livestock, present in a field with livestock, or present on private property are not considered to be in of attacking. Wolves may not be intentionally baited, fed, or deliberately attracted for any purpose, including killing under this provision. Wolves killed under this provision must be reported to WDFW within 24 hours, with additional reasonable time allowed if there is limited access to the take site. The wolf carcass must be surrendered to WDFW and preservation of physical evidence from the scene of the attack for inspection by WDFW is required.

During all listed statuses, if this provision were used inappropriately or if two wolves were killed under it in a year, it would trigger a review by WDFW. A review of this type would evaluate the circumstances of the mortalities or other problems, and would result in a determination of whether WDFW would stop issuing new permits or withdraw existing permits.

F. Proactive Measures to Reduce Wolf-Livestock Conflicts in Washington

Proactive non-lethal tools offer livestock producers different methods for reducing wolf-livestock conflicts and depredations. WDFW will actively encourage and provide technical assistance to livestock producers to implement proactive management techniques. Fewer conflicts could aid wolf conservation by improving social tolerance for the species and could lead to lowered compensation costs over the long-term.

WDFW will work with livestock producers to provide technical assistance on proactive, non-lethal management methods and technologies (Chapter 12, Task 4.2.2). It is recognized that these measures will result in higher costs for livestock producers. Under Task 4.4.6, funding will be sought to assist producers with some of their expenses associated with implementing proactive measures. WDFW will also be open to partnerships with other agencies and organizations (e.g., Defenders of Wildlife through its Proactive Carnivore Conservation Fund) that are interested in providing livestock producers with funding, additional training, and other resources needed to implement these measures.

G. Compensation for Wolf-Caused Livestock Depredation in Washington

Currently, state laws RCW 77.36 and WAC 232-36 allow owners of commercial livestock (cattle, sheep, and horses held or raised by a person for sale) to be compensated by WDFW for animals killed or injured by bears, cougars, and wolves if required conditions are met (Appendix F) and the State Legislature approves funding for that purpose each biennium. Under these laws, claimants can receive no more than $200 per sheep, $1,500 per head of cattle, and $1,500 per horse up to a $10,000 limit per claim. Other types of livestock are excluded from coverage. To qualify for compensation, livestock owners must have (1) gross sales of at least $10,000 during the preceding tax year, (2) a minimum of $500 in damage, (3) used self-help preventative measures (including non-lethal methods and department-provided materials; some exceptions may apply) prior to the depredation, and (4) exhausted other compensation options from non-profit organizations. Compensation cannot be redundant with payments made by non-profit organizations and will not be paid if the damages are covered by insurance. An appeals process exists for applicants to dispute claim denials or settlement offers. The Legislature has not yet provided funding for this program. WDFW received funding from other sources in 2010 to pay compensation for confirmed and probable losses caused by wolves. This included a $15,000 grant from the U.S. Fish and Wildlife Service provided under the 2009 Wolf Loss Demonstration Project Bill, Public Law 111-11, and a $15,000 donation for the required match from Defenders of Wildlife.

State Wolf Compensation Program

This plan provides for a state compensation program for documented confirmed and probable wolf-killed livestock in order to reduce the financial losses that some livestock producers might experience while wolves are state listed. Public support for a state-funded wolf compensation program was expressed in the comments received during public meetings in 2007 and 2009 and the plan's public review period in 2009-2010. Many people supporting wolf restoration view compensation as an opportunity to share in the burden that livestock producers may experience and as a way to build public support for wolf recovery (see Montag et al. 2003). An effective compensation program supported by the public and Legislature can also help maintain tolerance for wolves among some landowners and livestock producers (Bangs et al. 2006, Stone 2009), which can help decrease illegal killings and aid wolf recovery.

Payment for Confirmed and Probable Depredations on Livestock

The plan expands compensation for wolf depredation beyond that currently provided for by the state in RCW 77.36 and WAC 232-36 (Appendix F). Under this plan, livestock eligible for compensation include cattle, sheep, horses, pigs, mules, llamas, goats, and guarding/herding animals. All livestock owners would be eligible, regardless of gross sales level during the preceding tax year. Domestic pets and hunting dogs would not be covered for compensation; however, dogs used for animal control efforts under contract with WDFW or other public entities may be eligible. The WDFW plans to seek funding through other partners to address the expanded compensation provisions.

To receive compensation, producers will be responsible for following appropriate management methods that seek to limit wolf attractants in the vicinity of their livestock, including removal of dead and dying animals and other proactive measures. Producers who have already been compensated for a depredation would be required to demonstrate that they are implementing appropriate management methods to be eligible for compensation for subsequent depredation occurrences.

To receive compensation for direct losses, incidences of suspected wolf depredation must be reported to WDFW and verified as confirmed or probable (as defined below) during a follow-up investigation conducted by trained personnel authorized by WDFW. If wolves are federally listed, the U.S. Fish and Wildlife Service and USDA Wildlife Services will respond to depredation reports. Prompt investigations are critical for determining the validity of reported complaints, and livestock producers need to report suspected wolf depredations as soon as possible (see Appendix K for reporting guidelines and associated information). Agency personnel will conduct their investigation within 48 hours of receiving a report. After an investigation is completed, the complaint will be classified under one of the following categories:

- Confirmed Wolf Depredation – There is reasonable physical evidence that the dead or injured animal was actually attacked or killed by a wolf. Primary confirmation would ordinarily be the presence of bite marks and associated subcutaneous hemorrhaging and tissue damage, indicating that the attack occurred while the victim was alive, as opposed to simply feeding on an already dead animal. Spacing between canine tooth punctures, feeding pattern on the carcass, fresh tracks, scat, hairs rubbed off on fences or brush, and/or eyewitness accounts of the attack may help identify the specific species or individual responsible for the depredation. Predation might also be confirmed in the absence of bite marks and associated hemorrhaging (i.e., if much of the carcass has already been consumed by the predator or scavengers) if there is other physical evidence to confirm predation on the live animal. This might include evidence of an attack or struggle. There may also be nearby remains of other victims for which there is still sufficient evidence to confirm predation, allowing reasonable inference of confirmed predation on an animal that has been largely consumed.

- Probable Wolf Depredation – There is sufficient evidence to suggest that the cause of death was depredation, but not enough to clearly confirm that the depredation was caused by a wolf. A number of other factors will help in reaching a conclusion, such as (1) any recently confirmed predation by wolves in the same or nearby area, and (2) any evidence (e.g., telemetry monitoring data, sightings, howling, fresh tracks, etc.) to suggest that wolves may have been in the area when the depredation occurred. All of these factors and possibly others would be considered in the investigator's best professional judgment.

- Confirmed Non-Wild Wolf Depredation – There is clear evidence that the depredation was caused by another species (coyote, black bear, cougar, bobcat, domestic dog), a wolf hybrid, or a pet wolf.

- Unconfirmed Depredation – Any depredation where the predator responsible cannot be determined.

- Non-Depredation – There is clear evidence that the animal died from or was injured by something other than a predator (e.g. disease, inclement weather, or poisonous plants). This determination may be made even in instances where the carcass was subsequently scavenged by wolves.

- Unconfirmed Cause of Death – There is no clear evidence as to what caused the death of the animal.

Table 10. Compensation levels for each confirmed and probable wolf depredation of livestock (cattle, pigs, horses, mules, sheep, llamas, goats, and guarding/herding animals) in Washington.

Depredation	**Grazing sites of 100 or more acres where the agency determines it would be difficult to survey the entire acreage (*double payment would not apply if all other animals were accounted for)**	**Other sites**
Confirmed	Full current market value for 2 animals	Full current market value for 1 animal
Probable	Half the current market value for 2 animals	Half the current market value for 1 animal

Two-Tiered Payment Plan

A two-tiered payment plan is used for confirmed and probable wolf-killed livestock on private and public lands (Table 10). Payments are higher on grazing sites of 100 or more acres, where the agency determines it would be difficult to survey the entire acreage because it is harder to find carcasses on larger sites (see Section A of this chapter). For each animal confirmed as a wolf kill on the larger sites, owners would receive the full current market value for two animals. For each animal documented as a probable wolf kill, owners would receive half the current market value for two animals. The higher payments are to account for a possible missed carcass and would not apply if there were no missing animals beyond the confirmed or probable kill. On grazing sites not meeting the above criteria, owners would receive the full current market value of each animal confirmed as a wolf kill and half the current market value of each animal documented as a probable wolf kill.
On the smaller sites, payment does not include an additional animal because livestock owners should be able to supervise their stock more closely and find nearly all carcasses.

All payments are based on current market value, which is defined as the value of an animal at the time it would have normally gone to market. Appropriate documentation, such as a contract, previous sales record, or current market reports, will be required to help determine this value. Compensation payments will be contingent on availability of funding and, where applicable, any restrictions of state or private funding sources. If, in the future, a program is developed to compensate for unknown losses (see below), producers could receive payment under only one program - either confirmed/probable or unknown - but not both.

Compensation payments will be made in a timely manner using a system developed by WDFW (Chapter 12, Tasks 4.3 and 4.4). Payments for wolf-caused depredation will be reduced by the amounts received by the owner from insurance covering livestock losses or from any other source for the same purpose, including a federal or private compensation program. Payment will also be reduced by the amount received for any financial gain that the owner receives from the sale of a partially salvaged carcass or other product.

Payment for Injured Livestock

Under this plan, producers would be able to recoup veterinary treatment costs for injured animals, not exceeding their current market value. If injured livestock need to be euthanized, owners will receive compensation for the current market value of the animal. If livestock are injured to the extent that they must be sold prematurely, the operator will receive the difference between the selling price and current market value.

Development of Compensation Payments for Unknown Losses

There is interest in developing a program to compensate livestock producers for unknown losses presumed to be caused by wolves. It is recognized that this is difficult and can encounter numerous problems. After the plan is approved, WDFW will work with a multi-interest stakeholder group to attempt to develop an appropriate payment system for unknown livestock losses where there is no direct evidence that wolf predation caused the losses. The purpose of this part of the program would be to compensate livestock producers for losses in areas where wolves are confirmed to be present, documented wolf depredation is occurring nearby, and differences exist between historical and current return rates of livestock that are not attributable to other causes. Compensation for unknown losses would not be paid in addition to compensation for confirmed and probable losses. A producer could be compensated for one or the other, but not both.

The stakeholder group should contain an equal number of members representing livestock producer and conservation interests. Some of the criteria that would need to be part of a program to compensate for unknown losses include: development of a method to validate historical losses as a baseline, demonstration of current year losses, criteria for excluding payment for unusual levels of death losses from non-wolf-related sources (e.g., other predators, weather, disease), and determining the best method for reviewing and validating claims. A mechanism for reviewing this part of the compensation program would also need to be established in order to maintain accountability and assess effectiveness.

Idaho and Wyoming have developed programs to compensate for unknown losses. Idaho has encountered a number of limitations and problems in implementation (J. Allen, pers. comm.). For this type of compensation program to succeed, it must establish a high degree of accountability and verifiability, avoid creating a costly new bureaucracy, be as low cost as possible, be implementable, and be simple to understand and use. If such a compensation program meeting these conditions cannot be developed for Washington, WDFW will work with a balanced advisory group to determine the need for alternative compensation provisions. It is recognized that this would not be allowed under current state laws (WAC 232-36; Appendix A) and that if such a program were developed, the WAC would need to be amended.

Funding Sources for Compensation

WDFW will work with the livestock industry and conservation organizations to identify potential funding sources, including special state or federal appropriations, private foundations, and other private resources. These funding sources could augment state compensation and/or may provide funding for compensation of wolf-caused livestock losses that are not funded by the State Legislature. An example of one such funding source is the specialty license plates issued for this purpose by Wisconsin and Montana.

Changes Needed to Make Current State Law Consistent with the Wolf Plan

Portions of the wolf compensation program in this plan are inconsistent with state laws (RCW 77.36 and WAC 232-36). Inconsistencies include different payment levels, different definitions of livestock and eligible recipients, and coverage for unknown losses. In order to implement the plan's recommended compensation program using state funds, WAC 232-36 may need to be amended. Different fund sources may be needed to implement portions that are different from RCW 77.36 (e.g. definitions of livestock, eligible recipients, etc).

Accountability, Review, and Phasing Out

The wolf compensation program will be subject to review, along with the rest of the wolf conservation and management plan, when the listing status of wolves changes from state endangered to threatened and from threatened to sensitive. Upon delisting, compensation for livestock depredations may transition to the provisions contained within WAC 232-36 for other predators, and could eventually be phased out depending on the type of management tools that are authorized and the flexibility of control options available to livestock owners. It is assumed that a new management plan will accompany delisting and the need for continued compensation will be evaluated at that time.

5. WOLF-UNGULATE INTERACTIONS

Gray wolves dispersing into Washington likely will settle in areas with abundant prey that already support multiple types of predators and hunters. The effect on ungulate populations from adding wolves to existing predation levels and hunter harvest is difficult to predict in the state because of localized differences in predator and ungulate abundance, habitat characteristics, topography, and ungulate harvest management practices. However, information from Idaho, Montana, and Wyoming, each of which currently supports 340-700 wolves, as well as the Great Lakes states that each support between about 600 (Michigan, Wisconsin) and 3,000 (Minnesota) wolves, provides useful insight on impacts that can be expected in Washington as wolves reestablish. In general, wolves have had limited effect on overall elk and deer abundance and hunter harvest in these states, where most populations remain stable or are above population objectives (see Section B of this chapter). However, wolves have been linked to localized elk herd declines in some areas. In these locations, wolves are one of several factors affecting the herds (e.g., changes in habitat, severe winter weather, drought, hunting pressure, and increasing populations of other predators). In some wolf-occupied areas, hunter success rates have declined due to a variety of causes, including changes in elk behavior and habitat use as well as from localized declines in elk abundance.

This chapter focuses on interactions between wolves and wild ungulates and provides:

- background on wolf predation of ungulates (Section A)
- background on recent impacts of wolves on ungulates in others states (Section B)
- background on current status of ungulates in Washington (Section C)
- background on wolf-elk interactions on wintering grounds (Section D)
- estimates of predicted wolf predation on deer and elk in Washington (Section E)
- a description of the management tools available for managing wolf-ungulate interactions in Washington (Section F)

Specific management strategies pertaining to wolf-ungulate interactions are in Chapter 12, Task 5.

A. Wolf Predation of Ungulates

Ungulates are the primary food of wolves throughout their geographic range. Prey selection by wolves probably reflects a combination of capture efficiency and profitability versus risk (Mech and Peterson 2003). Thus, wolves may concentrate on species that are easier to capture or offer greater reward for the amount of capture effort expended rather than on species that are most common. Diet can vary greatly among locations in the same region (Table 2) or even among packs living in the same vicinity (e.g., Kunkel et al. 2004, Smith et al. 2004) in response to differences in prey populations, seasonality, weather conditions, the presence of other predators, levels of human harvest, and other circumstances (Smith et al. 2004).

In the central and northern Rocky Mountains of the United States and Canada, wolves commonly rely on elk as their primary prey, but deer and moose are more important in some areas (Table 2). Moose are the major prey in much of British Columbia, including southern areas (G. Mowat, pers. comm.). Bighorn sheep and mountain goats are not regularly taken anywhere in the overall region, probably because of little habitat overlap with wolves (Huggard 1993). In the Great Lakes states, white-tailed deer are the main prey of wolves (DelGiudice et al. 2009). Wolf diets in Washington are expected to be similar to those in the Rockies, with elk, deer, and, in some locations, moose being the primary prey species.

The rates at which wolves kill and consume prey are highly variable with respect to time of year and species taken. Both rates (usually expressed as biomass per wolf per day) have been investigated in many North American studies and average about 7.2 kg/wolf/day for kill rate (winter only; Mech and Peterson 2003) and 5.4 kg/wolf/day for consumption rate (winter only; Peterson and Ciucci 2003). The figure for kill rate roughly corresponds to about one 150-kg elk killed per 21 days per wolf (or 17 elk per wolf per year) or one 60-kg deer killed per 8.3 days per wolf (or 44 deer per wolf per year). In Yellowstone National Park, winter kill rates by wolves declined from 2000 to 2004 (1.1 elk/wolf every 30 days) compared to 1995 to 2000 (1.9 elk/wolf every 30 days), and wolf kill rates did not increase between early and late winter in the later period (2000-2004) compared to the first five years after wolf restoration (1995-2000) (Stahler et al. 2006). However, these estimates are probably somewhat inaccurate because they are based on (1) winter studies, when predation rates in terms of biomass consumed are highest causing annual take to be overestimated, and (2) do not account well for the number of fawns and calves killed in summer or supplementary prey (e.g., beavers, hares) taken in other seasons (Mech and Peterson 2003, Smith et al. 2004). In contrast, Sand et al. (2008) found that predation rates in terms of numbers of prey killed by wolves in Scandinavia were much higher in summer than winter due to the large number of juveniles taken, which would cause total annual kill to be underestimated when extrapolating from winter-only data. White et al. (2003) attempted to overcome some of these problems and estimated an annual kill rate of 25 ungulates per wolf in prey-rich Yellowstone National Park. It should be noted that wolf kill rates are generally higher for reestablishing and expanding wolf populations like those at Yellowstone than for long established and stable populations (Jaffe 2001).

Wolves are selective hunters and tend to choose more vulnerable and less fit prey. Young-of-the-year (especially in larger prey like elk and moose), older animals, and diseased and injured animals are taken in greater proportion than healthy, prime-aged individuals (Mech 1970, 2007; Fritts and Mech 1981; Kunkel and Pletscher 1999; Kunkel et al. 1999; DelGiudice et al. 2002, 2006; Mech and Peterson 2003; Smith et al. 2004; Stahler et al. 2006; Sand et al. 2008; Boertje et al. 2009; Hamlin and Cunningham 2009). In some areas and situations, wolves select adult bull elk disproportionately. This may relate to the relatively poor condition that bull elk are in during winter and their choice of habitat (Atwood et al. 2007, Winnie and Creel 2007, Hamlin and Cunningham 2009). Winter severity, particularly greater snow depth, increases wolf predation on deer (Nelson and Mech 1986, DelGiudice et al. 2002, 2006). Similar to other coursing predators that chase prey over long distances, wolves will test and evaluate available prey, and will focus on those animals that require the least energy to capture and present the least risk of injury or death to pack members. When young or infirm animals are not available, wolves are capable of killing healthy, prime-aged animals. Predatory performance of individual wolves declines with age (MacNulty et al. 2009).

Prey species have evolved defensive techniques such as alertness, speed, herding behavior, synchronous birthing of young, spacing, migration, and selection of safer habitat including retreating into water to reduce their vulnerability to wolves (Mech and Peterson 2003, Laporte et al. 2010, Muhly et al. 2010b). Because of these defense mechanisms, the majority of hunts initiated by wolves are unsuccessful. Hunting success of wolves can be influenced by many factors, including pack size, terrain, habitat features, snow and other weather conditions, time of day, prey species, age and condition of prey, season, and experience (Mech and Peterson 2003, Hebblewhite 2005, Kauffman et al. 2007).

The impacts of wolves on prey abundance have been, and continue to be, widely debated (see Boutin 1992). Some common conclusions on this topic have been drawn. A number of studies indicate that wolf predation can limit ungulate populations (Bergerud and Snider 1988, Larsen et al. 1989, Ballard et al. 1990, Skogland 1991, Gasaway et al. 1992, Dale et al. 1994, Messier 1994, Van Ballenberghe and Ballard 1994, Adams et al. 1995, Boertje et al. 1996, National Research Council 1997, Hayes and Harestad 2000, Hebblewhite et al. 2002, 2006, Hayes et al. 2003, Mech and Peterson 2003, White and Garrott 2005, Hebblewhite and Merrill 2007). Population-level effects result primarily through predation on young-of-the-year and are frequently enhanced when occurring in combination with other predators (e.g., bears) (Larsen et al. 1989, Barber-Meyer et al. 2008, Boertje et al. 2009).

Creel et al. (2009) and Christianson and Creel (2010) reported that elk declines in the greater Yellowstone ecosystem were not in fact caused by actual wolf predation, but instead resulted simply from the threat of wolf predation. They hypothesized that female elk responded to the presence of wolves by spending less time feeding and moving to safer habitats of poorer nutritional quality, resulting in reduced nutrition and lowered calf production that pushed the population downward. However, recent evidence refutes this theory by showing that Yellowstone cow elk have maintained high levels of body fat (some of the highest in North America) and high pregnancy rates in the years following wolf reintroduction (White et al. 2011).

Several studies have detected little or no effect from wolves on ungulate populations (Thompson and Peterson 1988, Bangs et al. 1989, Peterson et al. 1998; see Mech and Peterson 2003; DelGiudice et al. 2006, 2009). Mech and Peterson (2003) suggested three reasons why researchers have failed to reach agreement regarding the significance of wolf predation on the dynamics of prey populations. These are: (1) each predator-prey system has unique ecological conditions, (2) wolf-prey systems are inherently complex, and (3) population data for wolves and their prey are imprecise and predation rates are variable. Whether the prey population exists at or below its ecological carrying capacity is another important element in assessing the results of such studies (D. W. Smith, pers. comm.). As pointed out in many studies, numerous other factors (human harvest, severe winters, variable forage quality, fluctuating abundance of other predators and prey, disease, human disturbance and development, and vehicle collisions) also influence prey populations and complicate the ability to make solid conclusions about wolf-related impacts. In summary, wolf-prey interactions are probably best characterized as being exceedingly complex and constantly changing, as seen at Isle Royale National Park, Michigan, where wolf-moose relationships still cannot be predicted with confidence despite 50 years of detailed research on this subject (Vucetich and Peterson 2009).

The question of whether wolf-caused mortality is "compensatory" or "additive" is another widely debated topic. Predation is considered compensatory when it replaces other mortality sources (starvation, disease, etc.) that would have otherwise occurred. Predation can be classified as additive when prey are lost that would not have died of other causes in the short term. Mech and Peterson (2003) concluded that in most cases wolf predation is probably a combination of both (e.g., see Varley and Boyce 2006). This holds especially true for predation on young animals (calves and fawns), where because of their increased vulnerability, some young killed by wolves would have likely survived to adulthood.

Analyses from Yellowstone National Park are contradictory on this topic. Vucetich et al. (2005) reported that wolf predation on elk in the park was primarily compensatory in the first decade after wolf reestablishment and replaced mortality that would have been caused by hunting and severe winter weather, but noted that wolf predation could become more additive in the future as circumstances (e.g., weather patterns, overall rates of predation) change. Others (White et al. 2003, White and Garrott 2005) have concluded that take of female elk by wolves and hunters is probably additive because of the high survival rates of females in the absence of hunting and major predators. In multi-predator ecosystems, where species such as cougars, bears, and coyotes also exist, one might expect that wolf reestablishment would result in declines in some other predators and that wolf predation would therefore be compensatory. However, under recent conditions at Yellowstone, predation (primarily by bears, but also including that by wolves and coyotes) on elk calves was considered mainly additive (Barber-Meyer et al. 2008). At Glacier National Park, Kunkel and Pletscher (1999) reported that prey losses from wolves were largely additive to those from other predators. Recent evidence from five northwestern states indicates that wolf predation on young elk calves is minor and most likely compensatory with predation by other species (Griffen et al. 2011)

A myriad of literature can be produced that presents examples of each type of mortality in predator-prey systems involving mammals. Each is unique to the ecosystem studied and the inherent strengths and weaknesses of the study design. However, one major influence on the conclusions of such studies is whether or not the prey population occurred at carrying capacity. Wolf predation is often determined to be compensatory for prey populations at or near carrying capacity, but additive for those below carrying capacity (D. W. Smith, pers. comm.). For example, wolf predation may be a source of compensatory mortality in white-tailed deer relative to starvation if deer numbers are beyond the carrying capacity of their range during winters of higher severity (DelGiudice et al. 2002). It is beyond the scope of this plan to attempt to evaluate these studies in the context of wolf reestablishment in Washington, and would add little value in terms of a management plan. For a more complete treatment on the theories of predator regulation, compensation, and other related topics on population dynamics, see Sinclair and Pech (1996).

Eberhardt et al. (2007) reported that predation by wolves has a much lower overall impact on ungulate populations than does antlerless harvest by hunters. Wolves primarily prey on young of the year and older individuals beyond their prime, both of which have lower reproductive value, whereas antlerless removals by hunters result in a greater proportional take of adult females of prime age. Thus, wolf predation has considerably less effect on reproductive rates and growth of populations. Eberhardt et al. (2007) also remarked that to maintain ungulate populations exposed to both hunting and predation by multiple species of large carnivores at or near carrying capacity, hunter harvests of females need to be conservative. Others have suggested consideration of winter severity, snow depth, ungulate population goals, and use of antlerless permits in an integrated ecological approach to wolf-ungulate management (DelGiudice et al. 2002, 2009).

As with other predators, wolf predation has the potential to threaten some small populations of prey, which often have a limited capacity to increase. In Washington, examples of such populations potentially include mountain caribou and certain herds of bighorn sheep.

Preliminary evidence suggests that wolf predation can reduce the occurrence of some diseases in prey populations through the removal of infected individuals, thus perhaps imparting an overall benefit to surviving animals (Wild et al. 2005, 2011, Barber-Meyer et al. 2007). For example, wolf predation could potentially reduce the prevalence of brucellosis in elk, an increasing problem in Wyoming, by reducing elk numbers and group sizes (Cross et al. 2010), or chronic wasting disease in deer (Wild et al. 2011). However, in situations where predation might cause greater herding behavior, increased transmission of other diseases could result (Barber-Meyer et al. 2007).

B. Recent Impacts of Wolves on Ungulates in Other States

Montana

Elk populations are considered to be at or above management objectives in most areas of Montana (Ballard 2009). Impacts of wolves on elk herds vary considerably with location, habitat, landownership, and management (Hamlin and Cunningham 2009, Hamlin et al. 2009). In a few locations with public lands managed for nature conservation and having few livestock and few predator-livestock conflicts, wolf and grizzly bear numbers have generally increased and contributed to decreasing elk numbers through predation or behavioral changes.

Wolf predation is one of several causes, along with high human harvest (including high antlerless take through 2005), drought, severe winters, and increased bear and cougar predation, contributing to a 72% decline (from about 16,800 to 4,600) in the northern Yellowstone elk herd from 1996 to 2010, which had existed at artificially high levels for decades due to declines and extirpations of large predators. As the wolf population expanded, it had an increasingly greater impact on this herd (Vucetich et al. 2005, White and Garrott 2005, Barber-Meyer et al. 2008). However, bear predation on elk calves has greatly increased over the last decade or two in and around Yellowstone National Park and is currently having a larger impact on elk recruitment than wolf predation (Barber-Meyer et al. 2008). Cougar densities have also increased in the park over the past decade (Hebblewhite and Smith 2010). The wolf population has fallen from a peak of 174 wolves in 2003 to 97 wolves in 2010, mostly because of the smaller elk population (USFWS et al. 2011).

The wintering Gallatin elk herd declined from about 1,500 to 225 elk between 2005 and 2009 due in part to the high numbers of wolves and grizzlies living in the area, but much of the decline is also related to the shift of many elk to neighboring winter range in the Madison Valley in response to high levels of hunter harvest and wolf and bear predation (Cunningham 2009). The West Fork of the Bitterroot elk population decreased from about 1,900 to 750 elk from 2005 to 2010 (MFWP 2010). Wolf predation is considered a main factor in the decline because cougar and black bear harvests in the area remain high, habitat conditions for elk are favorable, antlerless elk hunting opportunity was reduced, and poor weather has not occurred.

In contrast, on public multiple-use lands surrounded by private agricultural lands and in valleys that contain largely private agricultural ownership, lethal wolf control is practiced to remedy conflicts with livestock, which keeps local wolf densities low enough to minimize impacts on elk populations. This and other factors have allowed elk herds in two-thirds of the hunting districts in southwestern Montana (all of which support some wolves) to remain stable or expand. These areas currently allow some of the most liberal elk hunting opportunities seen in 30 years (J. Gude, pers. comm.).

Most information suggests that pregnancy rates, calf survival, and adult female survival of elk in Montana have not been affected by wolves, although cow and calf survival has declined in some areas with high numbers of wolves (Hamlin and Cunningham 2009, Hamlin et al. 2009, MFWP 2010). During the winter, wolves can have localized effects on elk distribution and movement rates, but such impacts are less than those created by human hunting activity (Hamlin and Cunningham 2009). Data suggest the possibility that wolves may have some effects on the larger-scale seasonal distribution of elk and the timing of elk migration in parts of southwestern Montana (Hamlin and Cunningham 2009).

Direct impacts on deer and other ungulates in Montana have not been well documented to date (C. Sime, pers. comm.), but an increase in mule deer abundance and recruitment has been noted in parts of southwestern Montana where elk abundance and recruitment have declined (Hamlin and Cunningham 2009). In northwestern Montana, where white-tailed deer are likely the primary prey of wolves (Boyd et al. 1994, Kunkel et al. 1999, Arjo et al. 2002), white-tailed deer numbers have increased during much of the period of wolf recovery. Recent decreases in deer numbers were associated with record or near record antlerless deer harvest and two severe winters (USFWS et al. 2009).

Idaho

A recent assessment by the Idaho Department of Fish and Game determined that 23 of 29 elk management zones in Idaho were within or above management goals for female elk (IDFG 2010a). An ongoing study in a representative sample of 11 elk management zones found that wolves were the primary cause of death of female elk in three of those zones (Lolo, Smoky Mountains, Sawtooth zones). Mountain lions either equaled or exceeded wolves as the primary cause of elk mortality in two additional elk management zones (Elk City, Salmon). Elk populations have been declining in these five zones since 1995 or earlier, and are below management objectives in the Smoky Mountains, Lolo, and Sawtooth zones. Hunter harvest was the primary cause of death in the other six zones.

Besides predation, other factors affecting elk survival include habitat conditions, weather, and hunter harvest. Severe winters and deteriorating habitat conditions have contributed to long-term declines in elk populations in the Sawtooth and Lolo zones (IDFG 2010a). The Lolo herd fell from 16,050 to 4,700 elk from 1989 to 2002-2003, when wolves were either absent or present in small numbers (IDFG 2010b). Since then, however, wolves have become the greatest source of mortality, accounting for 74% of deaths of cow and calf elk (IDFG 2010b). The total elk population in this zone numbered about 2,200 animals in 2010, with cow and calf elk survival below the rates needed for population growth.

IDFG (2008) has reported that wolves are possibly reducing success rates for some hunters in parts of the state without declining elk populations by changing the behavior and habitat use of elk during the hunting season. As observed in the greater Yellowstone ecosystem (Creel and Winnie 2005, Mao et al. 2005), Idaho's elk may now be spending more time in forested areas, on steeper slopes, and at higher elevations than before wolf reintroductions, making it more difficult for hunters to find animals. Changes in herding behavior and movement rates due to wolf- and human-predation risk (Proffitt et al. 2009) may also affect hunting success.

Wolves are believed to be a main factor in the recent decline of moose in the Lolo zone, but their impact on moose abundance in other parts of Idaho is not well known (J. Rachael, pers. comm.). Moose populations in some areas may be more directly affected by habitat changes, harvest levels, or other causes (S. Nadeau, pers. comm.). The impact of wolves on deer and other ungulates in the state appears negligible (J. Rachael, pers. comm.; S. Nadeau, pers. comm.), and white-tailed deer numbers increased moderately during the first decade of wolf recovery (IDFG 2004).

Wyoming

All 22 state-managed elk herds surveyed in Wyoming during the winter of 2008-2009 were at or above population objectives (Schilowsky 2009, J. Obrecht, cited in Ballard 2009), suggesting that wolves have had relatively little, if any, impact on elk abundance at the state level. Some of these herds occur in areas where wolf numbers are controlled to reduce conflicts with livestock, which has helped lessen impacts on elk (M. D. Jimenez, pers. comm.). Wolf predation is believed to be an important contributing factor in the decline of the Madison Headwaters elk herd at Yellowstone National Park (Hamlin et al. 2009) and the decline in calf/cow ratios in three elk sub-herds (Sunlight Basin, Gros Ventre, and Spring Mountain) in other parts of western Wyoming (M. D. Jimenez, pers. comm.).

To date, wolves have not had substantial effects on other ungulates in the state (White and Garrott 2005, White et al. 2008; M. D. Jimenez, pers. comm.). Wolves are considered a potential threat to populations of bighorn sheep and moose on their wintering ranges, but documented effects on such populations are lacking (WGFC 2008). A severe decline in moose has occurred in northwestern Wyoming since the late 1980s, but the decline has been primarily attributed to deteriorating habitat quality, with bear and wolf predation being a minor contributing factor (Becker 2008).

Minnesota, Wisconsin, and Michigan

In the Great Lakes region, where about 4,000 wolves occur, white-tailed deer populations are thriving and continue to be managed at relatively high densities with numbers often above local management goals (DelGiudice et al. 2009). Annual hunter harvest has remained high in the region, averaging 96,000 deer in Minnesota, 148,000 deer in Wisconsin, and 73,300 deer in Michigan. Wolves have been estimated to reduce the pre-harvest deer populations in Minnesota, Wisconsin, and Michigan by <15%, <1.8%, and about 1.3%, respectively (DelGiudice et al. 2009). In Wisconsin, a study that compared deer densities in deer management units with and without wolves from 1987 to 1997 found no significant differences in deer densities and recruitment (WDNR 1999). Habitat and climatic factors seem to have greater impacts on deer population trends in Wisconsin than wolf predation. Mech and Nelson (2000) concluded that wolf predation did not influence hunter harvest of deer in most areas of Minnesota, but did exert a negative impact in locations with low deer densities.

C. Ungulate Status in Washington

Elk

Elk are a highly valued resource in Washington. Ten major herds are recognized in the state (Figure 13) and range in size from estimates of 1,250 to over 13,000 animals (Table 11). These total

61,000 or more animals statewide, of which about 61% occur west of the Cascade crest. Additionally, smaller but unknown numbers of elk reside year-round on some tribal and federal lands (Figure 13), but are excluded from the herds recognized by WDFW. Elk are largely absent from a sizable portion of the state, including much of the Columbia Basin, much of Okanogan County, the North Cascades, and the Puget Sound region (Figure 13). Elk are not uniformly distributed within identified herd ranges, but instead are concentrated in some areas and less abundant or absent in other areas. Many herds display distinct seasonal movements, which also influence distribution. Animals generally occupy higher elevations in the summer and lower elevations in the winter (usually November to April).

The greatest source of adult and yearling elk mortality (55-69%) in those portions of the state examined thus far is legal harvest (including wounding loss); illegal killing accounted for an additional 5-14% of adult and yearling elk mortality (Table 12). About 8,000 elk are harvested annually in Washington, excluding kill by treaty tribes. Marked reductions in timber harvest, especially in western Washington, increased exclusion of fire in eastern Washington, and increasing human populations in elk habitat have reduced the state's carrying capacity for elk compared to past decades. However, in eastern Washington, some of this reduced capacity has been offset in recent years by the occurrence of large high-severity fires, which have created substantial areas of early successional forest (i.e., good foraging habitat). Each herd is different and has different management issues. Individual summaries of the 10 herds are provided below.

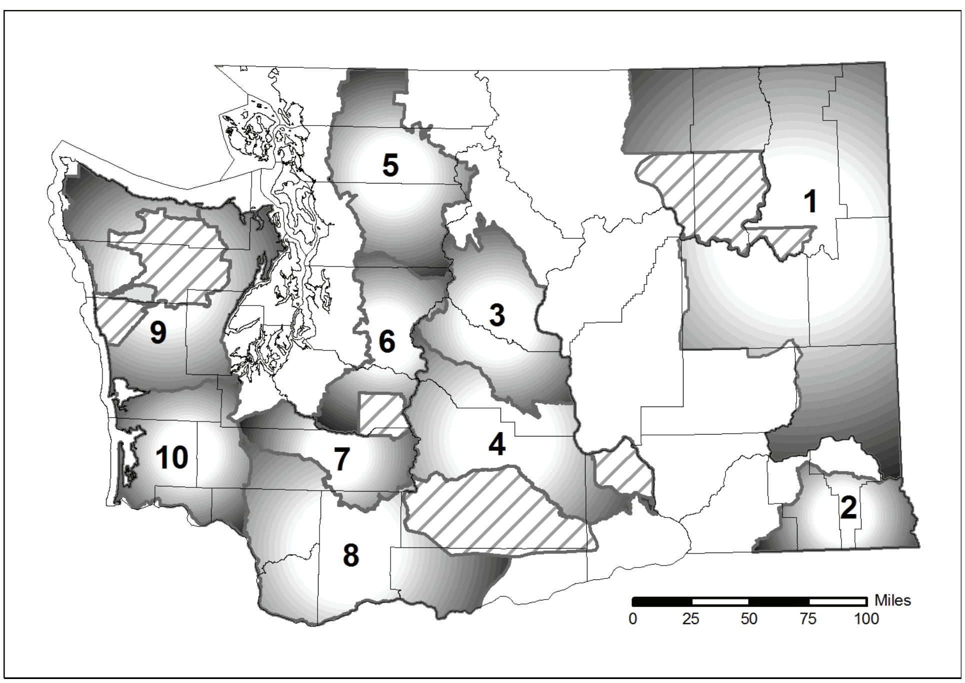


Figure 13. Ten major elk herds managed by WDFW in Washington (1, Selkirk herd; 2, Blue Mountains herd; 3, Colockum herd; 4, Yakima herd; 5, North Cascade (Nooksack) herd; 6, North Rainier herd; 7, South Rainier herd; 8, Mount St. Helens herd; 9, Olympic herd; and 10, Willapa Hills herd). Elk living year-round on some tribal and federal lands are not included in these herds, but their distribution is illustrated here (diagonal lines) to give a more complete depiction of elk distribution in the state.

Table 11. Current population estimates of the 10 major elk herds managed by WDFW in Washington (from WDFW 2008-2011). Estimates represent the number of elk present in each herd after the hunting season and before the calving season.

	Estimated herd size[a]	
Elk herd[b]	Eastern Washington	Western Washington
1. Selkirk	2,400	-
2. Blue Mountains	5,100	-
3. Colockum	4,880	-
4. Yakima	11,320[c]	-
5. North Cascade (Nooksack)	-	1,248
6. North Rainier	-	3,200
7. South Rainier	-	2,100
8. Mount St. Helens	-	>13,000[d]
9. Olympic	-	8,620
10. Willapa Hills	-	9,000-11,000
Total	23,700	37,168-39,168

[a] Excludes animals residing year-round on tribal and National Park Service lands. For example, an estimated 5,000 elk reside inside the Yakama Reservation (J. Bernatowicz, pers. comm.) and 3,060 elk are present inside Olympic National Park (Jenkins and Manley 2008).
[b] The herd numbers (1 through 10) used in this column correspond to those displayed in Figure 13.
[c] Includes the Rattlesnake Hills sub-herd.
[d] Estimating techniques for the Mount St. Helens herd are currently under improvement. Project completion and better estimates are anticipated in 2012.

Table 12. Examples of elk mortality in Washington.

		Cause of mortality (%)								
Herd(s) and age group	Sample size	Legal harvest	Wound-ing loss	— Illegal Killing	Malnu-trition	Preda-tion	Other natural causes	Vehicle and other accidents	Un-known causes	Source[a]
Adults, yearlings										
Mt. St. Helens, Olympic, Colockum	165	59	7	15	12	2	-	<2	3	1
Blue Mountains[b]	47	41	14	9	-	11[c]	-	-	25	2
Blue Mountains	78	60	5	5	1	13[d]	8	-	8	3
Yakima	39	56	13	13	13[e]	5[e]	-	-	-	4
Calves										
Blue Mountains	113	5	-	-	-	76[f]	-	2	16	5

[a] Source and dates of study: 1, Smith et al. (1994), 1988-1993; 2, Myers et al. (1999a), 1990-1996; 3, McCorquodale et al. (2010), 2003-2006; 4, McCorquodale et al. (2003) and S. M. McCorquodale (pers. comm.), 1992-1999; 5, Myers et al. (1999b), 1992-1998.
[b] Study results also included two capture-related mortalities and three cougar mortalities that were likely related to capture activities, but these are excluded here.
[c] Predation was attributed to cougars in three instances and undetermined predators in two instances.
[d] Cougar predation was confirmed in four instances and strongly suspected in five others (S. M. McCorquodale, pers. comm.). An undetermined predator was involved in one instance.
[e] In addition to the hunting-related losses cited in McCorquodale et al. (2003), S. M. McCorquodale (pers. comm.) reported that five elk were considered winterkill and two were killed by cougars.
[f] Predation was attributed to cougars (60% of predation losses), black bears (21%), coyotes (6%), and unknown predators (13%).

1. Selkirk Herd – Herd size totals about 2,400 elk, which represents substantial growth from an estimate of 1,200 animals in 2001 (WDFW 2001a, 2008). The management objective for this herd is being developed and will be finalized when the herd's management plan is completed. The herd is informally broken into two sub-herds known as (1) the Pend Oreille sub-herd located in Pend Oreille, Stevens, Ferry, eastern Okanogan, and northern Spokane counties, and (2) the Spokane sub-herd in southern Spokane, Lincoln, and Whitman counties. Habitat conditions in parts of the herd's range appear favorable for continued population growth for at least the near future (Zender and Base 2006). Damage to agricultural crops has been an ongoing problem at various sites south of the Spokane River and at a few farms in northern Pend Oreille County.

Current harvest management consists of:

1) A general hunting season for bulls or either-sex elk, depending on the Game Management Unit (GMU) and weapon type.
2) A special permit season for a limited number of either-sex elk in GMUs having any bull general seasons.
3) A tribal either-sex season conducted by the Colville, Spokane, and Kalispel tribes on their respective reservations and on the "North Half" (GMUs 101 and 204) by the Colville tribe.

2. Blue Mountains Herd –Recent herd estimates of about 5,100 elk are within the management objective of 4,800-5,900 elk (WDFW 2001b, 2008, Fowler and Wik 2010a). Abundance has been limited by habitat changes, loss of habitat, and past levels of antlerless and damage-related hunting. The herd occupies an area of about 900 mi^2. Elk damage to crops and fences is a continuing problem on the lowland portions of the herd's range.

Current harvest management consists of:

1) A general season for spike bulls or antlerless elk, depending on GMU and weapon type.
2) A special permit season for a limited number of any bulls, 3-point minimum bulls, or antlerless elk, depending on GMU and weapon type.
3) A tribal either-sex season held by the Umatilla and Nez Perce tribes.

3. Colockum Herd – This herd has shown a declining trend since the late 1990s due to high antlerless and damage-related harvest and hard winters in the early 1990s (WDFW 2006a). However, the most recent herd estimate totals about 4,880 elk, which is at the desired population objective of 4,100-5,000 animals (J. Bernatowicz, pers. comm. 2011). The herd inhabits about 1,600 mi^2, with most use occurring in the eastern half of the area. Elk damage on private lands has been a problem at a number of locations since the late 1980s.

Current harvest management consists of:

1) A general season for spike bulls or either-sex elk, depending on GMU and weapon type.
2) A special permit season for small numbers of bulls or antlerless elk, depending on GMU and weapon type, mostly to address agricultural damage.
3) A tribal either-sex season held by the Yakama Nation.

4. Yakima Herd – Total numbers in this herd were about 11,320 elk as of 2011. About 10,550 elk occur in the Cascade Slope sub-herd that resides west of the Yakima River, whereas the much smaller Rattlesnake Hills sub-herd, numbering about 770 animals, is centered on the Arid Lands Ecology Reserve and Yakima Training Center east of the Yakima River (WDFW 2002a, 2008, unpubl. data; Bernatowicz and Livingston 2010). The main sub-herd is considered at management objective at 10,550 (WDFW 2008). The herd size estimate of 11,320 does not include an additional estimated 5,000 elk residing year-round on the Yakama Reservation (J. Bernatowicz, pers. comm.). Two unique aspects of management of this herd come from the extensive crop damage that it has caused dating back to the early 1900s. This has resulted in the building and maintenance of more than 100 miles of elk-proof fencing to keep animals out of high value croplands and orchards. Because the fences block elk from their historical winter range, WDFW conducts a large-scale winter-feeding program at nine sites to keep animals at higher elevations (see Section D of this chapter for more information on the winter-feeding of this herd).

Current harvest management consists of:

1) A general season for spike bulls or antlerless elk, depending on GMU and weapon type.
2) A special permit season for a limited number of bulls, antlerless elk, or either-sex elk, depending on GMU and weapon type.
3) Some tribal either-sex hunting by the Yakama nation and Umatilla tribe.

5. North Cascade Herd – This herd, also known as the Nooksack herd, is the smallest in Washington and currently numbers about 1,248 elk (S. McCorquodale, pers. comm. 2011). The remains below the population objective of 1,750-2,150 animals, but the herd has shown positive growth in recent years (WDFW 2002b, 2008). Augmentation efforts in 2003 and 2005 added reproductive-aged females and calves to the herd. The core population currently inhabits about 500 mi^2 between the Skagit River and Mt. Baker (WDFW 2002b). Intensive logging and loss of winter range from urban development and agricultural conversion are the main threats to the herd. Elk cause some agricultural damage in the Skagit River valley.

Current harvest management consists of:

1) A general season for 3-point minimum bulls or antlerless elk, depending on GMU and weapon type.
2) A special permit season for a small number (less than 20 at this writing) of any bulls, depending on GMU and weapon type.
3) An equally limited number of elk permits authorized by the Point Elliot Treaty tribes for tribal members.

6. North Rainier Herd – Herd size totals about 3,200 elk, which is above the management objective of 2,520-3,080 animals (R. Link, pers. comm. 2011). The bulk of the herd ranges over a 2,800-mi^2 area of eastern King and Pierce counties. Herd numbers declined 46% from 1989 to 2000 (WDFW 2002c), but have since stabilized. The decline was attributed to several interrelated factors including antlerless harvest, predation, a decline in habitat quantity and quality due to forest succession, low calf survival, and poor nutrition.

Current harvest management consists of:

1) A general season for any bull, 3-point minimum bulls, or antlerless elk, depending on GMU and weapon type.
2) A special permit season for a small number of bulls in GMUs 485 and 653.
3) Tribal either-sex or bull-only hunts (depending on GMU) by the Medicine Creek Treaty and Point Elliot Treaty tribes.

7. South Rainier Herd – This herd contains about 2,100 elk, which is below the desired objective of 2,700-3,300 animals (WDFW 2002d, 2008). Most of the herd occupies a 1,000-mi^2 area of northern Lewis and southern Thurston counties and southern Mt. Rainier National Park. WDFW has tried to balance the desire to meet the current population objective, maintain hunting opportunity, and address depredation on crops. Agricultural and property damage by the elk herd has increased over the past 10-15 years.

Current harvest management consists of:

1) A general season for 3-point minimum bulls or antlerless elk, depending on GMU and weapon type.
2) A tribal either-sex season by the Medicine Creek Treaty tribes.

8. Mount St. Helens Herd – This is one of the largest herds in the state, with over 13,000 elk (WDFW 2006b, 2008). Management objectives call for numbers to be reduced to 9,000-11,000 animals by 2015, primarily through expanded antlerless harvest. Abundance is highest in south-central Lewis, Cowlitz, and northern and central Skamania counties (WDFW 2006b). Numbers are relatively low in the southern portion of the herd's range (GMUs 564, 568, 574, 578, and 388), where liberal harvests of elk are conducted to enhance deer abundance and minimize conflicts. Wintering elk in the Toutle River valley, which typically comprise only about 3-6% of the herd, occasionally suffer substantial mortality from malnutrition caused by winter weather conditions and declining forage quality (WDFW 2006b). Chronic elk damage to agriculture and commercial forestlands occurs in several areas and has become more widespread in recent years.

Current harvest management consists of:

1) A general season for 3-point minimum bulls, antlerless elk, or either-sex elk, depending on GMU and weapon type.
2) A special permit season for bulls or antlerless elk, depending on GMU and weapon type.
3) No tribal harvest occurs.

9. Olympic Herd – This herd holds an estimated 8,620 elk and has shown some recent population growth, but remains below the management objective of 10,200-12,500 animals (WDFW 2005b, 2008). These numbers exclude Olympic National Park, where an additional 3,060 elk are estimated to reside year-round (Jenkins and Manley 2008). Elk abundance is highest on the west side of the Olympic Mountains, followed by several southern drainages (WDFW 2005b, Jenkins and Manley 2008). Elk are less common on the northeast and east sides of the Olympic Peninsula, where small groups are generally present. Restrictions on antlerless harvest have allowed the herd to increase over the past decade. Damage caused by the herd is generally restricted to a few localized areas.

Current harvest management consists of:

1) A general season for 3-point minimum bulls or antlerless elk, depending on GMU and weapon type.
2) A special permit season for small numbers of any bull or 3-point minimum bulls, depending on GMU and weapon type, mostly to address agricultural damage issues.
3) A tribal either-sex hunt by nine treaty tribes on the Olympic Peninsula.

10. Willapa Hills Herd – This herd occurs almost entirely on private industrial timberland and numbers an estimated 9,000-11,000 animals (J. Nelson, pers. comm. 2011). A herd management

plan is being prepared by WDFW, which will include management objectives. Little research has been conducted on the biology of this herd, but one current study suggests that survival among adult bulls is below herd objectives. The herd causes only minor agricultural damage.
Current harvest management consists of:

1) A general season for 3-point minimum bulls, antlerless elk, or either-sex elk, depending on GMU and weapon type.
2) A special permit season for small numbers of antlerless elk, depending on GMU and weapon type, mostly to address agricultural damage issues.
3) No tribal harvest occurs.

Deer

Two species of deer, represented by four subspecies, occur in Washington: mule deer, black-tailed deer, white-tailed deer, and Columbian white-tailed deer (Figure 14). Total deer numbers in the state are estimated at roughly 300,000 animals (after hunting season and before fawning season; J. Nelson, pers. comm.), with population trends varying by species and location. From 2000 to 2010, hunters harvested an average of about 38,600 (range of 34,000 to 44,500) deer annually in Washington, which was divided fairly equally among black-tailed deer, white-tailed deer, and mule deer (Nelson 2009; WDFW unpubl. data). Deer generally prefer habitat in early to mid-successional stages. Reductions in clear-cutting, fire exclusion in eastern Washington, and other changes in forest management practices on public lands and expanding human development in low elevation habitats have caused a decline in deer abundance in Washington since the early 1980s (Nelson 2009). However, some of the loss of suitable habitat for deer has been offset in recent years by the

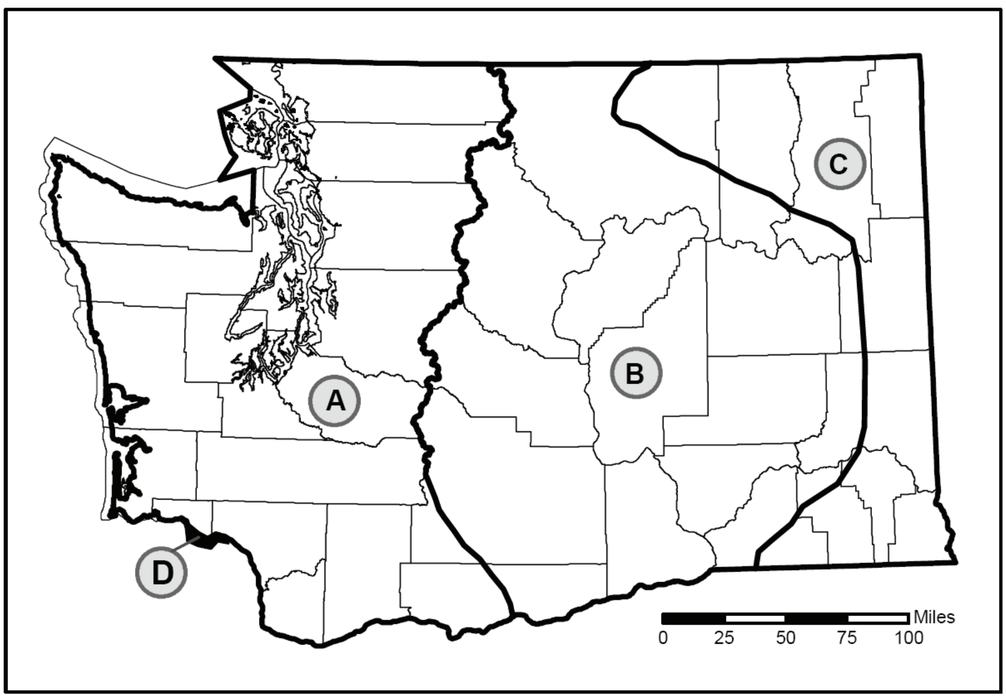


Figure 14. Distribution of four deer subspecies in Washington (A = black-tailed deer; B = mule deer, C = mule deer and white-tailed deer, D = Columbian white-tailed deer and black-tailed deer). Some overlap of subspecies occurs along the depicted range boundaries.

increased occurrence of large fires of severe intensity in eastern Washington, which have created large areas of early successional forest.

Unlike elk, deer in Washington are not currently assigned to or managed as herds. Instead, WDFW manages deer harvest by Population Management Units (PMU), which are defined geographic areas usually comprised of multiple game management units. Population estimates are generally unavailable for specific PMUs, but population trends are tracked using harvest and survey data. WDFW's goal for managing black-tailed deer, mule deer, and white-tailed deer populations is to maintain numbers within habitat limitations, while taking into account landowner tolerance, a sustainable harvest objective, and interests in non-consumptive opportunities. Deer-related damage to agricultural land and residential properties is widespread and will continue to increase as human activity expands across traditional deer habitat. Deer-vehicle collisions are a problem in some areas (Myers et al. 2008).

White-tailed Deer

White-tailed deer occur primarily in the eastern quarter of Washington (Figure 14). Total population estimates are beyond the scope of WDFW's budget and staffing resources (WDFW 2010a), but white-tailed deer numbers statewide are probably somewhat higher than for mule deer or black-tailed deer. Densities are highest in Pend Oreille, Stevens, and Ferry counties. Population trends have been gradually declining in these counties since the early 1990s due in part to a substantial reduction in grain and alfalfa production (WDFW 2010a). Trends are generally stable or increasing elsewhere.

White-tailed deer commonly undertake seasonal movements in elevation in many areas of their Washington distribution. Populations are influenced significantly by winter severity and tend to increase during years with mild winters and experience major declines during severe or protracted winters. Outbreaks of epizootic hemorrhagic disease have also produced some temporary localized declines. White-tailed deer have one of the highest potential maximum rates of increase of any North American ungulate due to their early age at first reproduction and ability to produce twins when nutritionally fit. Coupled with a higher tolerance for human disturbance and agriculture, white-tailed deer can persist and thrive in Washington. These traits make the white-tailed deer somewhat less susceptible to harvest level than mule deer.

Estimated numbers of white-tailed deer harvested in Washington have been variable but with a slightly declining trend since 2001, with an average annual kill of about 13,200 animals from 2001 to 2010 (WDFW 2008, unpubl. data). Current harvest management consists of:

1) An early general season in October for bucks as well as either-sex hunts in many locations for youth, seniors, and hunters with disabilities. Some GMUs have antler point restrictions.
2) A late general season for bucks in November, with some antlerless opportunity for youth, seniors, and hunters with disabilities.
3) Early (September) and late (November-December) archery seasons for either-sex or antlerless deer, or 3-point minimum bucks.
4) Early (September) and late (November-December, with a limited number of GMUs) muzzleloader seasons for either-sex or antlerless deer, or 3-point minimum or any bucks.
5) A late (December) general season for antlerless deer in a limited number of GMUs.

6) A substantial number of special permits are offered for antlerless or any deer, with a more limited number of late season buck special permits for quality hunts.
7) Tribal either-sex seasons held by the Colville, Spokane, Umatilla, and Nez Perce tribes.

Columbian white-tailed deer

This subspecies is state and federally listed as endangered in Washington. Information on population size and distribution is presented in Chapter 6, Section C.

Mule Deer

Mule deer are distributed throughout eastern Washington (Figure 14). Total population size is unknown. Densities are currently highest in Okanogan County, but are probably declining there because of a long-term reduction in landscape carrying capacity (Fitkin and Heinlen 2010). Populations have also been declining in the southern Cascades since about 2003 due in part to the expansion of the exotic louse *Bovicola tibialis* (Bernatowicz 2010). Elsewhere, numbers appear to be stable or gradually increasing since the late 1990s (Nelson 2009, WDFW 2010b). Most mule deer in Washington undertake seasonal elevational movements and the species is considered more reliant on access to winter range than other deer in the state. Population levels are closely tied to winter severity and are sensitive to overharvest. The species is also more vulnerable than white-tailed deer to suburban sprawl, agricultural expansion, fire suppression, and ecological succession of younger-aged habitat. These factors suggest that mule deer in Washington may experience declining trends in the future.

Statewide harvest of mule deer showed a declining trend 2001 to 2010, averaging about 11,600 animals per year (WDFW 2008, unpubl. data). Current harvest management consists of:
1) An early general season in October for bucks having at least three antler points on one side.
2) Early (September) and late (November-December) archery seasons for antlerless deer or 3-point minimum bucks. Antlerless hunting is allowed during archery if population numbers can sustain the pressure. Currently, antlerless hunting is not offered in central Washington due to low mule deer numbers.
3) Early (September) and late (November-December) muzzleloader seasons primarily for 3-point minimum bucks, with a very limited number of GMUs open for late muzzleloader (November-December).
4) Antlerless special permits are offered when populations can sustain the pressure. A limited number of late season buck special permits are offered for quality hunts, mostly in Chelan, Okanogan, and Douglas counties.
5) Tribal harvest by the Colville, Spokane, and Yakama tribes.

Black-tailed Deer

Black-tailed deer occur throughout western Washington (Figure 14). No estimates of total population size exist, but harvest data suggest that densities are highest in Cowlitz, Lewis, San Juan, and portions of Thurston and Grays Harbor counties. Black-tailed deer numbers appear to be stable throughout their range in Washington (WDFW 2008). Some animals move elevationally in response to seasonal conditions, but the extent of this behavior is less than in either mule deer or white-tailed deer. Hairloss syndrome has had some localized impacts on abundance in recent decades, but the effects are usually short-term. Habitat for black-tailed deer has been reduced in western Washington due to reductions in timber harvest, natural succession of aging timber stands, and expansion of human development. These changes are expected to result in a gradual decline in overall abundance in the future. Black-tailed deer readily hybridize with mule deer where their ranges meet in Washington, especially in the southeastern Cascades and parts of Klickitat County.

Estimated numbers of black-tailed deer harvested in Washington have declined over the past decade, with an average annual kill of about 13,600 animals between 2001 and 2010 (Nelson 2009; WDFW, unpubl. data). Current harvest management consists of:

1) Early (October) and late (November) general seasons primarily for bucks. Some GMUs are restricted to 2-point minimum bucks or either-sex deer.
2) Early (September) and late (November-December) archery seasons for either-sex deer, 2-point minimum bucks, or bucks only.
3) Early (October) and late (November-December) muzzleloader seasons for bucks only or either-sex deer.
4) Antlerless special permits are offered when populations can sustain the pressure. A limited number of late season special permits for bucks are offered for quality hunts.

Moose

Numbers of moose in Washington increased from about 60 in 1972 to about 1,500-2,000 in 2007 (S. Zender and H. Ferguson, pers. comm. in WDFW 2008), corresponding to an average annual increase in population size of 9.6-10.5%. This growth is the result of greater moose density in prime habitats and colonization of animals into new areas. Moose primarily occur in Pend Oreille, Spokane, Stevens, Ferry, and Okanogan counties (Figure 15). They are occasionally recorded in Chelan, Lincoln, Whitman, and Whatcom counties, with a few dispersing animals documented in more distant areas. Small numbers of moose are in the process of colonizing the Blue Mountains in Asotin, Garfield, Columbia, and Walla Walla counties, but have not yet formed a breeding population there.

Moose generally occur above 3,000 feet in elevation (S. Zender, pers. comm.) and prefer dense thickets of willows and other hardwood shrubs that are frequently associated with 15-25-year-old clear cuts or thinnings on mesic sites (Shepherd and Base 2010). Forest successional conditions in northeastern Washington generally appear to be excellent for moose and will likely remain so over the next few decades, thus moose numbers are expected to continue at current levels or gradually increase for some time. Harvests are currently by permit only and have totaled about 90-120 animals annually in recent years (Shepherd and Base 2010; D. A. Martorello, unpubl. data). Moose occasionally become a nuisance or create problems for human safety, but agricultural damage has not been reported.

Bighorn Sheep

Washington's population of bighorn sheep currently numbers about 1,670-1,740 animals distributed in 17 isolated herds distributed in the Cascades, northeastern Washington, and the Blue Mountains (Figure 16; WDFW 2010b). Herd size averages about 100 sheep and ranges from about 10 to 210. Populations are increasing in eight herds, stable in seven herds, and declining in two herds. The

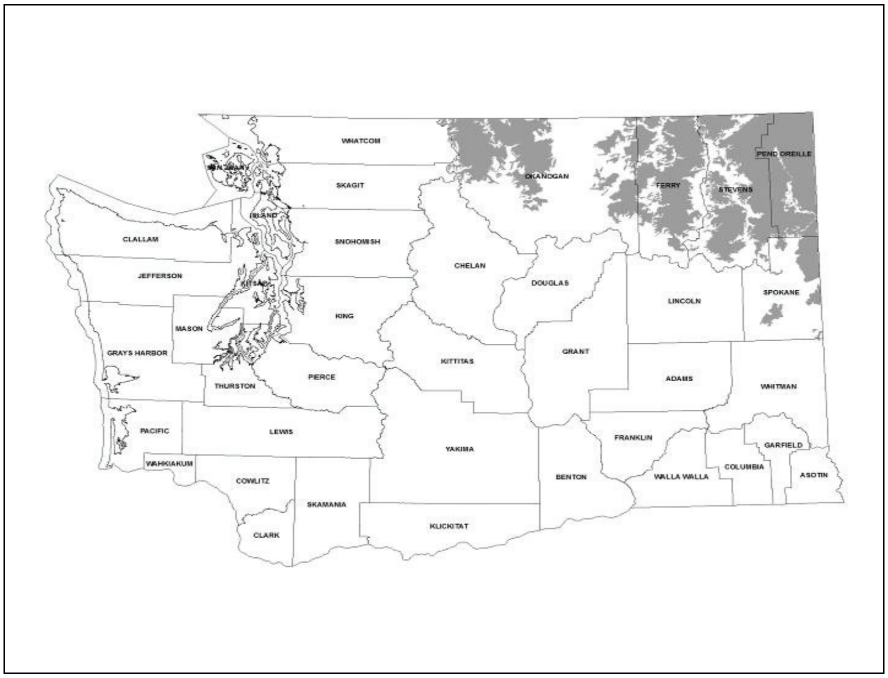


Figure 15. Primary distribution (shaded area) of moose in Washington.

statewide population estimate is beneath the desired objective of 1,750-2,130 sheep, which is based on potential habitat capacity (WDFW 2008). Diseases and parasites from domestic sheep are the primary causes for decline (e.g., Fowler and Wik 2010b), but many herds are also limited by habitat availability. Harvests are currently by permit only and have increased in recent years to 37 animals in 2010 (WDFW, unpubl. data).

Mountain Goats

Mountain goat populations have been declining in Washington for many years. Current numbers total about 2,400 animals, with nearly all populations located in the Cascade and Olympic Mountains (Figure 17; Martorello 2010b). A few populations appear to be stable or slightly increasing, including those in the southern Cascades, along the north shore of Lake Chelan, around Mt. Baker, in the Methow region, and in the Olympics. Historical overharvest, impacts of timber harvest on wintering habitat, degradation and loss of alpine meadows, and increasing human recreational use and disturbance of alpine habitat likely have had the greatest negative impacts on abundance. Hunting opportunity and total harvest have decreased with falling populations. Harvests are currently by permit only and totaled 14 goats in 2010 (WDFW, unpubl. data).

Mountain Caribou

Washington's population of mountain caribou is state and federally listed as endangered. Information on numbers and distribution is presented in Chapter 6, Section C.

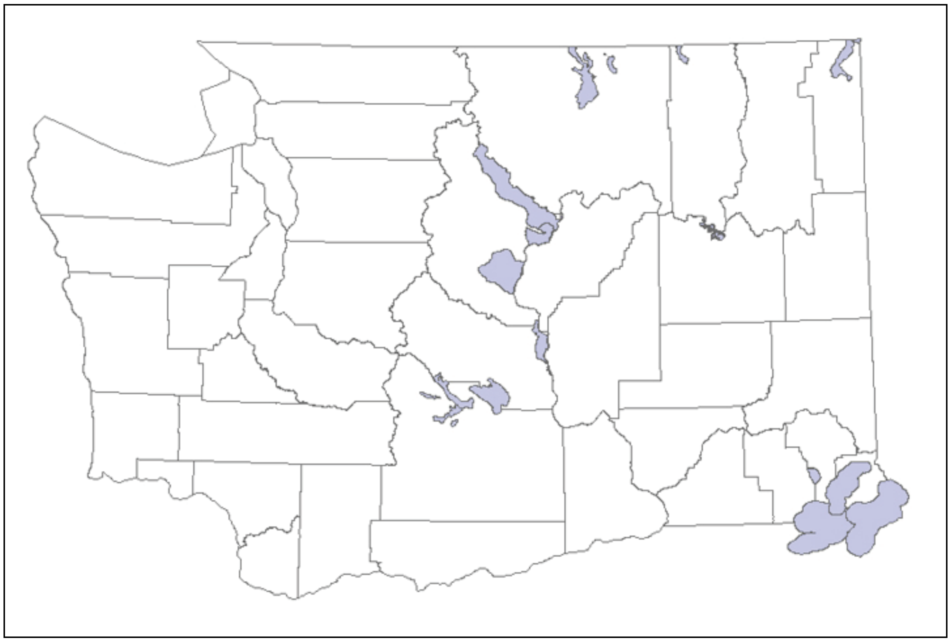


Figure 16. Distribution (shaded areas) of bighorn sheep in Washington.

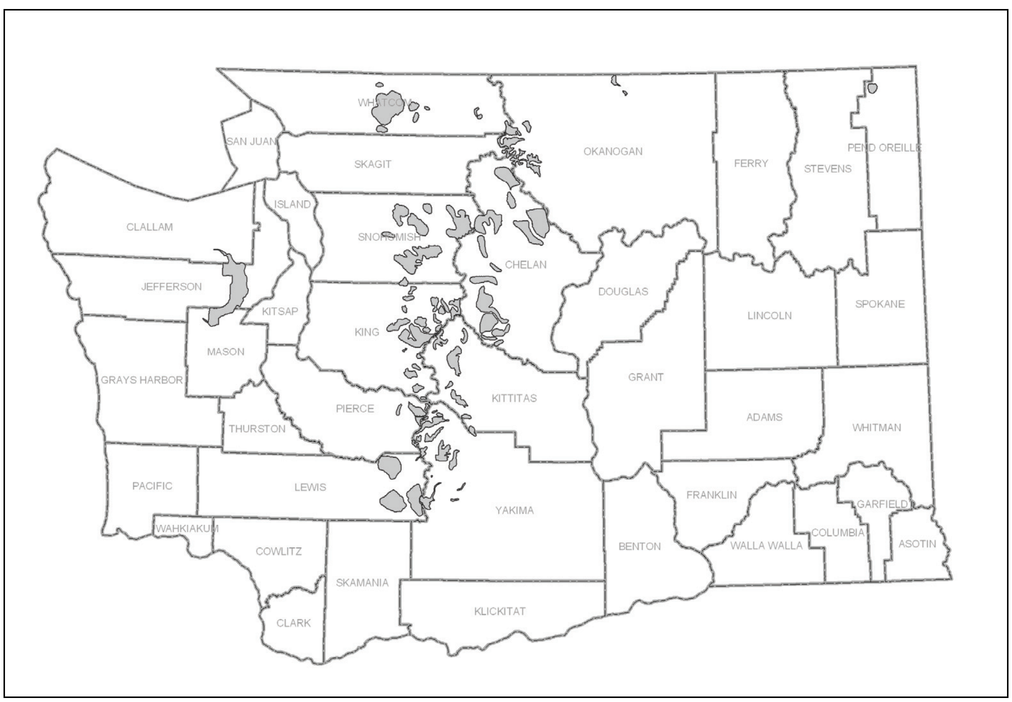


Figure 17. Approximate distribution (shaded areas) of mountain goats in Washington.

D. Wolf-Ungulate Interactions on Wintering Grounds

WDFW is mandated by statute (RCW 77.36) to address damage to commercial agricultural crops, orchards, and vineyards caused by elk and deer, which occurs primarily in the winter. Two of the methods used to accomplish this have been fencing and supplemental winter feeding to keep animals at higher elevations away from agricultural sites. About 100 miles of 8-ft-tall elk-proof fence exist in Yakima and Kittitas counties and border nine permanent feeding stations. An additional 27 miles of elk fence run between the Wooten and Asotin Wildlife Areas in the northern Blue Mountains to segregate elk from agricultural lands. Fencing along Highway 97A north of Wenatchee is also being built to keep mule deer and bighorn sheep off the highway. WDFW conducts winter elk feeding operations at nine permanent feeding stations in Yakima and Kittitas counties. Feeding starts as soon as elk arrive in significant numbers (usually in December) and lasts until animals depart during spring green-up. An estimated 70% of the main Yakima sub-herd, or about 6,500-6,800 elk, is fed during typical winters (J. Bernatowicz, pers. comm.), although up to 90% of the sub-herd visits feeding sites during harsh winters with extreme snow depths. Sub-herd use of these feeding stations is predicted to gradually increase in the future. Up to 200 bighorn sheep also make use of one feeding site.

How wolves will interact with ungulates at fenced sites and winter feeding stations in Washington is mostly speculative. Fencing will likely impede ungulate escape and facilitate capture by wolves. Presence of wolves near feeding stations and at other fenced locations will probably increase management costs for WDFW (e.g., see discussion below for Wyoming). Reasons for this may include (1) increased fence maintenance if elk are pushed into or break through fences by wolf activity, (2) increased transport and manpower costs associated with hauling feed to more dispersed locations, (3) higher costs for conducting winter population surveys, and (4) changes in disposal or burial practices for elk carcasses at feeding stations. Some nearby landowners may also experience financial losses if wolves cause elk to break through fences and enter croplands. Furthermore, wolves could potentially follow elk onto farmlands, thereby possibly increasing wolf-livestock conflicts. These situations will be evaluated on a case-specific basis to determine if management responses are needed and, if so, what the responses should be (Chapter 12, Section 5.3).

Observations from winter feeding stations in Wyoming may be instructive for determining the types of interactions between wolves and elk that might occur at these locations in Washington. Dean et al. (2003) reported that wolf visitation increased from one of Wyoming's state-operated 22 feeding sites in 1999 to 14 sites by 2003. Total numbers of elk killed by wolves at these sites were insignificant when compared to herd size. In four of the five years between 1999 and 2003, wolves killed a total of fewer than 30 elk per year. Wolves tended to select for elk calves when hunting at feeding stations. Attempted predation by wolves sometimes temporarily displaced elk less than 3 miles from feeding sites for as long as a day. On occasion, elk moved up to 30 miles away and relocated to another feeding station, or were displaced onto private lands, where they created conflicts with livestock and landowners. None of the feeding sites were ever completely abandoned by elk during any given winter.

Elk at Wyoming feeding stations commonly responded to the presence of wolves by banding together in larger than normal herds, which increased potential competition between elk, damage to soil and vegetation, and possibly disease transmission (Dean et al. 2003). However, some management benefits were gained because elk diversified their use of feeding stations and moved sooner to spring transitional ranges. The unpredictable movements of elk in response to wolf activity created logistical problems for the Wyoming Game and Fish Department, which needed to increase the amount of hay purchased and stored for the program. During mild winters, elk made less use of feeding stations and more animals were dispersed in the surrounding landscape. In response, wolf packs made fewer visits to stations and preyed more frequently on animals in poorer condition than those being fed. Wolf-elk interactions at Wyoming winter feeding stations have changed little since Dean et al.'s (2003) report (M. D. Jimenez, pers. comm.). Wolves continue to kill relatively small numbers of elk in and around the stations each winter, and incidences of surplus killing of elk are rare. Wolves and coyotes are known to key in on fence lines and follow them while searching for prey (M. D. Jimenez, pers. comm.). However, increased fence breaching by elk has not been noted in wolf-occupied areas in Wyoming and few if any fence-related injuries to elk have been recorded.

Winter feeding of elk and deer also occurs in Idaho, but on a much smaller scale than in Wyoming. Most sites operate infrequently or on an emergency basis. Wolves do visit some winter feeding stations, but have not caused significant losses or other problems at these locations to date (J. Rachael, pers. comm.).

E. Predicted Levels of Wolf Predation on Ungulates in Washington

Wolf diets in Washington are expected to be similar to those in Idaho, Montana, and Wyoming, with elk and deer being the primary prey species. Prey selection will likely vary among locations based on species availability and vulnerability, and variation in season, local terrain, and other factors. In areas of the state with few or no elk, deer will undoubtedly serve as the primary prey. Moose, which are widely distributed in northeastern Washington, may also contribute significantly to diets in that area. Predation on bighorn sheep and mountain goats will probably be minor. For mountain goats, range overlap with wolves is most likely to occur in the spring as wolves follow other prey to higher elevations and encounter goats still lingering in mid- to high elevation forests used during winter (C. Rice, pers. comm.).

It is difficult to predict with confidence the impacts that different population sizes of wolves will have on ungulate populations and hunter harvest in Washington. This is due largely to the many uncertainties involving where and how rapidly wolves become reestablished, their eventual abundance and diet composition, prey species behavior and population changes, hunter and agency responses, and other influences. For these reasons, the effects of wolf predation on ungulate populations are highly situation-specific (Garrott et al. 2005).

Keeping these limitations in mind, some general approximations of wolf predation levels are presented in Table 13 using dietary information from elsewhere in North America. Total populations of 50 and 100 wolves are expected to have minor overall impacts on Washington's ungulate populations. Fifty wolves may kill about 425-630 elk and 700-1,050 deer per year, with annual take doubling for 100 wolves (see Table 13 for an explanation of these estimates). These levels of predation could result in noticeable effects on elk and deer abundance in some localized areas occupied by wolf packs, but should not have broad-scale impacts. These levels of loss potentially represent 1-2% of the state's elk population and less than 1% of the combined deer population. With larger populations of wolves, greater numbers of ungulates would be removed

Table 13. Projected numbers of elk and deer that may be killed annually by four different population size categories of wolves in Washington. As described in Section A of this chapter, these estimates may not be accurate because they are based only on winter kill rates when predation rates are highest. They also fail to consider the number of fawns, elk calves, and supplementary prey eaten. Because of these reasons and the absence of biological data on wolves living in Washington, numbers presented here should be considered as very rough approximations.

	Population size category			
Number of wolves present	50	100	200	300
Estimated total no. of prey killed per year[a]	1,130-1,675	2,260-3,350	4,520-6,700	6,780-10,050
Estimated no. of elk killed per year[a]	425-630	850-1,260	1,700-2,520	2,550-3,780
Estimated no. of deer killed per year[a]	705-1,045	1,410-2,090	2,820-4,180	4,230-6,270

[a] Numbers represent the estimated range in numbers of prey killed by different sizes of wolf populations based on (1) an average winter kill rate of 7.2 kg/wolf/day (derived from Table 5.5 in Mech and Peterson [2003]) plus or minus 20%, (2) average body weights of 150 kg per elk and 60 kg per deer, and (3) a diet of 60% elk and 40% deer by biomass (see Table 2). Because of the large differences in body weight between elk and deer, fewer elk than deer are expected to be killed. Estimates given here are based on an average annual kill rate of 8.5-12.6 elk and 14.1-20.9 deer per wolf, or about 22.6-33.5 ungulates total per wolf.

annually, with perhaps 1,700-3,800 elk and 2,800-6,300 deer taken if 200-300 wolves became reestablished (Table 13).

Populations of 50 to 100 wolves should have few negative effects on big game hunting in Washington, as demonstrated by the relatively small estimated take of ungulates described above (by comparison, Washington hunters kill about 7,900 elk and 38,600 deer annually). As noted elsewhere (Creel and Winnie 2005, Mao et al. 2005, Proffitt et al. 2009), wolves may also cause some redistribution of game, which could make these species somewhat less vulnerable to hunter harvest. However, these impacts together would be restricted to the relatively few areas occupied by packs during the early to middle stages of recovery and would probably not reduce statewide harvests of elk and deer by more than 1-3%. Larger wolf populations would be expected to have greater impacts on game and hunting opportunity, but such impacts become increasingly difficult to predict or measure. To accommodate larger elk and deer losses from wolves, reductions in antlerless take and perhaps other restrictions such as shortened hunting seasons or reduced availability of special permits may be needed in some areas where wolves become common. Additional discussion of wolf-related impacts on hunter harvest and hunting revenue is presented in Chapter 14, Section C.

F. Management of Wolf-Ungulate Interactions in Washington

Wolves are expected to inhabit areas of Washington with abundant prey that already support multiple species of predators and recreational hunting. The effect on ungulate populations from adding wolves to existing predation levels and hunter harvest is difficult to predict, but information from other states with wolves suggests that wolves will have little or no effect on elk and deer abundance or hunter harvest across large areas of Washington. While wolves have been linked to declining elk herds in some areas, they are often one of several contributing factors (e.g., increasing populations of other predators, changes in habitat, severe winter weather, and drought) affecting the herds, as described in Section B of this chapter.

Maintaining robust prey populations will benefit wolf conservation in Washington by providing adequate prey for wolves, supplying hunters and recreational viewers of wildlife with continued opportunities for hunting and seeing game, and reducing the potential for livestock depredation. Implementation of WDFW game management plans for ungulates (WDFW 2001a, b, 2002a-d, 2005b, 2006 a-c, 2008, 2010) should result in achieving healthy population objectives for elk, deer, and other species. This goal would be accomplished primarily through habitat improvement, harvest management, and minimizing illegal hunting (see Chapter 12, Task 5, for more detail). Harvest objectives may need to be adjusted if overall predation levels increase, and they should be compatible with long-term sustainable populations of predators and prey.

During recovery stages, while wolves are listed in Washington, it is unlikely that they will have a significant negative effect on ungulate populations in the state. However, if WDFW determined that wolf predation was a primary limiting factor for an "at-risk" ungulate population, and the wolf population in that wolf recovery region was at least 4 successful breeding pairs, WDFW could consider reducing wolf abundance in the localized area occupied by the ungulate population before state delisting occurs.

For the purposes of this plan, an at-risk ungulate population is any federal or state listed ungulate population (e.g., Selkirk Mountain woodland caribou, Columbian white-tailed deer). An at-risk population would also include any ungulate population which falls 25% below its population objective for two consecutive years and/or if the harvest decreases by 25% below the 10-year average harvest rate for two consecutive years. In ungulate populations without numeric estimates and/or without management objectives, the Department will rely on other factors of information to assess a decline, such as harvest trends, hunter effort trends, sex and age ratios, and others.

Under this form of management, wolves would be controlled by moving them to other areas, through lethal control, and/or with other control techniques. While wolves are recovering, non-lethal solutions will be prioritized to be used first. Before deciding to proceed with this type of management, WDFW would consider the status of wolves statewide as well as within the specific wolf recovery region where the ungulate impact is occurring. The extent of wolf control undertaken would not be sufficient to push the region's overall wolf population below delisting objectives and put it at risk. Management decisions of this type would be based on scientific principles and evaluated by WDFW.

Authority for the "take" of wildlife exists with the director of WDFW under state law RCW 77.12.240.

WDFW used the population persistence model (Appendix G) to evaluate the effect of conducting wolf management in response to ungulate population concerns when recovery objectives for delisting had been met in one wolf recovery region, but not in the other two regions (Appendix H, scenarios 6-9). All of the scenarios used the Eastern Washington recovery region, which has the smallest number of potential territories, as the example of a region that had met recovery objectives. All scenarios assumed that 1 of the 5 breeding pairs in Eastern Washington was in the Blue Mountains. Scenarios 6 and 8 evaluated the effects statewide, whereas scenarios 7 and 9 evaluated the effects within the region.

The resulting analyses suggested that under scenarios 6 and 8, the proposed option to manage wolves in the Eastern Washington recovery region before achieving statewide delisting was not likely to inhibit the ability to achieve recovery statewide, in all three regions, over time. Within the Eastern Washington recovery region, under scenario 7, with immigration, there was some risk (7%) of not achieving recovery within the recovery region. Under scenario 9, with no immigration, there was a much higher risk (48%) of failing to achieve recovery in the Eastern Washington recovery region.

6. WOLF INTERACTIONS WITH OTHER SPECIES

This chapter describes potential interactions between gray wolves and other species, including federal and state listed species. With the prospect of wolves entering Washington, much of the overall discussion and concern about wolves has centered on interactions with livestock and ungulates. However, wolves will also interact with a host of other species, including other carnivores such as cougars and coyotes, as well as other mammals and birds. Many of these interactions will have immediate implications for either wolves or the species in question; other interactions may be more subtle, long-term, and difficult to directly relate to wolves. As with livestock and ungulates, the extent of wolf-related impacts on non-prey species and ecosystems in Washington will depend on where and how many wolves eventually inhabit the state. Many of the effects of wolves described in this chapter are likely density dependent, with less dense wolf populations creating fewer impacts than populations at carrying capacity (Campbell et al. 2006).

This chapter of the plan provides:

- background on interactions between wolves and other carnivores (Section A)
- background on interactions between wolves and scavengers (Section B)
- background on potential interactions between wolves and listed or candidate species in Washington (Section C)

A. Wolves and Other Carnivores

As with ungulates, gray wolves in North America and elsewhere have co-existed for centuries with a variety of other carnivore species in many different habitats. How different carnivores interact with wolves varies depending on the extent of dietary overlap, habitat, environmental conditions, and other factors. To date, no definitive research exists on the effects that wolves have on carnivore community structure or populations (USFWS 1994, Ballard et al. 2003). Information regarding the interactions between other carnivores and wolves is primarily observational and subject to interpretation when attempting to make predictions at the population or community level. Because wolves are wide-ranging and many carnivores are secretive in nature, collecting data on interactions is difficult. Observations to date suggest that wolves can reduce, or in rare cases eliminate, certain carnivores (such as coyotes) locally, but no evidence of long-term spatial partitioning of resources within an area has yet been detected (Ballard et al. 2003).

In Washington, wolves will share habitats occupied by a number of other carnivores, including cougars, coyotes, black bears, grizzly bears, bobcats, lynx, red foxes, river otters, mink, martens, weasels, skunks, wolverines, badgers, raccoons, and fishers. Direct interactions almost certainly will occur as wolves begin to reoccupy portions of their historical range in Washington and reestablish packs. A review of the scientific literature offers clues to what may occur in Washington when wolves interact with the carnivore species noted above.

<u>Cougars</u>

Cougars and wolves both rely on ungulates as their main food source, but use different hunting techniques. Wolves hunt in packs and generally course or test prey, whereas cougars are solitary hunters and rely on ambush of unsuspecting prey. Few observations of direct wolf-cougar interactions have been reported, but the two species do occasionally kill each other. Although cougars and wolves are similar in size, wolves tend to be dominant because of their pack social structure, which gives them a competitive advantage with cougars (Ruth and Murphy 2010). Wolves have been noted to kill kittens, subadults, and adult cougars in Glacier and Yellowstone national parks (White and Boyd 1989, Boyd and Neale 1992, Ruth 2004a, 2004b, Ruth and Buotte 2007). Reports of cougars killing wolves are rare and usually involve cougars killing solitary wolves (e.g., Jimenez et al. 2008).

During winter, wolves and cougars often occupy the same range and may have similar diets (Kunkel et al. 1999, Husseman et al. 2003, Akenson et al. 2005, Kortello et al. 2007), but wolves may be more likely to select younger prey or prey in poorer condition (Husseman et al. 2003). Cougars have been noted moving away from kills to avoid wolf contact (Akenson et al. 2005) and in general may avoid areas recently used by wolves (Kortello et al. 2007). Wolves also seek out and take over cougar kills, which may force cougars to increase their kill rates to replace lost prey (Hornocker and Ruth 1997, Murphy 1998, Kunkel et al. 1999, Kortello et al. 2007, Hebblewhite and Smith 2010). In one area of central Idaho, cougars showed lower recruitment, fewer adults, and a disrupted social structure several years after recolonization by wolves, but other factors (declining prey populations, high hunter harvest, and a large forest fire) occurring simultaneously probably contributed to these effects (Akenson et al. 2005).

Recent information from Yellowstone National Park indicates that cougar abundance there has declined slightly since the reestablishment of wolves and that cougars now focus more of their hunting behavior in denser habitats that are more conducive to their hunting style (K. Murphy, unpubl. data). In one area of Banff National Park, Alberta, a largely wolf-related decline in the elk population resulted in cougars shifting their diets toward mainly deer and bighorn sheep (Kortello et al. 2007). Cougars also exhibited low annual survival and poor body condition during the period of wolf reestablishment. Thus, cougars were negatively affected by wolf recolonization (Hebblewhite and Smith 2010). Griffin et al. (2011) reported substantially lower rates of cougar predation on young elk calves in ecosystems with wolves.

<u>Bears</u>

Ballard et al. (2003) summarized wolf-bear interactions in North America. Most reported encounters between wolves and black bears involved fighting or chasing one another, or wolves killing black bears. In a smaller number of interactions, wolves displaced black bears from kills. Wolves will seek out and kill black bears in their dens but often do not consume them, suggesting that interference competition exists between the two species. One observation of a black bear killing a wolf has also been made.

Most wolf-grizzly bear interactions involve fighting and chasing, which often take place at kill sites (Ballard et al. 2003). Encounters at kill sites usually appear to be won by grizzlies, whereas wolves usually win those at wolf dens. Both species occasionally kill one another (e.g., Jimenez et al. 2008, Hebblewhite and Smith 2010). Because grizzlies readily usurp ungulate kills made by wolves (e.g., Hebblewhite and Smith 2010), Servheen and Knight (1993) speculated that the presence of wolves might be beneficial to threatened populations of grizzlies by supplementing their diet with greater amounts of protein through increased availability of ungulate carcasses. This may be especially true following mild winters, when ungulate carrion is normally far less available. However, at Banff National Park, wolves were three times more likely to take over grizzly kills than to lose their own kills to grizzlies, indicating that wolves may out-compete grizzlies at some locations (Hebblewhite and Smith 2010).

Coyotes

Interactions between wolves and coyotes have been discussed in the scientific literature more often than for other carnivores. Reestablishment of wolves has led to reductions in coyotes in some areas (e.g., Yellowstone and Grand Teton National Parks), but not at others (Ballard et al. 2003). Extirpation of coyotes by wolves can occur rarely (e.g., at Isle Royale National Park; Krefting 1969), but probably only under limited ecological circumstances, such as where immigration is prevented. Recent studies at Grand Teton and Yellowstone national parks have detected declines in coyote densities of 33% and 39%, respectively, in areas reoccupied by wolves and are reflective of competition between the two species (Berger and Gese 2007). Localized or short-term decreases in coyote abundance can be even higher, such as a 50% loss in the Lamar Valley population of Yellowstone from 1996 to 1998 (Crabtree and Sheldon 1999).

In contrast to these locations, Berger and Gese (2007) hypothesized that wolves may have little or no effect on coyote densities outside of protected areas (where overall wolf densities are likely to be lower because of conflicts with humans), although this observation was based on few data. Transient coyotes are especially vulnerable to wolves and exhibit poorer survival and greater rates of dispersal when wolves are present (Berger and Gese 2007, Berger et al. 2008). Although records of wolves killing coyotes are common in the literature (e.g., Seton 1929, Young and Goldman 1944, Carbyn 1982, Thurber et al. 1992, Ballard et al. 2003), coyote mortality from wolves is usually fairly low (3-16%; see Berger and Gese 2007, Merkle et al. 2009). Wolf-coyote interactions typically occur near wolf kills as coyotes attempt to scavenge ungulate carcasses (Crabtree and Sheldon 1999, Merkle et al. 2009, Atwood and Gese 2010).

Switalski (2003) found that coyotes quickly learn to avoid interactions with wolves by becoming more vigilant and waiting to feed at carcasses until after wolves have departed. Other behavioral changes by coyotes, such as denning closer to roads and reducing their vocalizations, presumably also help avoid detection by wolves (Switalski 2003). Additionally, increased group size makes coyotes less susceptible to wolf-caused mortality (Merkle et al. 2009, Atwood and Gese 2010). Resident coyote home ranges often overlap extensively with those of wolves, suggesting that coyotes may in fact derive some benefit from wolves by having a year-round source of ungulate carcasses on which to scavenge (Arjo et al. 2002, Switalski 2003, Berger and Gese 2007, Merkle et al. 2009). Carrera et al. (2008) hypothesized that competition between the two species may be especially high where their diets substantially overlap. In western Montana, wolves and coyotes feed on similar prey and exhibit extensive overlap of annual home ranges (Arjo and Pletscher 1999, Arjo et al. 2002, Atwood and Gese 2010). Wolves and coyotes may be able coexist in this region by partitioning prey resources by age and size class, by coyotes exploiting alternative prey during summer and scavenging during winter (Arjo et al. 2002), and by coyotes changing their behavior, resulting in spatial and temporal separation from wolves (Arjo and Pletscher 1999, Atwood and Gese 2010).

Other Carnivores

Wolves can affect some other carnivores, such as wolverines, red foxes (including Cascades red foxes), and fishers, in the same ways described above for bears and coyotes (Ballard et al. 2003). Increased availability of wolf-killed carcasses may benefit these species by providing more food for scavenging, particularly during the winter months (e.g., van Dijk et al. 2008). However, wolves sometimes kill these species during direct interactions. In Wisconsin, a fisher apparently killed by a wolf has been reported and fisher abundance has declined in regions of the state occupied by wolves (A. P. Wydeven, pers. comm.). In areas where coyote abundance is reduced by wolves, predators such as red foxes, lynx, and bobcats may benefit from reduced competition with coyotes (Mech and Boitani 2003b). Additionally, some prey species of coyotes may increase, which has the potential to enhance populations of other medium-sized and small carnivores (Buskirk 1999).

It is doubtful that wolves will greatly affect the overall numbers or distribution of other carnivore species in Washington. However, the presence of wolves likely will change the local distributions and behaviors of some carnivores as they attempt to avoid direct interactions with wolves or as they respond to changes in food availability. Such changes could favor some carnivore species over others.

B. Wolves and Scavengers

Increased availability of wolf-killed carcasses can benefit a number of vertebrate and invertebrate scavenging species (Hebblewhite and Smith 2010). Many vertebrates benefit especially during winter when other foods become scarcer (Smith et al. 2003). At Yellowstone National Park, at least 12 vertebrate species scavenge at wolf-killed carcasses, with five (bald and golden eagles, coyotes, ravens, and magpies) visiting nearly every kill (Wilmers et al. 2003a, 2003b). At Banff National Park, at least 20 vertebrate species fed off wolf kills, with ravens, coyotes, magpies, martens, wolverines, and bald eagles visiting most often (Hebblewhite and Smith 2010).

C. Wolves and Listed/Candidate Species

Gray wolves are likely to have few significant adverse impacts on any current federal or state listed (endangered, threatened, sensitive) or candidate species (see Appendix A) in Washington in the foreseeable future, with the possible exception of mountain caribou. Interactions with listed or candidate carnivores and birds of prey (i.e., grizzly bears, lynx, wolverines, fishers, Cascades red foxes, bald eagles, and golden eagles) are briefly discussed in Sections A and B.

Washington's only population of mountain caribou, the Selkirk Mountains herd, spends most of its time in the British Columbia portion of its range, with members infrequently entering Washington. The herd increased from 33 caribou in 2004 to 46 caribou in 2009. Distribution in Washington is restricted primarily to the Salmo-Priest Wilderness Area in northeastern Pend Oreille County. The area is characterized by high elevations and extensive closed canopy forests, and therefore supports relatively low densities of other ungulate species. Hence, few wolves are expected to reside in the Salmo-Priest, meaning that predation on caribou would probably occur infrequently. Nevertheless, any wolf-related losses to the herd would have a significant impact on the population.

Recent declines of woodland caribou populations in British Columbia have been linked to the expansion of moose and the subsequent increase of wolves, which has resulted in greater predation on caribou (Wittmer et al. 2005, Stotyn et al. 2007). To reduce the threat of predation, woodland caribou attempt to isolate themselves from predators and other more abundant prey species by selecting old forests and alpine areas, and avoiding areas near roads during all seasons (Stotyn et al. 2007). However, loss of mature forests and fragmentation of winter habitat may compromise this strategy. Habitat overlap between caribou and wolves is greatest in the spring and calving season, resulting in increased risk of predation for caribou. Localized reductions of specific wolf packs and other large predators have been used to reduce the impact of predation on mountain caribou populations in the province (G. Mowat, pers. comm.), but regular use of this type of management may carry unacceptable ethical implications for the recovery of rare species in the United States (Wittmer et al. 2005).

The population of Columbian white-tailed deer occurring along the lower Columbia River in Washington (in Wahkiakum and Cowlitz counties; Figure 14) and Oregon numbered about 600 animals in 2009, including about 235 animals in Washington (Meyers 2009). Coyote predation is the primary cause of fawn mortality and may limit the population (USFWS 2010b). Wolf predation levels that might occur in the future if the two species overlap are difficult to predict, but could potentially harm this deer's recovery in Washington. However, if wolves were to reduce coyote abundance in the area occupied by the deer, this could result in lower overall predation rates on the deer.

Golden eagles and bald eagles may both benefit from the presence of wolves through greater availability of wolf-killed ungulate carcasses, especially during winter. Golden eagles in particular may currently be food limited because of declines in jackrabbits and perhaps other prey species in Washington (J. Watson, pers. comm.).

Wolves feed on many different small prey species (e.g., mice, tree squirrels, muskrats, woodchucks, grouse, songbirds; van Ballenberghe et al. 1975, Fritts and Mech 1981, Boyd et al. 1994, Arjo et al. 2002), especially in the summer when ungulates become less available, but small prey never comprises a significant portion of the diet. A number of listed and candidate species in Washington fall into this size category and might be rarely caught and eaten by wolves. These include Merriam's shrew, pygmy rabbit, white-tailed jackrabbit, black-tailed jackrabbit, western gray squirrel, Washington ground squirrel, Townsend's ground squirrel, Mazama pocket gopher, gray-tailed vole, greater sage-grouse, and sharp-tailed grouse. Many of these species occur in open habitats (i.e., shrub-steppe, grasslands, prairies, farmland) that are unlikely to be recolonized to any significant extent by wolves in Washington.

Although not state or federally listed, Olympic marmots have been declining in recent years and are now estimated to total fewer than 1,000 animals (Griffin et al. 2008). Coyote predation is probably the main threat to the species (S. C. Griffin, pers. comm.). Coyotes were historically rare or absent from the Olympic Peninsula when wolves were widespread in western Washington (Taylor and Shaw 1929, Scheffer 1995). Although recolonization of the Olympic Mountains by wolves might result in additional predation pressure on Olympic marmots, it more likely could benefit marmots by reducing coyote abundance.

7. WOLF-HUMAN INTERACTIONS

Because of the long absence of gray wolves from Washington, most people in the state are unfamiliar with wolves and wolf behavior. Addressing public safety concerns and providing information on wolf behavior are important steps in achieving conservation and tolerance of wolves by citizens.

This chapter of the plan provides:

- background on wolves and human safety (Section A)
- discussion on interactions between wolves and the public in Washington (Section B)
- background on interactions between wolves and dogs (Section C)
- discussion on management of conflicts between wolves and pet dogs in Washington (Section D)
- background on wolf hybrids and pet wolves (Section E)
- background on wolves and tapeworm disease (Section F)

A. Human Safety

Background

Wild wolves generally fear people and rarely pose a threat to human safety. Attacks on humans by wolves are quite rare compared to those by other species. Since 1950, wolves are known to have killed nine people in Europe, where current wolf numbers total 10,000-20,000, and eight people in Russia, where about 40,000 wolves exist (Linnell et al. 2002, Boitani 2003). Human deaths have also been reported in India, where conditions have deprived wolves of wild prey and livestock are heavily guarded (Fritts et al. 2003). In North America, where there are about 60,000 wolves, two human deaths have been attributed to wolves in the past 60 years (Linnell et al. 2002, Boitani 2003, NPS 2003, McNay 2007). One occurred in Saskatchewan in 2007 and the other in Alaska in 2010. The first death apparently involved habituated wolves being fed by people or attracted to garbage.

Injuries from wolves have also been extremely rare in North America (Linnell et al. 2002, McNay 2002a, 2002b). By comparison, domestic dogs in the United States are responsible for 4.7 million bites resulting in 500,000-800,000 hospital visits and 15-20 fatalities per year (Sacks et al. 1996, Centers of Disease Control 2003). Dogs are also the single most important vector for the transmission of rabies to humans (Moore et al. 2000).

Annual numbers of interactions between humans and other wildlife species in the United States average about 27,000 bites/injuries and an unknown number of fatalities by rodents, 8,000 bites/injuries and 15 fatalities by venomous snakes, 750 bites/injuries by skunks, 500 bites/injuries by foxes (Conover 2001), and 40-50 fatalities by bees (Cyr and Johnson 2006). Among other large carnivores, grizzly/brown bears killed about 36 people in Europe, 206 in Asia, and 71 in North America during the 20th century (Swenson et al. 1996). An estimated 25 attacks by black bears occur annually in North America (Conover 2001), with an average of almost two fatal attacks per year from 2000 to 2009 (Herrero et al. 2011). For cougars, there were 17 fatal and 72 injurious attacks from 1890 to 2001 in North America (Beier 1991; L. Fitzhugh unpublished data in Linnell et al. 2002).

About half of the human fatalities from wolf attacks worldwide since about 1950 have involved wolves infected with rabies (Linnell et al. 2002). Wolves are not a reservoir of rabies, but contract it from contact with other wildlife harboring the disease. The severity of sporadic attacks by rabid wolves in Europe and Asia in past centuries likely contributed to a perception brought to North America by European settlers that all wolves were violently dangerous animals. However, in the United States and Canada, interactions involving rabid wolves and humans have rarely occurred due to the low overall incidence of rabies on the continent (Linnell et al. 2002). No such cases have occurred in Idaho, Montana, or Wyoming since the reestablishment of wolves in the 1980s (Linnell et al. 2002, McNay 2002a, 2002b; E. Bangs, pers. comm.).

Attacks by non-rabid wolves typically involve captive wolves, healthy wild wolves that became habituated to humans (with or without food being present), territorial attacks by wolves on pet dogs where the dog owner tried to intervene, defensive attacks by wolves when trapped or cornered or when den sites with pups were threatened, wolves acting as predators under unique circumstances, and wolf-dog hybrids (Linnell et al. 2002, McNay 2002a). In the 33-year period from 1969 to 2001, 28 reports of unprovoked aggression by wolves were documented in North America (Linnell et al. 2002, McNay 2002a, 2002b). Nineteen of these involved wolves habituated to humans and five involved people accompanied by dogs. The dogs may have been the primary reason for the wolves' aggression, with attacks on the people occurring secondarily. An unusual number (at least eight) of wolf-human encounters, including several attacks, occurred in Ontario in 2006-2007, but many of these apparently involved animals habituated to people (Grooms 2007). There have been no physical attacks on people by wolves in Idaho, Montana, or Wyoming from the time wolf recovery began in the 1980s until the present.

McNay (2002a) reported a substantial increase in unprovoked aggression by wolves toward humans from 1969 to 2000, as compared with 1900 to 1968, and noted that this corresponded with increased protections for wolves, larger wolf populations, and greater numbers of humans visiting parks and other areas inhabited by wolves. As with other wildlife species, these factors provided more opportunities for wolves to become conditioned to humans and their foods.

Habituation of wolves to humans can occur in locations where wolves commonly encounter people and may or may not involve conditioning to human foods (McNay 2002a, NPS 2003). Instances of camp robbing by wolves have long been known (Young and Goldman 1944) and may develop from wolves finding novel or chewable items (e.g., camping equipment, clothing) on a repeated basis in a human setting. This type of conditioning does not involve the presence of food, but can nevertheless lead to unprovoked aggression toward humans (see Linnell et al. 2002 for examples). Wolves can quickly develop persistent aggressive approach behavior in situations where they receive food directly from people (McNay 2002a). Habituated wolves can remain non-aggressive toward humans for extended periods, but can quickly transition to strong aggressive or predatory behavior depending on the behavioral stimuli shown by humans (McNay 2002a).

Avoidance of Close Encounters with Wolves

Because wolves are large carnivores capable of inflicting serious injury to people, wolves should be respected for their capabilities and humans should avoid close contact at all times. Wolves are best left wild and observed from a safe distance. Wolves can gradually lose their fear of people through increasingly frequent contact and receiving food rewards for their boldness (NPS 2003, MFWP 2007a). Bold wolves are more likely to approach humans and human-populated areas when positively rewarded for doing so.

To prevent wolves from becoming habituated, people should:

- Resist the temptation to approach wolves.
- Not approach fresh wolf kills, dens, or rendezvous sites.
- Not entice or allow wolves to come nearby.
- Not feed wolves or other wildlife, or leave food outdoors, including pet food.
- Keep garbage in a secure location.
- Not let wolves become comfortable near human-inhabited areas.
- Notify authorities about wolves that seem comfortable around people, seek human food, or frequent human areas. Early intervention can keep a problem from getting worse.

During a close encounter with a wolf, people should do the following to frighten the animal away:

- Stand tall and make themselves look larger.
- Act aggressively towards it -- make noise, throw objects, and wave clothing.
- Calmly but slowly back away and maintain eye contact.
- If the wolf does not run away immediately, continue making themselves large, keeping eye contact, and backing away.
- Not turn their back on the wolf or run away.

The federal Endangered Species Act provides that "...any person may take endangered wildlife in defense of his own life or the lives of others" (50 CFR 17.21(c)(2)). State law also makes it permissible to kill "…wild animals engaged in the physical act of attacking a person" (Chapter WAC 232-36-050(3)(a)). It is important to understand that wolves passing near, watching, or otherwise behaving in a non-threatening way near humans should not necessarily be considered as dangerous. Under these circumstances, wolves could and should be hazed using non-lethal methods; use of lethal force is unneeded and illegal.

B. Interactions with the Public

In Washington, various groups of people with a higher than average likelihood of coming in contact with wolves in the wild include, but are not limited to, hunters, trappers, rural residents, recreationists, outfitters and guides, forest workers/contractors, other natural resource workers, and utility workers. Some members of these groups may welcome seeing wolves and may seek them out, while others may consider wolves as problematic to their activities. Regardless, user groups should be informed about wolves. To reduce concerns over safety, efforts should be made to inform rural residents and backcountry users of ways for reducing the likelihood of encounters with wolves and methods for preventing habituation toward people. Strategies for accomplishing this are presented in greater detail in Chapter 12, Tasks 6 and 9, and will be essential to achieving the conservation and management goals for wolves.

C. Interactions with Domestic Dogs

Situations where wolves and domestic dogs encounter each other can result in deaths and injuries to dogs. Attacks on dogs are usually related to defense of pups at dens or rendezvous sites or defense of territories rather than acts of predation (Bangs et al. 2005a, Ruid et al. 2009). Wolves killed at least 144 dogs in Idaho, Montana, and Wyoming from 1987 to 2010 (Table 5) and at least 385 dogs in the Great Lake States from 1979 to 2008 (Table 6). Dogs used for livestock guarding, herding, and hunting are the most vulnerable to attack, but pet dogs are also at some risk (McNay 2002b, Treves et al. 2002, Bangs et al. 2005a, Edge et al. 2011). None of the dogs killed in Idaho, Montana, and Wyoming through 2006 were accompanied by their owners at the time of attack (USFWS 2007b). Most attacks on dogs in these states occur in remote areas away from homes (Bangs et al. 2005a), but in a few cases, wolves have come close to homes to fight with dogs, even when people were present close by. Domestic dogs are also vulnerable to attack or killing by a variety of predators other than wolves, including coyotes, cougars, bears, and feral dogs. Wolf predation on domestic dogs in upper Michigan occurs in all months of the year except February and November (Edge et al. 2011).

As wolves expand their range in Washington, dog owners will need to be aware of the potential risks to their animals if they are within wolf pack territories. Some wolves will occupy areas near human habitation and areas used recreationally (e.g., national forests), which could put hunting or pet dogs at risk of depredation, especially if they are running at large.

In areas occupied by wolves, homeowners with dogs should:

- Not leave their dogs outside overnight unless they are kept in a sturdy kennel.
- Avoid letting their dogs outside for bathroom breaks after dark except in areas with good lighting or fencing.
- Keep dogs on a leash or in visual/auditory range on walks and vocalize regularly including use of whistles.
- Not allow dogs to roam at large. Dogs running loose may attract wolves.
- Train their dogs not to chase or approach wildlife, and to return on command.
- Not leave dog food outside at night.
- Avoid feeding wildlife near their home.

Hikers should consider leaving their dogs at home when visiting sites with wolves. Hikers with dogs should:

- Be able to recognize wolf sign.
- Bring a leash to restrain their dogs if wolves or wolf sign are encountered.
- Keep their dogs on leash when walking in known wolf habitat.
- Consider placing a bell on the dog's collar to alert wolves that people are also present.

Hikers with dogs that encounter a wolf should:

- Bring the dogs to heel at the person's side or put them on leash as quickly as possible.
- Stand between the dogs and the wolf, which often ends the encounter.

- Not attempt to break up a physical fight between a wolf and a dog, which could result in injury to the person.

Hunting Dogs

Recreational hunting for cougars, bears, and bobcats with hounds was banned in Washington by state initiative (I-655) in 1996. Through legislative authorization and exceptions provided in the initiative, hounds were used to pursue three game species in Washington from 2001 to 2010, including cougars in a pilot program for six counties (Pend Oreille, Stevens, Ferry, Okanogan, Chelan, and Klickitat), raccoons statewide, and black bears causing timber damage in western Washington (by permit only). Hounds used for hunting in areas occupied by wolves are susceptible to wolf attacks. In Idaho and Montana, one or two fatal attacks were reported in most years from 2000 to 2008, all involving dogs hunting cougars (USFWS et al. 2009 and older annual reports; S. Nadeau, pers. comm.). Hunting dogs appear to be more vulnerable to wolves in parts of the Great Lakes region, where for example as many as 23 hounds have been killed in a year in Wisconsin (Ruid et al. 2009). The majority of dog deaths in this region occur during bear hunts or dog training periods (Edge et al. 2011).

The six counties in northeastern and north-central Washington where hound hunting of cougars was authorized are among those likely to be recolonized by wolves in the future. If the use of hounds for cougar hunting is continued or reauthorized in the future, or where hound hunting of raccoons and bears continues, houndsmen should be trained on steps that can be taken to reduce interactions between their dogs and wolves. They should:

- Avoid releases in areas with fresh evidence of wolves.
- Release hounds only on fresh sign of the target species to avoid long chases.
- Yell or make noise when releasing hounds and going to the tree.
- Reach hounds at trees as quickly as possible so they are not unattended for long periods.
- Leash dogs at trees to control them.
- Place bells or beeper collars on hounds.

Hunters using dogs to locate forest grouse can reduce the risk of encounters between wolves and the dogs by keeping dogs within sight, placing a bell or beeping collar on those that range farther, talking loudly to dogs and other hunters, using a whistle, and placing dogs on leash if wolves or wolf sign are sighted.

D. Wolf Hybrids and Pet Wolves

Wolves are capable of hybridizing with other canid species and have been documented breeding with coyotes, domestic dogs, and feral dogs. However, behavioral differences between wolves, coyotes, dogs, and wolf hybrids usually keep the populations distinct. Possession of wolf hybrids and wolves as pets should be discouraged because of the potential threat to human safety. Hybrids and pet wolves are dangerous to people because of their physical strength, lack of shyness, and predatory instincts, which make their behavior unpredictable in many situations (Fritts et al. 2003). Hybrids and pet wolves killed at least 13 children and injured at least 43 others in North America from 1981 to 1999 (Linnell et al. 2002). Wolf hybrids and pet wolves regularly end up in the wild when their owners allow them to run free, abandon them, permanently release them, or when the animals escape. Washington has had a number of instances of hybrids being killed on roads in vehicle collisions, or released in national forests or other areas. These are commonly reported as wolf sightings by the public.

Because wolf hybrids can be difficult to distinguish from wild wolves, negative encounters between humans and hybrids often are attributed to wild wolves and therefore can impede efforts to reestablish and conserve wolves. There is also potential for the genetic pollution of wild wolf populations, although the risk is low considering the poor survival of wolf hybrids released into the wild. Genetic evidence of hybridization between wolves and dogs or hybrids was recently described from Vancouver Island, British Columbia (Muñoz-Fuentes et al. 2010). A domestic dog mitochondrial DNA haplotype was detected in three females (2 adults, 1 immature) that were morphologically identified as wolves in 1986. The data suggested that a female dog or hybrid with dog mitochondrial DNA must have mated with a male wolf and produced at least one female offspring that subsequently reproduced. Muñoz-Fuentes et al. (2010) attributed this hybridization event to the small size of the wolf population and lack of available mates when wolves were recolonizing. Wolves were virtually eliminated from the island by 1950 as a result of eradication efforts, and slowly re-colonized from mainland British Columbia beginning in the mid to late-1970s. Their findings exemplify how small wolf populations are at risk of hybridization.

A state law (RCW 16.30) enacted in 2007 prohibits the ownership, possession, and breeding of pet wolves and other potentially dangerous wildlife species. Provisions of the law allowed current owners of pet wolves to retain their animals until the death of the animals and allow licensed facilities to possess wolves. The law is enforced by local animal control authorities and law enforcement officers or, in their absence, WDFW law enforcement officers. Although hybrids of all other species included in the law are prohibited, the law did not include wolf-dog hybrids. These animals are regulated as domestic dogs in Washington. WDFW has no jurisdiction over wolf hybrids. Authority to regulate the ownership, possession, and breeding of wolf hybrids currently lies with individual Washington counties and cities. King County, Tacoma, and Puyallup are among the jurisdictions that have adopted ordinances prohibiting possession of wolf hybrids (and wolves) as pets by private citizens. Wolf hybrids are commonly kept as pets in Washington, with an estimated 10,000 animals present in the state in the late 1990s (P. Joslin, pers. comm., cited in Gaines et al. 2000).

E. Tapeworm Disease and Wolves

The parasitic tapeworm *Echinococcus granulosus* is found almost worldwide in canids (e.g., dogs, wolves, coyotes, and foxes) and has been recently detected in more than half of the wolves tested in Idaho and Montana (Foreyt et al. 2009). This tapeworm requires two hosts to complete its life cycle. Ungulates (e.g., deer, elk, moose, domestic sheep, pigs, and cattle) serve as intermediate hosts and become infected by ingesting tapeworm eggs while grazing. The eggs hatch into larvae, which form hydatid cysts in the lungs, liver, and other parts of the body. Canids usually are the final hosts and become infected by eating ungulates with cysts. Consumption of cysts releases larval tapeworms, which attach to the small intestine where they mature into adults. Adult tapeworms are 3-5 mm long and produce eggs that are shed in the final host's feces.

This tapeworm can rarely cause hydatid disease (or echinococcosis) in humans. People can obtain the disease by drinking water or eating vegetation contaminated with tapeworm eggs. Infections can also result from handling contaminated canine fur or scat, and then transferring the eggs to the person's mouth by touching the face or eating before adequate hand washing. The disease is extremely unlikely to be spread by handling ungulate capes or meat, unless those parts are contaminated with canid feces and handlers do not use good basic hygiene. People cannot be infected by eating the cysts found in ungulates. These tapeworms are neither wind-born nor transmissible to humans in any way other than direct ingestion of eggs.

To avoid infection, people should practice good hygiene when handling live wild animals, dead wild animals, their secretions, or their products. Dogs should not be allowed to feed on or scavenge ungulates (especially entrails), or allowed to roll in canine scat in geographic areas where the tapeworm occurs. People should always wash their hands after handling dogs with access to ungulate carcasses and regularly deworm the dogs.

8. LAND MANAGEMENT

Gray wolves are habitat generalists and one of the most adaptable large predators in the world (USFWS 2009). They require only a sufficient year-round prey base and protection from excessive human-caused mortality. Wolf populations are able to persist in many parts of the world featuring greater human development than the northwestern United States (Boitani 2003). Even active wolf dens can be resilient to non-lethal disturbance by people (Thiel et al. 1998, Frame et al. 2007, Person and Russell 2009). In parts of the species' range (e.g., in northwestern Montana), wolf packs use a matrix of public, private, and corporate-owned lands where a variety of land uses occur, including dispersed outdoor recreation, timber production, livestock grazing, home sites within the rural-wildland interface, hobby farming/livestock, and even full-scale resort developments with golf courses.

Restrictions on human development and other land use practices have not been necessary to achieve wolf recovery in Idaho, Montana, and Wyoming (USFWS 2009), and the U.S. Fish and Wildlife Service did not designate critical habitat for wolves in the western United States. With the exception of some temporary area closures near den sites in national parks, there have been no restrictions on grazing methods, road use, timber management and logging, mining, recreation (e.g., camping, hiking, and backcountry horse use), public access, or other activities due to the presence of wolves. Outside of national parks, no wolf-related restrictions have been placed on public or private lands in Montana (C. Sime, pers. comm.).

Based on the habitat use and large home ranges of wolves in Idaho, Montana, and Wyoming, it is expected that wolves will use a matrix of public, private, and corporate-owned lands in Washington, but with primary occupancy on public lands (see Chapter 2, Section C, for further background on habitat use). In some areas, expanded use of private lands may occur in the winter as wolves follow their prey to lower elevations. As in Idaho, Montana, and Wyoming, wolf reestablishment is not expected to result in any additional land use restrictions in Washington.

A. Federal Land

Responsibility for managing federal lands resides with the federal administering agencies. WDFW has no legal authority to implement land use restrictions on land it does not manage and land management agencies can and may adopt seasonal or localized area restrictions independently from WDFW. Therefore, it will be important for federal agencies and WDFW to coordinate on land use issues as they relate to wolf management, especially the administration of livestock grazing permits.

Wolf activity on national forest lands in Montana has not generally prompted any area closures or travel restrictions, primarily because recreational use of these lands is often dispersed and sporadic (MFWP 2003). Temporary area closures are sometimes established around occupied den or rendezvous sites in national parks because of the strong public desire to view wolves and the high visitation of areas with wolf activity that would otherwise occur. At Yellowstone National Park, areas around dens are closed until June 30, but at Glacier National Park, this type of seasonal closure has been implemented for only one wolf pack (MFWP 2003).

In Wyoming, the U.S. Fish and Wildlife Service always discouraged other agencies from placing any restrictions on federal lands to protect wolves (M. Jimenez, pers. comm.). The only exception would have been potential take involving a den site. For example, if an agency planned a controlled burn in April, the U.S. Fish and Wildlife Service would have asked the agency to wait until the wolves were out of the affected den later that summer. No other restrictions on federal lands have been added by other agencies.

B. State Land

As with federal lands, responsibility for managing state lands resides with the state administering agencies. WDFW has no legal authority to implement land use restrictions on land it does not manage and land management agencies can and may adopt seasonal or localized area restrictions independently from WDFW. The only lands that WDFW has management authority over are 32 designated wildlife areas totaling nearly a million acres that are located across the state. WDFW is developing a Habitat Conservation Plan for its lands that ensure that activities on these lands are in compliance with the federal Endangered Species Act. For the wolf, conservation measures will focus primarily on minimizing disturbance to established and active den and rendezvous sites and minimizing conflicts between wolves and domestic livestock (J. Sutter, pers. comm.).

The Washington Department of Natural Resources administers the Washington State Forest Practices Act Critical Habitats Rule for threatened and endangered species (WAC 222-16-080), which contains a provision for wolves. The rule applies to timber harvest permit applications on state and private lands. Forest practices where harvesting, road construction, or site preparation is proposed within 1 mile of a known active wolf den, as documented by WDFW, between the dates of March 15 and July 30, or 0.25 mile from the den at other times of the year, are designated as a Class IV-Special and require an extra 14 days of review, and are subject to State Environmental Policy Act (SEPA) review. The lack of confirmed wolf dens in Washington has meant that no forest practice applications for state lands have been affected to date by the wolf critical habitat rule. The rule was established in 1992, but much has been learned since then about habitat issues involving wolves in neighboring states, in particular that large disturbance buffers are not necessary for conservation of the species. This newer information suggests that the rule should be reviewed and modified to reflect prevention of disturbance of occupied dens only during the denning period.

C. Private Land

As noted above, private lands in Idaho, Montana, and Wyoming have never had wolf-related restrictions placed on them by federal or state agencies. Therefore, minimal impacts to private land uses in Washington are expected due to the presence of wolves. Although WDFW has no legal authority to implement land use restrictions on private lands (with the exception of hydraulic permits), it may nevertheless ask a private landowner to temporarily delay an activity near a den during the denning period, especially while wolves remain state listed.

The Washington State Forest Practices Act Critical Habitats Rule for threatened and endangered species (WAC 222-16-080), discussed above in Section B, also applies to timber harvest permit applications on private lands. No forest practice applications for private lands have been affected to date by the wolf critical habitat rule.

Other jurisdictions, such as counties, have regulations that apply to private land. Counties may access WDFW information on species and habitats of concern through WDFW's Priority Habitats and Species program. Counties may use that information in developing critical areas ordinances. Currently, there are no known county critical areas ordinances for wolves in Washington.

9. INFORMATION AND EDUCATION

A well-informed public is essential to gray wolf conservation and some authorities consider outreach efforts to be the highest priority in restoring the species (Fritts et al. 1995, 2003). It is crucial that wolves and wolf management issues be portrayed in an objective and unbiased manner, and that the public receives accurate information on the species. Conflicts with wolves and the solutions and compromises needed to resolve those conflicts must be discussed fairly (Fritts et al. 2003).

Extensive public outreach was conducted before and during wolf recovery in Montana, Idaho, and Wyoming, with a broad mix of approaches used (Fritts et al. 1995). These efforts conveyed a factual and balanced view of wolves, stressed the differences between wolves and other canids, described the legal and biological rationale for recovery, pointed out that some wolf control must accompany recovery, and emphasized that very few restrictions on use of public or private lands are necessary for wolf recovery. The success of wolf recovery in these states is at least in part due to these information and education efforts.

Washington's citizens need access to factual information about wolves and wolf management from wildlife managers; and wildlife managers need information from the public on sightings, depredation events, and wolf behavior to effectively manage wolves in the state. With this two-way communication, implementation of the Wolf Conservation and Management Plan will have a higher probability of success and both managers and the public will have the necessary information to make conservation and management decisions to achieve plan objectives. Two-way communication depends on a public that is informed about wolves and ongoing management activities and agency staff who are well informed and willing to listen to the real and perceived concerns of residents about wolves.

An outreach campaign that is active, rather than passive, in reaching specific groups will best benefit wolf conservation. Information and education strategies must be adaptive, reflecting the adaptive wolf conservation and management strategies described in the overall plan. Communication tools and education methods should be flexible and based on ongoing conservation and management activities, feedback from public attitude surveys, and available funding. Public attitude studies can be used to understand knowledge levels and information needs and to guide the design and targeting of outreach efforts (Schanning 2009, Troxell et al. 2009). Public attitude surveys were an important element in developing WDFW's recent outreach and education plan for cougars (WDFW 2010c) and would be expected to be used to help design outreach and education regarding wolves.

Many WDFW staff are likely be involved at some point in disseminating information about wolves or responding to inquiries from the public. It will be important to ensure that staff receive up-to-date information and training about wolves before engaging in education and outreach efforts. Most dissemination of official information is coordinated by the Public Affairs staff, who work with the news media and update website information. Outreach and education efforts with schools, community groups, and other organizations are conducted by all staff as available. Strategies and tasks for informing and educating people about wolf behavior, conservation, and management in Washington are presented in Chapter 12, Task 9.

10. RESEARCH

Development and implementation of research programs are essential parts of any successful wildlife conservation and management plan. Such programs should provide information that can promote adaptive management and process improvement over time. Future conservation and management actions involving Washington's gray wolves will depend on accurate and complete data related to a broad range of biological and social topics, including population status and impacts on affected resources and human activities.

Extensive research on wolves and their impacts has been conducted in recent decades in Idaho, Montana, and Wyoming, and has provided excellent information for directing wolf recovery and management in those states. This body of work will be useful in guiding future wolf investigations in Washington. In some instances, the results of this research will be directly applicable to Washington, but in many cases similar studies will be needed in-state because of differences among states in habitat quality, prey availability, human densities, and other characteristics.

Research will be needed to clarify the understanding of wolves in Washington, their impacts on other species, and to guide the development of longer-term area-specific conservation and management objectives for wolves. Research will likely be conducted by WDFW, other federal and state agencies, tribes, universities, and other scientists, and will rely on cooperative relationships among these entities.

Important research needs relating to wolf conservation and management in Washington are identified in Chapter 12, Task 11. Availability of funding and personnel will determine the rate at which research is conducted. Long-term commitments of funding and support will be needed to do this work. Efforts will be made to obtain funding from multiple sources to conduct the needed research.

11. REPORTING AND EVALUATION

The purpose of reporting and evaluation is to determine the success of the plan in meeting the established goals and objectives. Measurements of positive and negative outcomes for wolves and other groups must be identified, compiled, and compared to a standard. Tracking the status and trend of various measurements against a standard will indicate whether implementation of the plan is meeting its goals. An adaptive management approach will be used so that new information can be incorporated into management strategies, which can then be changed if warranted. Strategies for monitoring, evaluating, and reporting the effectiveness of the wolf plan's implementation are presented in Chapter 12, Task 12. These strategies will begin after this plan goes into effect.

Benchmarks for measuring progress toward achieving wolf conservation and management in Washington will be whether objectives are being met for recovery (population numbers and distribution), for managing wolf-livestock conflicts and wolf-ungulate conflicts, for public outreach and education, and for law enforcement. While benchmarks measure results, not effort, monitoring those results can help determine whether to modify program objectives or management practices. The Washington Wolf Interagency Committee and a citizen advisory group could assist WDFW in evaluating the effectiveness of wolf conservation and management in Washington. An evaluation could include measuring how well each portion of the plan is being implemented.

WDFW will also work with U.S. Fish and Wildlife Service on status reviews, designation of distinct population segments, and other activities related to areas where wolves remain federally listed in Washington.

12. GOALS, OBJECTIVES, STRATEGIES, AND TASKS

The purpose of the Wolf Conservation and Management Plan for Washington is to ensure a self-sustaining population of gray wolves in the state and to encourage social tolerance for the species by reducing and addressing conflicts. The following goals, objectives, strategies, and tasks are intended to meet this purpose.

A. Goals

The goals of the Wolf Conservation and Management Plan for Washington are to:

- Restore the wolf population in Washington to a self-sustaining size and geographic distribution that will result in wolves having a high probability of persisting in the state through the foreseeable future (>50-100 years).
- Manage wolf-livestock conflicts in a way that minimizes livestock losses, while at the same time not negatively impacting the recovery or long-term perpetuation of a sustainable wolf population.
- Maintain healthy and robust ungulate populations in the state that provide abundant prey for wolves and other predators as well as ample harvest opportunities for hunters.
- Develop public understanding of the conservation and management needs of wolves in Washington, thereby promoting the public's coexistence with the species.

B. Objectives, Strategies, and Tasks

This section identifies objectives, strategies, and tasks associated with the recovery and management of wolves so that the species can be removed from state listed status in Washington.

1. Develop and implement a program to monitor the population status, trends, and conservation and management needs of wolves in Washington.

A comprehensive population monitoring program is an essential part of the wolf conservation and management program and will be conducted throughout the implementation of this plan. Monitoring will begin as wolves become reestablished and be most intense while the species remains classified as state endangered, threatened, and sensitive. Upon delisting, monitoring should transition from counting numbers of successful breeding pairs to numbers of packs or total wolves.

WDFW will have primary responsibility for monitoring wolves, but collaboration with tribes, other state, federal, and provincial agencies, jurisdictions, universities, landowners, local governments, and the public will be necessary for a successful monitoring program. This coordination will be especially important when monitoring animals located on or near federal, tribal, and private lands, and along state borders. In areas where wolves are federally delisted, the U.S. Fish and Wildlife Service will continue its monitoring and reporting for five years, as required by the Endangered Species Act. WDFW will work with the U.S. Fish and Wildlife Service to coordinate monitoring activities during this period.

1.1. Establish and maintain a wolf specialist position within WDFW, and re-direct activities in field staff work plans to locate wolf packs, monitor wolf movements, and conduct other wolf-related activities as time allows.

1.2. Monitor the locations of wolves in Washington and determine when resident packs and territories become reestablished.

1.2.1. Use howling and "howlbox" surveys, winter tracking, remote camera surveys, trapping, genetic testing, and other methods to determine locations of recolonizing wolves.

Refinements in survey methodology developed and tested in other states will be employed in Washington when appropriate. Some newer techniques (e.g., genetic testing of scat and hair, greater deployment of remote cameras, and use of "howlboxes" and hunter surveys) may be suitable for incorporation into monitoring programs (Ausband et al. 2009b, 2010, USFWS et al. 2011).

1.2.2. Solicit, collect, and evaluate sighting reports by the public and cooperators and conduct follow-up investigations, where warranted, to locate colonizing wolves and packs.

The public will be encouraged to submit reports of wolf activity and sightings (Appendix K). Outreach will be conducted to encourage the public to provide credible wolf sighting reports. Information on wolf identification and where to report sightings will be included in WDFW publications and on the agency's webpage. All recent and current sighting reports will be mapped and reviewed to evaluate their accuracy and to look for clusters of reports.

1.2.3 Maintain a listing of wolf reports submitted to WDFW by the public on the WDFW website.

Under RCW 77.12.885, WDFW is required to post on its website all reported cougar, wolf, and grizzly bear interactions, including human safety confrontations, sightings, and depredations by these species on humans, pets, or livestock, within 10 days of receiving the report. The posted material must include the species, location and time, known details, and a summary of the report. This information is taken from citizen reports made to the WDFW Enforcement Program.

1.3. Determine the status, trends, distribution, and other population parameters of wolves while listed.

1.3.1. Monitor members of each pack as packs become reestablished.

Trapping and radio telemetry will be important tools for monitoring wolves while listed. The goal will be to radio collar the breeding male and female, and as many remaining members of each pack as feasible. An attempt will be made to track at least one adult member of each pack via radio collars using satellite technology when possible to locate and record an individual's movements. Captured animals will be genotyped using collected DNA to allow identification and may be marked with a PTT tag.

1.3.2. Determine the locations and numbers of successful breeding pairs, packs, and individual wolves each year.

Numbers of successful breeding pairs (with at least two pups surviving until December 31), packs, and total wolves will be determined annually using the results of radio-tracking and other survey techniques. Packs with territories straddling recovery region (or state) boundaries will be counted only in the area where the den site is located. If the den location is not known with certainty, then other criteria such as amount of time, percent of territory, or number of wolf reports will be used to determine pack residency. Thus, a pack will not be counted in more than one recovery region.

1.3.3. Determine home ranges, mortality, reproductive success, habitat selection, dispersal, and animal health.

Information from radio tracking and other survey methods will be used to determine ecological and biological characteristics of each pack, such as habitat use, prey selection, locations of den sites and rendezvous sites, number of pups, survival, and mortality.

1.3.4. Assess the genetic characteristics and monitor health through the collection and analyses of biological samples from live-captured and dead wolves.

Investigate the potential to have the WDFW genetics lab work with established canid genetic labs to develop the in-house ability to analyze tissue, blood, hair, and scat samples for wolf DNA testing.

1.3.5. Publish an annual report with monitoring results, including status, trends, distribution, and other population parameters for wolves each year, and assess progress toward meeting recovery objectives.

1.4. Determine the status, trends, distribution, and other population parameters of wolves after delisting.

Following delisting, wolf populations will be monitored to determine annual population status and trends. Because of the difficulty in validating successful breeding pair status as numbers of packs increase, monitoring efforts will change from determining numbers of successful breeding pairs to numbers of packs or total number of wolves. These efforts may provide an indirect estimator of breeding pairs (Mitchell et al. 2010) or alternative measures to assist with determining population size. Expanded use of genetic testing of scat and hair, remote cameras, "howlboxes", hunter surveys, predictive habitat modeling, and other methodologies may prove to be more cost-effective and less intrusive than trapping and radio-collaring (Ausband et al. 2009b, 2010, Stenglein et al. 2010, USFWS et al. 2011). Collaring may be used in select situations, such as with wolves that appear in new locations.

1.5. If needed, move individual wolves within Washington for genetic purposes.

If genetic research (Task 11.2) determines that an isolated wolf population has reduced genetic diversity, an individual wolf from another population/pack may be moved into the population to increase genetic diversity in an effort to increase population viability. This activity would be conducted solely to facilitate genetic exchange with other populations in the state. Consideration would be given to determining the appropriate source population for animals moved for improving genetic diversity. Because wolves would already be present in the release area, this would not require a feasibility assessment or reviews under SEPA or NEPA.

2. Protect wolves from sources of mortality and disturbance at den sites.

2.1. Identify human-related and natural sources of mortality.

Intensive monitoring and research activities will be the primary means of identifying both human-related and natural mortality factors for wolves.

2.2. Minimize factors contributing to wolf mortality.

2.2.1. Minimize mortality from lethal control.

Although lethal control is a necessary tool for reducing wolf depredation on livestock, excessive levels of lethal removal can preclude the recovery of wolf populations, as noted with the Mexican gray wolf in New Mexico and Arizona (USFWS 2005). WDFW will therefore monitor and, if necessary, adjust the extent of lethal removals (including mortalities from lethal take of wolves "in the act" of attacking livestock) to meet both conservation and management needs. Constraints on lethal control have recently been recommended by Brainerd et al. (2008) to minimize negative impacts on recolonizing wolf populations. They suggested that lethal control be limited to solitary individuals or territorial pairs whenever possible, and that removals from reproductive packs should not occur until pups are more than six months old, the packs contain six or more members (including three or more adults or yearlings), neighboring packs exist nearby, and the population totals 75 or more wolves. Consideration should also be given to minimizing lethal control around or between any core recovery areas that are identified, especially during the denning and pup rearing periods (April to September) (E. Bangs, pers. comm.).

2.2.2. Minimize mortality from illegal killing.

Illegal killing is expected to be a source of mortality as wolves recolonize Washington, based on findings from other western states (USFWS 2009).

2.2.2.1 Implement enforcement efforts to protect wolves from illegal killing.

Ensure that WDFW enforcement officers are aware of locations of wolf pack territories within their districts, including den sites and rendezvous sites. Increase patrols and monitor wolves within these areas. WDFW biologists, wolf specialists, and enforcement officers will maintain communication so that any issues that need to be addressed are handled quickly. Work with partners on federal and state lands to ensure protection for wolves, and coordinate enforcement efforts between the U.S. Fish and Wildlife Service and WDFW.

2.2.2.2 Implement efforts to increase social tolerance for wolves.

Programs that increase social tolerance for wolves will help reduce the illegal killing of wolves. Effective management programs that respond to and limit livestock depredation and provide compensation for losses will be especially important in reducing this type of wolf mortality (see Task 4). Education programs that provide accurate information about wolves to the public are equally necessary to reduce this threat (see Task 9).

2.2.2.3 Investigate and prosecute illegal killings of wolves.

Suspected illegal killings should be aggressively investigated. Where wolves are federally listed in Washington, the U.S. Fish and Wildlife Service Office of Law Enforcement would be lead investigative agency. Where they are federally delisted, WDFW would be the lead.

2.2.2.4 Increase penalties for illegally killing wolves when classified as protected wildlife under state law.

Under current state law, wildlife listed as threatened or sensitive are among the species designated as protected fish or wildlife. The penalty for illegally killing these species is relatively minor, being a misdemeanor punishable by a maximum of up to 90 days jail time and/or a fine of up to $1,000. WDFW will seek increased penalties for illegally killing wolves. This would require a change in RCW 77.15.130.

2.2.2.5 Work with partners to establish rewards for information on suspected killing of wolves.

Conservation Northwest offers a $7,500 reward for information leading to a conviction of wolf poaching in Washington. Efforts of this type could be expanded in the future.

2.2.3. Minimize mortality from accidental killing.

Strategies will be implemented to minimize mortality of wolves from incidental shooting and trapping. Information and education efforts are needed to inform hunters and trappers about the presence of wolves in occupied areas of the state. Use hunting, fishing, and trapping regulation pamphlets and other means to provide educational messages and identification materials about wolves, including how to avoid accidental shooting during legal hunting seasons. These programs will assist hunters in becoming proficient at distinguishing wolves from coyotes, and trappers in learning methods for avoiding accidental capture of wolves and what to do if a wolf is inadvertently caught. Incidental trapping of wolves is expected to be minimal because, with the exception of tribal trappers, licensed trappers in Washington are only allowed to use box and cage traps.

2.3. Minimize disturbance at active wolf den sites.

2.3.1. Implement protective measures that may be appropriate for protecting active den sites.

Implementation of suitable protective measures around wolf den sites would likely be case-specific. Landowners should be provided information on the locations of den sites, the timing and duration of denning, and how to avoid disturbance of den sites.

2.3.2. Evaluate the state's Forest Practices Act Critical Habitats Rule for the gray wolf and determine if it should be revised.

The critical habitat rule protecting the den sites of wolves from disturbance or possible adverse impacts from forest practice activities was established in 1992 under the Washington State Forest Practices Act Critical Habitats Rule for threatened and endangered species (WAC 222-16-080). Since that time, much information relevant to these concerns has been collected on wolves in Idaho, Montana, and Wyoming. This information should be used to evaluate whether the rule is still appropriate or if changes should be recommended.

3. Translocate wolves within Washington, if needed, to help achieve recovery objectives.

The overall timeframe for wolves to disperse naturally into Washington and reestablish a population is difficult to predict, but it could take several decades to reach downlisting and delisting objectives. If wolves have exceeded these objectives in some recovery regions and not others, then the process may be initiated to evaluate the potential translocation of wolves to areas not achieving recovery objectives. Funding for both a feasibility assessment and an implementation plan should be a high priority.

3.1. Determine if wolves are successfully dispersing to each recovery region and establishing successful breeding pairs.

Howling surveys, monitoring of radio-collared individuals, and other methods will be used to determine whether (1) wolves are successfully dispersing to new areas of the state and (2) sufficient numbers of wolves exist in a recovery region to be used as a source for translocation.

3.2. Prepare a feasibility assessment for translocating wolves into recovery areas where recovery objectives have not been met.

The feasibility assessment will investigate whether an adequate amount and configuration of suitable habitat and prey are available to support successful breeding pairs of wolves at potential translocation sites. Federal and state lands will be targeted for inclusion in the assessment, especially those that are forested and have low densities of people and livestock. The connectivity of potential translocation sites to areas occupied by wolves will also be considered.

3.3. Develop an implementation plan for a translocation.

The implementation plan will be initiated following completion of the feasibility assessment, if it concludes translocation is feasible. If wolves are still federally listed in parts of Washington, WDFW will seek approval from the U.S. Fish and Wildlife Service to conduct the translocation. Coordination with the appropriate land management agencies will also occur.

The implementation plan will investigate and determine the best methods for conducting a translocation (e.g., consideration of appropriate genetic source animals, release methods, disease testing protocols, etc.) and identify and prioritize core release areas. Based on translocations in Idaho and Yellowstone National Park during the 1990s, a genetically diverse founding stock of wolves should be used in the translocation and a location capable of holding several packs and receiving immigrants from other populations should be selected (vonHoldt et al. 2008).

3.4. Conduct the environmental review process required to evaluate the proposal to translocate wolves.

If translocation is proposed on federal land, work with the federal land managers to conduct a National Environmental Policy Act (NEPA) review process. If wolves remain federally listed, this will also include a Section 7 consultation with the U.S. Fish and Wildlife Service. A NEPA review would preclude the need for a State Environmental Policy Act (SEPA) review. If the proposal is to translocate wolves onto non-federal land, a SEPA review process would be conducted.

3.5. Coordinate with federal and state agencies, tribal governments, landowners, and non-governmental organizations on translocation activities.

3.6. Translocate wolves within Washington.

Upon completion of SEPA or NEPA review and a decision to implement a translocation, wolves will be captured, radio-collared and permanently marked, and translocated, as specified in an implementation plan.

3.7. Conduct post-release monitoring of wolves to evaluate translocation success.

The implementation plan will describe the monitoring needed to evaluate the translocation's success. Success will be defined in terms of establishing successful breeding pairs of wolves within the targeted recovery region.

4. Develop and implement a comprehensive program to manage wolf-livestock conflicts in cooperation with livestock producers.

Based on experiences in other states, wolf depredation on livestock is expected to occur in Washington as wolves become reestablished. Resolving wolf-livestock conflicts will require both non-lethal and lethal control responses. Resolution of conflicts will need to be managed in a way that does not jeopardize recovery of the species or require relisting. This approach for managing a listed species is highly unusual, but is required because of the desire to reduce conflicts and build social tolerance for wolves, thereby enhancing the chances for reestablishing the species in the state. It is recognized that there will be some economic costs to livestock producers when conflicts occur. Depredation concerns will be addressed by investigating reported complaints, verifying depredations accurately, implementing depredation management actions to abate or prevent damage, and providing adequate compensation for documented losses in a timely manner.

4.1. Work with livestock producers to resolve conflicts with wolves.

4.1.1. Respond to and resolve reported wolf depredation events in a timely period and work with livestock owners to reduce potential conflicts with wolves.

Depredation management approaches are described in Chapter 4 and summarized in Table 9. Responses to specific depredation events will be based on the local status of wolves to ensure that recovery objectives are met. Management responses will emphasize non-lethal techniques while wolves are recovering and will transition to more flexible approaches as wolves progress toward a delisted status. Livestock producers and the public will be actively informed of and given technical assistance, training, and other resources as available to implement proactive non-lethal wolf management techniques. State personnel and cooperators will receive regular training for investigating complaints and resolving conflicts.

4.1.2. Provide information and assist livestock owners with obtaining resources necessary to implement non-injurious wolf control techniques such as fladry, hazing supplies, radio-activated guard devices, electric fences, guarding/herding animals, and other measures as they are developed.

4.1.3. Work with livestock producer organizations, county extension services, the Washington Department of Agriculture, local governments, conservation organizations, and other appropriate groups and agencies to develop and conduct a comprehensive outreach and educational program on methods to discourage wolf depredation through the use of media materials, workshops, website resources, site reviews, evaluations, and other tools.

4.1.4. Work with state and federal land managers who administer grazing permits in areas of wolf activity to provide permittees with information on resolving wolf-livestock conflicts.

4.1.5. Provide livestock owners with information on how to report suspected livestock depredation and protect the site so that the cause of death can be determined.

4.1.6. Inform public and private land managers of wolf activities on their respective lands.

4.2. Verify reported wolf depredations.

Verification of reported wolf depredations is a critical step in the process of managing depredation problems. Documenting losses is necessary for both the livestock owner and WDFW to understand the severity of the problem, to plan appropriate action, to pay compensation, and to foster good relations between agencies and livestock owners. Rapid notification of agencies by the livestock owner about suspected depredations is crucial for verification, and a timely response to suspected livestock depredation reports by state or federal staff is critical for accurately determining the cause of death.

4.2.1. Establish a contract with USDA Wildlife Services to assist WDFW staff in responding to wolf depredation calls in areas where wolves are not federally listed.

Prompt response by personnel trained in depredation investigation techniques is important for determining the validity of reported complaints. Personnel from WDFW or USDA Wildlife Services will conduct wolf depredation investigations.

4.2.2. Provide the public with contact numbers so that complaints of suspected wolf depredation can be promptly reported.

If livestock are suspected to have been killed or injured by a wolf, complaints should be reported to WDFW or USDA Wildlife Services as soon as possible, preferably within 24 hours of finding the animal. See Appendix K and the

WDFW wolf website for current contact telephone numbers, reporting guidelines, and associated information.

4.2.2.1 Make contact telephone numbers for reporting potential wolf depredation available through pamphlets, websites, and other media outlets.

4.2.2.2 Develop brochures for livestock operators that provide contact telephone numbers for reporting potential wolf depredation.

4.2.3. Respond to complaints of suspected wolf depredation in a timely manner.

Upon receiving a complaint involving suspected wolf depredation, WDFW or USDA Wildlife Services will contact the complainant by phone within 24 hours. If agency staff determine that a field investigation is warranted, an on-site inspection will be made within 24 hours of the telephone consultation. In the interim, the livestock operator should be given instructions on how to protect the site. In addition to an on-site inspection, an investigation into a reported wolf complaint may include examination of wolf pack location data and interviews with the complainant, adjacent landowners, veterinarians, and other depredation experts.

4.2.4. Complete the investigation about the suspected wolf depredation and provide the final results.

Upon completion of the investigation, the complaint will be classified as one of the following: confirmed wolf depredation, probable wolf depredation, confirmed non-wolf depredation, unconfirmed depredation, non-depredation, or unconfirmed cause of death (see definitions in Chapter 4, Section G). Results of the investigation will be provided to the complainant. Confirmed and probable wolf depredations will be eligible for compensation under this plan. Where appropriate, land management agencies will also be notified of the results of depredation investigations. If a reported complaint is determined by trained personnel authorized by WDFW to be a confirmed non-wolf depredation or unconfirmed depredation, the incident will be recorded. If wild animals other than wolves are determined to be the cause of the depredation, WDFW or other authorized personnel will provide the appropriate assistance. Appropriate assistance depends on the species involved and may include providing technical or operational assistance.

4.3. Provide compensation for livestock losses due to wolves and implementation of proactive deterrents to reduce such depredations.

4.3.1. Develop a compensation program that pays livestock operators for confirmed and probable wolf livestock losses.

WDFW will develop a process to implement the two-tiered compensation rates identified in Chapter 4 for confirmed and probable depredation by wolves.

4.3.2. Process and reimburse valid compensation claims for confirmed and probable wolf depredations within a timely period.

4.3.2.1. Develop an application and reimbursement process, including forms and instructions to applicants.

4.3.2.2. Provide technical assistance to help applicants apply for reimbursement.

4.3.2.3. Respond to applications within a reasonable time frame, e.g., 14 days, by either affirming the claim and initiating payment or seeking additional justification for the claim.

4.3.3. As part of the compensation program, develop a payment plan to compensate livestock operators for unknown livestock losses.

WDFW will work with a multi-interest stakeholder group to attempt to develop compensation for unknown losses based on the criteria provided in Chapter 4, Section G. If such a payment plan is developed, it should include standards for devising appropriate procedures for documenting historical and current-year livestock losses, determining the validity of claims, and paying valid claims.

4.3.4. Secure a funding source to provide compensation for confirmed, probable, and unknown livestock losses from wolves and to provide funding for implementing proactive non-lethal deterrents to reduce livestock losses from wolves.

WDFW will work with livestock producers, conservation groups, and other members of the public to explore funding sources for both the compensation program and a program to assist with implementing proactive non-lethal measures to reduce conflicts. This will include seeking funding from the state legislature (such as authorized under WAC 232-36), federal grants, foundations, non-governmental organizations, and other sources.

The use of proactive non-lethal tools by livestock producers will be encouraged as a way of reducing depredations by wolves. Defenders of Wildlife has stated its intention to make its Proactive Carnivore Conservation Fund available to producers in Washington for this purpose; and Conservation Northwest, a non-governmental organization in Washington, has expressed willingness to assist with proactive measures.

4.3.5. Ensure a high degree of accountability within the compensation program.

The compensation program will need to include a mechanism to ensure a high degree of accountability within the program, especially for payment for unknown losses. This may involve some sort of multi-interest review board to establish strict criteria for determining valid claims.

4.4. Cooperate with other entities to resolve wolf-livestock conflicts.

Cooperative relationships and agreements with other state, federal, and provincial agencies, tribes, landowners, local governments, and non-governmental entities will be developed and implemented to address depredation concerns. Close coordination with USDA Wildlife Services will be necessary to respond to wolf damage problems in a timely manner. Details regarding who will respond and what protocols are followed will be essential to successfully address wolf conflicts. Non-governmental organizations such as the Defenders of Wildlife, Washington Cattlemen's Association, and Washington State Sheep Producers will be engaged to assist on aspects of wolf-livestock conflict management.

5. Manage ungulate populations and habitats in Washington to provide an adequate prey base for wolves and to maintain harvest opportunities for hunters.

5.1. Monitor ungulate populations in areas occupied by wolves.

WDFW and its cooperators already conduct surveys of annual production, recruitment, and harvest of ungulate populations in the state. These data are used to monitor population abundance or trends, and to make recommendations for hunting seasons and other management actions. Nevertheless, management of many populations would benefit from increased survey intensity to improve the precision and accuracy of information. Improvements in survey protocols may enhance efforts to assess the impacts of wolves on prey and to determine if changes in ungulate management strategies are needed.

5.2. Enhance ungulate populations wherever possible, subject to habitat limitations and landowner tolerance.

Maintaining robust prey populations will result in three key benefits for wolf conservation in Washington: (1) providing wolves with an adequate prey base, (2) supplying hunters and recreational viewers of wildlife with continued opportunities to hunt and observe game, and (3) reducing the potential for livestock depredation by providing an alternative to domestic animals. Ungulate populations in areas occupied or likely to be occupied by wolves should be managed consistent with game management plans devised for those populations.

5.2.1. Improve habitat for ungulate populations.

Healthy ungulate populations require adequate summer and winter habitat. Deer and elk are generally most abundant in early successional forests, but this habitat has declined in many parts of Washington in recent decades due to reduced timber harvest, fire exclusion, intensification of reforestation methods, development, and other causes.

WDFW will continue to work with other public land agencies, private landowners, non-governmental organizations (e.g., Rocky Mountain Elk

Foundation, Mule Deer Foundation), and tribal governments to cooperatively manage forestlands and winter and summer habitat for the benefit of ungulate populations. This will include the use of appropriate management practices to improve forage quality in various habitats; management of some habitats preferentially for ungulates; reduction of road densities and off-road vehicle use in critical habitat; maintaining open habitats (e.g., meadows), winter habitats, and productive early successional habitat; improving control of noxious weeds; and protection of valuable lands through acquisitions, leases, landowner agreements, and other methods.

5.2.2. Manage recreational hunting to ensure sufficient prey for viable wolf populations while maintaining hunting opportunities for hunters.

Recreational hunting comprises the largest mortality source for elk and deer populations in Washington (Smith et al. 1994, Myers et al. 1999a, McCorquodale et al. 2003, 2010). Hunter take of antlerless animals is one of the primary tools used to manage ungulate population levels in the state. Recreational harvest levels are adjusted annually to maintain ungulate populations at desired management objectives. Harvest levels are reduced if localized ungulate populations decline due to any of a variety of factors such as severe weather, disease, overharvest, predation, or habitat loss. In order to provide adequate prey for wolves, greater restrictions on antlerless hunting, increased road closures (e.g., McCorquodale et al. 2003) or increased ungulate population objectives may be necessary.

5.2.3. Reduce illegal killing of ungulate populations in wolf-occupied areas.

Illegal killing can be an important source of mortality among elk and deer populations in Washington (Table 12). Elk herds where illegal killing has been identified as a concern includes the South Rainier elk herd and the Olympic elk herd.

Smith et al. (1994) recommended increased patrolling during October, November, and December, when most elk poaching occurs. They also recommended concentrating patrols within 30 miles of human population centers and in locations with high hunter and road densities because most poaching occurs in these areas.

5.3. Manage wolf-ungulate conflicts

5.3.1. Manage conflicts at winter-feeding stations and sites with game fencing.

Wolves could eventually be attracted to WDFW-operated winter-feeding stations for elk and bighorn sheep and to other locations where fences have been built to keep ungulates off croplands and highways. If wolf disturbance at these sites proves serious, it could cause some elk to disperse into agricultural lands and highway rights-of-way. These situations will be evaluated on a case-specific basis to determine if management responses are needed and, if so, what the responses should be. In some cases, it may be desirable to develop a response plan in advance to address an anticipated conflict.

5.3.2. Manage conflicts with ungulate populations.

Wolf predation is not expected to harm ungulate populations across broad geographic areas of the state. While it is possible for wolf predation to have an effect on ungulate abundance in localized areas, this most often occurs where ungulate populations are already compromised by other factors such as declining habitat quality, severe weather conditions, and predation by other carnivores. Nevertheless, in situations where WDFW determines that wolf predation is a limiting factor for an at-risk ungulate population, and the wolf population in that wolf recovery region is healthy (i.e., it exceeds the delisting objectives for that recovery region), WDFW could consider using site-specific strategies to reduce wolf abundance in the localized area occupied by the ungulate population. These strategies could include moving wolves, lethal control, or other non-lethal control techniques.

5.4. Integrate management of multiple species.

Management of ungulate and carnivore populations should be integrated on an ecological basis. The statewide Game Management Plan includes chapters for each of Washington's major ungulate and carnivore species (WDFW 2008) and management plans exist for eight of the state's 10 elk herds and white-tailed deer (WDFW 2001b, 2002a, b, c, d, 2005, 2006a, b, 2010a). Achieving management goals for all of these species will be enhanced if the plans are considered collectively. The ecological roles of predators and prey should be integrated in these management plans. Coordination among public agencies, landowners, tribes, and non-governmental organizations is also necessary to meet management goals.

6. Manage wolf-human interactions to reduce human safety concerns, prevent habituation of wild wolves, decrease the risk of conflicts between domestic dogs and wolves, and to build awareness of the risks posed by wolf hybrids and pet wolves.

6.1. Respond to human safety concerns.

Attacks on humans by healthy wild wolves are extremely rare events. However, when necessary, WDFW or a cooperating agency will take action if the continued presence of a wolf or wolves poses concerns for human safety, consistent with existing policy for black bears and cougars.

6.1.1. Provide information to the public on the low risk of attacks on humans by wolves, how to prevent and react to wolf attacks, and other concerns.

In particular, provide information to people who might encounter wolves, including hunters, trappers, rural landowners, outdoor recreationists, outfitters and guides, forest workers and contractors, other natural resource workers, and utility workers,.

6.1.2. Respond to reported wolf-human interactions of concern in a timely manner.

Reports of wolf-human interactions of concern will receive a high priority and be investigated by trained personnel authorized by WDFW. Reported wolf-human safety concerns will be verified and evaluated on a case-by-case basis before management actions are initiated, unless circumstances necessitate immediate action.

6.1.3. Develop WDFW response protocols for reported wolf-human conflicts.

Protocols similar to those used in responding to human safety concerns involving cougars and black bears will be prepared and implemented. Non-lethal methods will be used first unless the situation dictates a more aggressive response, including immediate lethal control (NPS 2003).

6.1.4. Move individual wolves if needed to resolve conflicts.

As described in Chapter 4, Section B, relocation could occur proactively when a wolf or wolves are present in an area that could result in conflict with humans or harm to the wolf. Wolves would be moved to suitable remote habitat on public land, within the same recovery region, at the direction of WDFW and in collaboration with land managers. Relocated individuals would be released in areas unoccupied by other wolves. This could be near, but not within, the territories of existing wolf packs.

6.2. Take actions to reduce the likelihood of wolves becoming habituated to humans.

6.2.1. Inform the public on the risks of habituation and actions that can be taken to prevent it from occurring.

A number of recommendations exist for people to prevent the habituation of wolves, such as not letting wolves become comfortable around humans or human-inhabited areas, not leaving food outdoors, and not feeding wolves (Chapter 7, Section A).

6.2.2. Work with land management agencies on actions that can be taken to reduce the likelihood of wolves becoming habituated to humans.

Examples of such actions would include, where appropriate, the installation of wildlife resistant food and garbage storage structures at recreation sites and the posting of signs and other educational materials at trailheads and campgrounds.

6.2.3. Provide information on avoiding wolf habituation to humans, thereby minimizing the need for lethal management responses.

6.3. Manage wolf-pet conflicts.

Situations where wolves and pet dogs (including hunting and service dogs) encounter each other can result in dog mortality. As wolves expand their range in Washington, dog owners must be made aware of the potential risks to their animals and become informed on methods for avoiding interactions with wolves. WDFW staff should provide informational materials to dog owners who live or recreate in wolf habitat, which explains how to prevent and react to wolf attacks on dogs (Chapter 7, Section C). Because dogs can transmit diseases to wolf populations, the public should be informed and educated regarding the importance of keeping pets vaccinated against rabies, canine parvovirus, and other canid diseases.

6.4. Address issues regarding wolf hybrids and pet wolves.

6.4.1. Work with local jurisdictions, veterinarians, and non-governmental organizations to discourage the ownership of wolf hybrids by members of the public and to prevent the release of wolf hybrids into the wild. Ownership of pet wolves is no longer allowed in Washington unless the animal was possessed prior to the passage of state law RCW 16.30 in July, 2007. Provide information to the public and local jurisdictions about the new law. Develop and deliver educational messages for wolf hybrid and pet wolf owners about the dangers that hybrids and pet wolves pose to wild wolf recovery and human safety. Information efforts should be aimed at communities where wolf hybrids and pet wolves might be confused with wild wolves.

6.4.2. Explore options for having a voluntary registration of wolf hybrids in Washington, similar to the program of Montana Fish, Wildlife & Parks.

6.4.3. Support efforts to further regulate wolf hybrids in Washington.

7. Maintain and restore habitat connectivity for wolves in Washington.

Safe passage within and between habitat areas is vital for allowing wolves to recolonize unoccupied habitat and for promoting genetic and demographic exchange between subpopulations.

7.1. When evaluating lands that might provide connectivity for large-ranging carnivores, consider areas that would benefit wolf dispersal and connectivity between populations.

In Washington, areas of greatest importance for restoring or maintaining connectivity between regions of suitable wolf habitat currently include the upper Columbia-Pend Oreille valleys, Okanogan Valley, Steven Pass-Lake Chelan, Snoqualmie Pass, and the I-5 corridor between the southern Cascades and the Willapa Hills-Olympic Peninsula (Singleton et al. 2002; S. Fitkin, pers. comm.). Other areas may be recognized in the future. Mechanisms to conserve lands and maintain working landscapes include conservation easements, agreements or land acquisitions with willing landowners, and other methods.

7.2. Coordinate with neighboring states and British Columbia to ensure cross-border connectivity between wolf populations.

7.3. Increase opportunities for wolves to move safely across landscapes.

Where appropriate, work with the Washington Department of Transportation to create wildlife crossing structures for assisting wolf movement across highways that act as barriers. Use education and enforcement programs to help reduce illegal and accidental killing of wolves in landscapes used by dispersing wolves.

8. Manage conflicts between wolves and state and federal listed/candidate species.

Conflicts between wolves and other listed/candidate species may occur in the future.

8.1. If conflicts between wolves and other state and federal listed/candidate species occur, make case-specific evaluations to determine if management responses are needed and, if so, what the responses should be. Preference should be given to non-lethal measures, if possible, while wolves remain listed.

Where wolves are federally listed, or if conflicts involve federally listed species, work with the U.S. Fish and Wildlife Service to plan and implement appropriate responses.

8.2. If determined to be needed, develop a response plan in advance to address an anticipated conflict.

For some species (e.g., mountain caribou), it may be desirable to have a response plan already developed, which would provide appropriate potential response options in advance.

9. Develop and implement a comprehensive outreach and education program.

A comprehensive outreach and education program will be needed to provide accurate and updated information on wolf conservation and management and to prepare Washington residents to coexist with wolves. Such a program will have many approaches and messages for meeting the varied information needs of different audiences.

9.1. Strengthen internal knowledge about wolves among agency staff.

It is important that agency (including WDFW) staff interacting with the public about wolves receive accurate background information on an ongoing basis so they can present consistent and factual messages about wolf conservation and management. Targeted staff should include enforcement personnel, biologists, administrators, and front desk staff.

9.2. Provide information to the public about ongoing wolf conservation and management activities.

9.2.1. Develop a wolf communication and outreach plan for Washington.

9.2.2. Implement wolf outreach and education efforts with programs and materials appropriate for key audiences.

9.2.3. Provide information on wolf status, biology, habitat use, ecological role, and place as a part of Washington's natural heritage.

As information becomes available and is appropriate for release (i.e., information must be non-sensitive), have maps of current wolf pack territories on the WDFW website. Include links to the websites of other government agencies and non-government organizations with additional wolf information. Update the WDFW website with information on implementation of the wolf plan and adaptive management, including public feedback tools such as surveys and blogs.

9.2.4. Issue news releases to news media and e-subscribers, as needed, about significant wolf activity or plan implementation, including field activities, new research, management responses, and public conduct advisories.

9.2.5. Work with local communities, land management agencies, and others to develop safe and unobtrusive wildlife viewing opportunities for wolves, as they may develop in the future.

9.3. Develop and provide training, information, and education programs to address concerns over wolf-livestock conflicts.

9.3.1. Provide livestock producers with training in methods to prevent, reduce, and respond to wolf-livestock conflicts or depredations, using USDA Wildlife Services staff in Washington and the experience of USDA Wildlife Services field staff in Idaho, Montana, and Wyoming.

9.3.2. Provide livestock producers with information on response options that they can take to protect their livestock from wolves, as described Chapter 4, Section E, and summarized in Table 9. Provide updates on these options as wolf listing designations change.

9.3.3. Inform livestock producers on how to report suspected wolf depredations.

9.3.4. Contact public and private land managers about wolf activities on their lands. Provide ongoing wolf monitoring information to livestock producers as needed.

9.4. Develop and provide information and education programs for hunters, people viewing ungulates, and others to address concerns over wolf-ungulate interactions.

9.4.1. Provide information on ungulate population status and trends in Washington. Provide research results from Washington or elsewhere on wolf diet, wolf-ungulate relationships, and wolf-ungulate population studies.

9.4.2. Communicate information for hunters and wildlife viewers through the WDFW website (e.g., Wolf, "Living with Wildlife," and wildlife viewing webpages); presentations to the WDFW Game Management and Wildlife Diversity Advisory Councils, hunting groups, and wildlife viewing organizations; and WDFW hunter education course materials.

9.5. Develop and provide training, information, and education programs for the public on how to coexist with wolves.

9.5.1. Produce and distribute informational materials and give presentations and workshops on how to safely live, work, and recreate in areas occupied by wolves. When possible, integrate training and educational opportunities about wolves with information about living with other carnivores in Washington, such as cougars, bears, and coyotes. A similar program that has been conducted in Washington, Oregon, and Idaho is the "Living with Carnivores" program. Such programs can be sponsored cooperatively by multiple agencies and organizations.

9.5.2. Distribute information at backcountry trailheads and other appropriate outlets on wolf identification, behavior, dealing with wolf encounters, methods for avoiding wolf habituation, and the potential for negative interactions with domestic dogs.

9.5.3. Give presentations to provide information to the public about co-existing with wolves in Washington.

Target communities closest to the most wolf activity and conduct open houses, town hall meetings, or other events to inform residents about wolf presence, coexistence, and real or perceived safety issues.

9.5.4. Work with other agencies and organizations to promote wolf outreach.

Work with agencies and a variety of non-governmental and tribal organizations to conduct effective information and education programs about living, recreating, and working with wolves in Washington. These entities could assist in the development and presentation of wolf education materials to the public, be a source of funding, and help increase trust among different stakeholder groups.

A potential model for community outreach is the Grizzly Bear Outreach Project (GBOP), a non-governmental organization whose focus is expanding to include wolves and cougars (http://www.bearinfo.org). The project engages community members in a process of education and multi-party dialogue and provides a non-advocacy setting for the involvement of all stakeholder groups. For example, the approach for grizzly bears includes:

- Assessing the knowledge and attitudes of community members prior to implementing education components.

- One-on-one meetings between project staff and community members to gauge concerns and share information.
- Small focus group meetings to discuss grizzly bear issues with 4–6 people at a time in informal settings.
- A coalition of community members to provide a local information source and extend the reach of project staff.
- A project brochure containing information about grizzly bear ecology, and sanitation and safety tips for the home, ranch, and campsite for distribution to communities, hikers, horse packers, hunters, and fishers.
- A modular slide show paralleling the content of the brochure.
- A project website for distribution of information and solicitation of comments from the public.

A similar program for wolves could be developed for selected local communities.

9.6. Develop and provide informational material about wolves and co-existing with them for use in school classrooms, environmental learning centers, and other appropriate outlets.

9.6.1. Develop and distribute materials for K-12 classrooms.

Develop lesson plan kits that include sets of materials and activities for students to learn about wolves (identification, biology, behavior, habitat use, history in Washington, etc.), using WDFW education webpages and as many already established wolf education resources as available and appropriate.

9.6.2. Develop a wolf education webpage.

Work with agency staff to develop a wolf education webpage to assist with lesson planning and presentations, serve as a clearinghouse for approved and appropriate links to more wolf education materials, and provide online learning games and activities.

9.7. Determine public attitudes towards wolves and their recovery in the state.

Conduct public attitude surveys in Washington to determine current perceptions about wolves, approval of management practices, and tolerances for conflict in order to inform wolf recovery and management and information and education needs. Develop follow-up surveys to determine the effectiveness of outreach programs relating to wolves and whether changes are needed in these programs.

10. Coordinate and cooperate with public agencies, landowners, tribes, and non-governmental organizations to help achieve wolf conservation and management objectives.

10.1. Coordinate and communicate with other entities and jurisdictions to share resources, reduce costs, and avoid potential duplication of effort.

10.1.1. Develop memoranda of understanding or cooperative agreements, if appropriate, to spell out roles and responsibilities and to ensure that certain actions are conducted in a timely manner.

It will be desirable to have key contact people identified in advance to facilitate rapid responses and decision making during conflict situations. Coordination with the following agencies and entities will be important: USDA Wildlife Services; U.S. Fish and Wildlife Service; U.S. Forest Service; National Park Service; Bureau of Land Management; tribal governments; Washington Department of Natural Resources; Washington Department of Agriculture; Washington Department of Transportation; other Washington state agencies; county governments; private landowners; law enforcement entities including the U.S. Fish and Wildlife Service, U.S. Forest Service, and county sheriff departments; natural resource agencies in neighboring states and British Columbia; and non-governmental organizations such as the Defenders of Wildlife, Washington Cattlemen's Association, Washington State Sheep Producers, Washington Farm Bureau, and hunting organizations.

10.1.2. Work with adjacent states and British Columbia to encourage maintenance of populations and habitat connectivity to support long-term viability of wolf populations in Washington.

10.2. Cooperate with other entities to secure funding for wolf conservation and management.

Recovery of wolves in Washington through the conservation and management activities described in this plan will be expensive and require long-term funding from new sources. WDFW will seek funding from a variety of sources, including special state or federal appropriations, private foundations, and other private sources. Coordination with other agencies and non-governmental organizations will ensure the optimal use of resources devoted to wolf conservation and management.

11. Conduct research on wolf biology, conservation, and management in Washington.

Seek funding and initiate partnerships with universities and other entities to carry out research on wolf biology, conservation, and management in Washington. WDFW will initiate wolf research if important management questions arise that could be answered through research and monitoring. Universities and other entities may also be interested in partnering and/or initiating research on the following topics and/or on more purely science-based questions. Research having significant WDFW funding or involvement will be reviewed under WDFW's Scientific Review Protocol.

11.1. Determine wolf population status, pack sizes and distribution, mortality rates and causes, productivity, rates of recolonization, dispersal behavior, and disease/health status in Washington.

Long-term research should be conducted on pack reestablishment, home ranges and movements of packs and lone animals, diet, habitat use, population dynamics, sources of mortality, diseases, threats to wolves and other factors limiting the reestablishment of populations, and related topics. Data from these studies and monitoring efforts should then be used to model the estimated size, viability, and habitat use of the state's wolf population, as well as to identify information gaps for additional surveys and research.

11.2. Determine the genetic relationships of recolonizing and established wolves to assess rates of gene flow, genetic diversity, risk of inbreeding, and sources of recolonizing individuals.

11.3. Determine the impacts of wolves on prey and other carnivore populations as wolves become reestablished.

Predator-prey relationships are inherently complex, especially in systems with multiple prey and predator species, as will be the case with wolves and their ungulate prey in Washington. These studies will require baseline data on prey and carnivore populations prior to wolf recovery to help assess the impacts of wolves during and after their reestablishment. Such studies should also examine landscape-level effects.

11.3.1. Determine the prey selection of wolves in Washington.

The year-round food habits of wolves should be identified in multiple regions of the state. Elk and/or deer are expected to comprise the vast majority of prey in most locations, but the contribution of other species (e.g., moose, bighorn sheep, mountain goats) is also of interest. Prey selection will likely vary with season, location, and species availability. Age and sex of prey should also be investigated and compared with availability.

11.3.2. Investigate the dynamics of ungulate populations in areas occupied by wolves.

If management questions arise about the status of ungulate populations in areas occupied by wolves, the ungulate populations in those areas should be investigated in greater detail to obtain improved information on abundance, demographic parameters, and sources of mortality. This information would provide a strong foundation for determining the extent that wolves or other factors affect prey populations and for making sound management decisions.

11.4. If it is determined to be needed, conduct research on wolf depredation of livestock and other domestic animals.

As wolves become reestablished, investigations may be needed on the levels and effects of depredation on livestock and other domestic animals, and the factors influencing depredation. Improved baseline data on depredation levels by other carnivores prior to wolf recolonization will be necessary to assess the impacts of wolves during and after their reestablishment. There is also a strong need to conduct research on non-lethal control methods to reduce wolf depredation on livestock.

11.5. Conduct research on the broader ecological impacts that wolves have on plant and wildlife communities.

As noted at Yellowstone National Park, wolves have the potential to affect ecosystems through regulation of ungulate abundance, thereby benefiting a variety of plants, habitats, and animals. These types of ecological interactions should be investigated in the future as wolves become reestablished in Washington.

12. Report on and evaluate implementation of the plan.

12.1. Centralize data collected during the wolf monitoring program.

WDFW will maintain a centralized database of wolf monitoring data and results to ensure accurate and consistent information is shared with wolf co-managers and the public. WDFW maintains a centralized database (Wildlife Resource Data System) and will retain copies of data collected during annual monitoring activities.

12.2. Publish an annual report summarizing information from wolf conservation and management activities.

Because of the intense interest in wolves and the implementation of this plan, WDFW will produce an annual report summarizing all the activities and results of wolf conservation and management that occurred in Washington during the previous year. The first report will be written one year after adoption of this plan. Reports will be similar to those produced by other western states (e.g., USFWS et al. 2011) and will provide summaries of monitoring results with information on population status, distribution, reproduction, population growth, and mortality; documented depredation on domestic animals and management responses; law enforcement; research; outreach; and other activities pertinent to wolves. The annual report will be available to the public on the WDFW agency website and provided to the Washington Fish and Wildlife Commission, elected officials, and any others requesting copies. Upon request, the Commission, Legislature, and others will be briefed and updated regarding the plan's implementation.

12.3. Evaluate WDFW's effectiveness in meeting the wolf plan goals, objectives, and strategies.

12.3.1. Develop measures to track progress toward meeting the objectives of this plan.

Measures to track progress might include: estimates and trends over time in the numbers and distribution of successful breeding pairs, packs, and total wolves; numbers and success of responses to wolf-livestock conflicts, numbers of wolf-human interactions, and extent of impacts on ungulate populations.

12.3.2. Review the effectiveness of the plan's implementation every five years.

WDFW will evaluate the status of Washington's wolves and the effectiveness of implementing the conservation and management plan every five years, with the first review expected in 2016. Measures identified under Task 12.3.1 will be used to assess progress in implementing the plan's objectives and areas where improvements and adaptive management are needed. The Washington Wolf Interagency Committee and a citizen advisory group will be asked to provide feedback on the evaluation.

12.4. Use the Washington Wolf Interagency Committee to help coordinate implementation and monitoring of the wolf plan.

There is currently a Washington Wolf Interagency Committee, consisting of members from WDFW, USDA Wildlife Services, U.S. Fish and Wildlife Service, U.S. Forest Service; National Park Service, tribal governments, Washington Department of Natural Resources, and Washington Department of Transportation. In the future, participation could be expanded to include other state, federal, and local agencies, as well as wildlife management agencies in Idaho, British Columbia, and Oregon. The purpose of the committee is to coordinate wolf management across land ownerships in the state. Meetings are open and available to the public. The group should prepare an annual report of its activities and contribute to five-year evaluations assessing the effectiveness of the wolf plan's implementation.

12.5. Form a citizen advisory group to provide public feedback on implementation of wolf conservation and management in Washington.

A citizen advisory group will be formed to provide feedback to WDFW on implementation of the conservation and management plan. Aspects addressed might include wolf conservation activities, depredation control activities, the impacts of outreach and education, reviewing problems, and determining needs for new adaptive management procedures. Membership of the advisory group should include a balanced representation of the range of stakeholder values regarding wolf reestablishment in Washington.

13. COSTS AND FUNDING PRIORITIES FOR IMPLEMENTATION

Adequate funding for implementing conservation and management activities is key to the long-term success of the overall plan. This chapter includes estimates of preliminary annual costs to implement some of the most important tasks in the Wolf Conservation and Management Plan during the first six years of implementation (fiscal years 2012-2017). Overall program costs are expected to be smaller during the initial years of wolf recovery when there are fewer wolves to monitor and few claims for compensation of livestock losses, but are expected to increase over time as the wolf population increases.

Priority investments needed to implement the Wolf Conservation and Management Plan during the first six years are listed in Table 14 according to objectives and tasks identified in Chapter 12. They include high priority activities within categories of population monitoring and protection, addressing conflicts with livestock, and outreach and education. The cost estimates for these actions come from a variety of sources, including discussion with government agencies and organizations about current expenditures and readily available budget information for ongoing programs. Wolves would benefit from several ongoing programs (e.g., habitat management for ungulates) that would be carried out regardless of the status of wolves. Only some estimates of partial costs of these programs that can be directly linked to the conservation and management of wolves are included at this time.

Spending levels associated with the plan will be contingent upon availability of funds and creation of partnerships.

Potential Sources of Funding

Some sources of funding for these activities are anticipated to be U.S. Fish and Wildlife Service endangered species recovery grants, U.S. Fish and Wildlife Service state wildlife grants, state nongame and endangered species funding, shared costs with partner agencies and non-governmental organizations, and research grants. Funding for some parts of the program, such as compensation, will likely come from non-profit organizations or appropriations sought from the Washington Legislature. Some non-governmental organizations (e.g. Conservation Northwest) have expressed interest in providing some funding for proactive, non-lethal measures to address livestock conflicts if they occur.

Suggestions for new sources of funding include the creation of a wolf license plate that would fund wolf conservation and management activities. WDFW already receives funds from five other wildlife background specialty plates. Wolf-related activities in Wisconsin are partially funded by a wolf license plate issued on behalf of the Wisconsin Department of Natural Resources. In Montana, the Department of Livestock is developing a plate to help fund the state's wolf compensation program. A wolf specialty plate in Washington could help fund wolf management and recovery activities in Washington. Examples of other possible funding sources could include voluntary public contributions (perhaps made through WDFW's website) and the state hotel/motel lodging tax.

Revenues from hunting licenses and game program funds, which are used for managing game populations, would not be used for the wolf management program. In the future, if wolves become a game species following delisting, game funds would be used for wolf management.

Potential Partners and Other Responsible Parties

Potential partners and responsible parties are agencies or organizations with authority, responsibility, or expressed interest to implement a specific conservation or management action. The listing of a party does not require them to implement the action(s) or to secure funding for implementing the action(s), but they are possible cooperators to accomplish the action(s).

Prioritized Expenditures for the First Six Years (Fiscal Years 2012-2017)

1. Monitor Wolf Distribution and Abundance – High Priority

A comprehensive population monitoring program is an essential part of the wolf conservation and management program and will be conducted throughout the implementation of this plan. Monitoring of population status and trends will begin as wolves become reestablished and will be most intense while the species remains classified as state endangered, threatened, and sensitive. WDFW will have primary responsibility for monitoring wolves, but collaboration with partners will be necessary for a successful monitoring program.

Task 1.1 Establish and maintain a wolf specialist position or redirect current staff within WDFW to locate wolf packs, monitor wolf movements, and conduct other wolf-related activities.

Task 1.2 Monitor the locations of wolves in Washington and determine when resident packs and territories become reestablished.

Task 1.3 Determine the status, trends, distribution, and other population parameters of wolves while listed.

Timeline: Immediate and ongoing for the wolf specialist; efforts will be increased as the wolf population expands in Washington

Cost: $100,000/yr (1 wolf specialist)
$60,000-100,000/yr (6 Wildlife Biologist @5%, telemetry equipment, other equipment, flights, etc)

Potential Partners: U.S. Fish and Wildlife Service, Forest Service, National Park Service, non-governmental organizations, Washington Department of Natural Resources, interested tribal governments, universities, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, British Columbia Ministry of Environment

2. Protect Wolf Populations – High Priority

Strategies will be implemented to protect wolves from sources of mortality and disturbance at den sites. Illegal killing is expected to be a source of mortality as wolves recolonize Washington, based on findings from other western states (USFWS 2009). Intensive monitoring and research activities will be the primary means of identifying both human-related and natural mortality factors for wolves. Wolf managers will ensure that WDFW enforcement officers are aware of locations of wolf pack territories in their districts, including den sites and rendezvous sites, so that increased patrolling and monitoring of wolves occurs in these areas. WDFW biologists, wolf specialists, and enforcement officers will maintain communication so that any issues that need to be addressed are quickly handled. WDFW will work with partners on federal and state lands to ensure protection for wolves, and will coordinate enforcement efforts with the U.S. Fish and Wildlife Service.

Task 2.1 Identify human-related and natural sources of mortality.

Task 2.2 Minimize factors contributing to wolf mortality.

Task 2.3 Minimize disturbance at active wolf den sites.

Timeline: Immediate and ongoing; efforts will be increased as the wolf population expands in Washington

Cost: $65,000-75,000/yr (10 Enforcement Officers @3%, 6 Wildlife Biologists @3%)

Potential Partners: U.S. Fish and Wildlife Service, Forest Service, National Park Service, Washington Department of Natural Resources, non-governmental organizations, interested tribal governments, state, county, and municipal law enforcement agencies

3. Manage Wolf–Livestock Conflicts – High priority

Wolf depredation on livestock is expected to occur in Washington as wolves become reestablished. Resolving wolf-livestock conflicts will require both non-lethal and lethal control responses. Resolution of conflicts will need to be managed in a way that does not jeopardize recovery of the species or require relisting. This approach is required because of the desire to reduce conflicts and build social tolerance for wolves, thereby enhancing the chances for reestablishing the species in the state. WDFW will provide technical assistance to livestock producers to assist proactive measures to prevent conflicts.

It is recognized that there will be some economic costs to producers when conflicts occur. Depredation concerns will be addressed by investigating reported complaints, verifying depredations accurately, implementing depredation management actions to abate or prevent damage, and providing adequate compensation for documented losses in a timely manner.

Where wolves are federally listed, the U.S. Fish and Wildlife Service and USDA Wildlife Services will be in the lead to respond to depredation reports. In areas where wolves are federally delisted, WDFW will be in the lead to respond.

Task 4.1 Work with livestock producers to resolve conflicts with wolves.
Task 4.2 Verify reported wolf depredations.

Timeline: Immediate and ongoing; efforts will be increased as the wolf population expands in Washington

Cost: $30,000/yr (10 Enforcement Officers @2%, 7 Wildlife Biologists @2%)
$25,000/yr (materials)

Potential Partners: USDA Wildlife Services, U.S. Fish and Wildlife Service, Forest Service, Washington Department of Natural Resources, non-governmental organizations, interested tribal governments, Washington Department of Agriculture, county extension services, private landowners, Bureau of Land Management

4. *Provide Compensation for Livestock Losses* – High priority

Task 4.3 Provide compensation for livestock losses due to wolves and to implement proactive deterrents to reduce such depredations.

Timeline: Ongoing; efforts will be increased as the wolf population expands in Washington

Cost: Currently $0; future costs to be determined. Compensation for confirmed and probable wolf depredation could range from $0-10,000/yr over the next 6 years. For comparison, see Table 20, which presents data from other states on compensation paid during varying levels of wolf population recovery. Washington payments would be somewhat higher because of the double payments on sites of 100 or more acres. Payment of claims would be dependent on availability of funds.

Potential Partners: Non-governmental organizations, state and federal agencies

5. *Assist with Proactive Deterrents to Reduce Livestock Conflicts* – High priority

Task 4.3 Provide compensation for livestock losses due to wolves and to implement proactive deterrents to reduce such depredations.

Timeline: Ongoing; efforts will be increased as the wolf population expands in Washington

Cost: Currently $3,000; future costs to be determined. Costs of proactive deterrents could range from $4,000-10,000/yr over the next 6 years, depending on the number of conflicts. These could include radio-collars, turbo-fladry, RAG boxes, Range Riders, etc. It is expected that public and private partners would help fund the use of proactive deterrents.

Potential Partners: Non-governmental organizations, state and federal agencies, private landowners, interested tribal governments

6. Conduct Outreach and Education – High Priority

A comprehensive outreach and education program will be needed to provide accurate and updated information on wolf conservation and management and to prepare Washington residents to coexist with wolves. Such a program will have many approaches and messages for meeting the varied information needs of different audiences. One initial priority is to develop a wolf communication and outreach plan for Washington. Outreach will involve providing the public with numerous types of information relating to wolves and their status in the state. Outreach to livestock producers will provide information and training in methods for preventing and responding to wolf-livestock conflicts and depredations. Outreach to hunters will focus on ungulate population status and trends, wolf diet, wolf-ungulate relationships, and wolf-ungulate population studies. Outreach to the general public will include information on how to safely live, work, and recreate in areas occupied by wolves. Public attitude surveys will be conducted in Washington to determine current perceptions about wolves, approval of management practices, and tolerances for conflict in order to inform wolf recovery and management and information and education needs. To better design a wolf outreach program, surveys of Washington residents are needed to assess the public's needs for wolf information and outreach.

Task 9.2 Provide information to the public about ongoing wolf conservation and management activities.

Task 9.3 Develop and provide training, information, and education programs to address concerns over wolf-livestock conflicts.

Task 9.4 Develop and provide information and education programs for hunters, people viewing ungulates, and others to address concerns over wolf-ungulate interactions.

Task 9.5 Develop and provide training, information, and education programs for the public on how to coexist with wolves.

Task 9.7 Determine public attitudes towards wolves and their recovery in the state.

Timeline: Immediate and ongoing; efforts will be increased as the wolf population expands in Washington

Cost: $30,000/yr (2 Public Affairs staff @5%, 9 Wildlife Biologists @1%, 10 Enforcement Officers @1%)
$25,000/yr (materials)
$50,000 (contract to conduct survey to assess public knowledge and attitudes prior to designing outreach plan; this would be a one-time cost in the first year)

Potential Partners: U.S. Fish and Wildlife Service, non-governmental organizations, Forest Service, National Park Service, Washington Department of Natural Resources, interested tribal governments, USDA Wildlife Services, county extension services, county and municipal governments

Table 14. Current (2011) and future (2012-2017) estimated costs for implementing high priority tasks in the Wolf Conservation and Management Plan.

Priority Expenditures	2011 Costs	2012 Estimate	2013 Estimate	2014 Estimate	2015 Estimate	2016 Estimate	2017 Estimate
1. Monitor Wolf Distribution and Abundance	$140,000	$160,000	$160,000	$180,000	$180,000	$200,000	$200,000
2. Protect Wolf Populations	$50,000	$65,000	$65,000	$65,000	$75,000	$75,000	$75,000
3. Manage Wolf-Livestock Conflicts	$5,000	$55,000	$55,000	$55,000	$55,000	$55,000	$55,000
4. Compensation for Livestock Losses	$0	$2,500	$4,000	$5,000	$6,000	$8,000	$10,000
5. Assist with Proactive Deterrents	$3,000	$4,000	$5,000	$5,000	$6,000	$8,000	$10,000
6. Conduct Outreach and Education	$30,000	$105,000	$55,000	$55,000	$55,000	$55,000	$55,000
Total	$228,000	$391,500	$344,000	$365,000	$377,000	$401,000	$405,000

14. ECONOMIC ANALYSIS

The main objectives of this chapter are to describe and assess the potential impacts (both negative and positive) to specific sectors of Washington's economy as wolves become reestablished in the state, with information provided on the following topics:

- background on Washington's human population and economy (Section A)
- potential impacts to livestock production (Section B)
- potential impacts to big game hunting (Section C)
- potential impacts to wildlife tourism (Section D)
- potential impacts to the forest products industry (Section E)
- potential impacts to other segments of the economy (Section F)

Values of wildlife are reflected in social attitudes and actions associated with wildlife use and management. Until recently the negative economic impacts of wolves, such as livestock depredation and wild game losses, dominated social perceptions of the species. Yet, economic activities and their relative importance change as social norms and practices change. This chapter provides recent data on a number of pertinent topics, including (1) economic activity in Washington, (2) statewide livestock production, (3) wolf depredation in neighboring states, (4) big game status and hunting in Washington, (5) WDFW license revenues and hunting tag sales, (6) wildlife watching in the state, (7) wolf viewing in other states, and (8) the forest products industry in Washington. This background information comes from many sources, but primarily from economic evaluations of wolf reintroductions in other states (e.g., MFWP 2003, Kroeger et al. 2006, Unsworth et al. 2005, Duffield et al. 2006, 2008), other literature on wolves from elsewhere in the United States, published and unpublished data from WDFW and other state and federal agencies, and interviews and correspondence with state and federal officials, especially state wolf managers in Idaho and Montana, and others such as the president of the Washington Outfitters and Guides Association. Data limitations have required that some information be presented on a broader statewide or subregional basis rather than on a county level, where wolf-related impacts are most likely to be felt.

Many of the (negative) costs and (positive) benefits that could result from the presence of wolves are included in this chapter. This discussion employs a regional economic accounting approach that focuses on expenditures and market prices to evaluate the economic impacts of wolves returning to Washington. It does not use a full benefit-cost framework wherein the net benefits and costs to society as a whole are examined. Under this latter approach, non-market values would also be considered (Duffield and Neher 1996, MFWP 2003) and would include, for example, the personal benefits that hunters derive from the experience of going hunting. Passive use or non-use values, such as those that some individuals may place on knowing that wolves are being restored in Washington, also fall under this approach.

Additionally, this chapter does not make use of multiplier values because they have not been reliably estimated for many of the economic sectors discussed. Multipliers reflect the total spending impact throughout an economy that can be expected from a specific activity through resulting "ripple effects" or spin-off activities.

A. Washington's Population and Economy

Washington had an estimated human population of 6.49 million people in 2007, which is the second largest of any western state (OFM 2007a, USCB 2007). Seventy-eight percent of the population, or about 5.07 million people, live in western Washington, whereas 22%, or about 1.42 million people, reside in eastern Washington. Total population size has expanded 10.2% since 2000 and is projected to grow another 33% by 2030, reaching 8.64 million people. Current overall human density (97.5 people per square mile) is higher than in any other state in the West aside from California. Average density is substantially higher in western Washington (204.9 people per square mile) than in eastern Washington (34.0 people per square mile). Seventeen of the state's 39 counties have average human densities of fewer than 25 people per square mile (OFM 2008). Average human density for the state is expected to reach 129.8 people per square mile by 2030 (OFM 2006a).

Median household income in Washington was $53,439 in 2004-2006, which was 10.9% greater than in the nation as a whole (ERFC 2007a). The state's median household income increased at a faster rate than the U.S. median in most years since 1996. In 2006, mean per capita personal income for the state was $38,067, which ranked 16th in the nation. Per capita income has increased steadily over the past decade at 3.0% annually and is also above the national average. Total personal income in the state was $243.5 billion in 2006.

Washington ranks fairly high nationally in most categories pertaining to quality of life (ERFC 2007a). It ranks well above the national averages for air and water quality, various health indices, availability and use of state parks and recreation areas, and public library service, and ranks well below the national averages for rates of violent crime, homicide, and amounts of environmental toxins released. However, the state rates relatively poorly for cost of housing in urban areas and funding for the arts. Washington also ranks in the upper half of the country in educational skills and accomplishments of its residents (ERFC 2007a).

B. Livestock Production

A concern about the reestablishment of wolves in Washington is their potential to kill, injure, or stress cattle, sheep, and other domestic animals. Financial losses may result directly from wolf depredation whether confirmed or not, and indirect financial losses may accumulate because of increased management activities or changes to ranching and farming operations. These financial losses would accrue to individual producers and may be significant to them (Muhly and Musiani 2009).

Overview of Livestock Production in Washington

The total value of agricultural production for all crops and livestock in Washington was $6.67 billion in 2006 (NASS 2007a), representing an estimated 2.3% of the state's economic output. Livestock accounted for 23% of the value of all farm products sold (NASS 2007a). Farm income comprised 0.5% of the total personal income in the state (ERFC 2007b).

Production value of cattle and milk totaled $1.28 billion and accounted for 82% of all livestock-related output in Washington in 2006. Estimated inventories of cattle and calves in the state have remained relatively stable at about 1.1-1.2 million head during the past decade (NASS 2004, 2007a).

These estimates include both beef and dairy cattle, as well as about 300,000 cattle confined to feedlots. Surveys from 2002, the most recent year for which full data are available, reveal that cattle inventories per county are generally largest in counties along the Cascade Mountains and in the Columbia Basin (Table 15). Most of the state's cattle operations are categorized as extra small (1-49 head; 80% of total), whereas 13% of operations hold 100 or more head (Table 16). The three geographic regions where wolves are most likely to first reestablish (i.e., northeastern Washington, southeastern Washington, and the Cascades) held about 669,000 cattle and 6,100 cattle ranching and farming operations in 2002, or 61% and 63% of the state's totals in these categories, respectively (Tables 15, 16). Within these regions, cattle numbers were largest in Yakima, Whatcom, and Okanogan counties and smallest in Skamania and Chelan counties (Table 15). The vast majority of non-confined cattle in the state are produced in eastern Washington.

Washington's sheep industry is far smaller than its cattle industry, with the statewide production value of sheep and wool totaling $3.9 million in 2006 and accounting for 0.3% of all livestock-related output. Historical sheep production peaked in the early 1900s, when more than 800,000 head were present, but has declined greatly since then. Estimated numbers have fluctuated between 46,000 and 58,000 head during the past decade (NASS 2007a). In 2002, the last year for which full data are available, sheep inventories totaled 58,000 head statewide and were largest in Yakima, Okanogan, Grant, and Whitman counties (Table 15). Most sheep operations in the state are categorized as extra small (1-24 head; 71% of total), whereas 5% of operations held 100 or more head (Table 16). The three geographic regions where wolves are most likely to first reestablish (i.e., northeastern Washington, southeastern Washington, and the Cascades) held about 35,000 sheep and 960 sheep ranching operations in 2002, or 60% and 56% of the state's totals in these categories, respectively. Among the counties in these regions, sheep numbers were largest in Yakima and Okanogan counties and smallest in Skamania, Pend Oreille, Garfield, Columbia, and Asotin counties (Table 16).

Table 15. Inventories of livestock and farmland in Washington's 39 counties in 2002 (NASS 2004).

	Number of animals					Total farmland (acres)[d]	% of county in farmland
	Cattle[a]	Sheep[b]	Horses	Goats[c]	Llamas		
Washington total	1,100,181	58,470	75,951	23,217	12,701	15,318,008	36.0
Average per county	28,210	1,499	1,947	595	326	392,769	33.0
Northeastern Washington							
Ferry	8,891	511	1,259	9	136	799,435	56.7
Okanogan	43,602	3,490	5,084	925	196	1,241,316	36.8
Pend Oreille	5,001	209	640	D[e]	59	61,239	6.8
Stevens	30,009	2,244	3,437	693	265	528,402	33.3
Average	22,626	1,614	2,605	542	164	657,598	33.4
Southeastern Washington							
Asotin	9,939	537	431	181	5	280,393	69.0
Columbia	5,709	384	326	94	D[e]	294,661	53.0
Garfield	10,520	376	273	51	-	312,425	68.7
Average	8,723	432	343	109	3	295,826	63.6

	Number of animals					Total farmland (acres)[d]	% of county in farmland
	Cattle[a]	Sheep[b]	Horses	Goats[c]	Llamas		
Columbia Basin							
Adams	36,462	981	508	115	37	1,067,079	86.6
Benton	28,513	2,116	2,434	1,855	144	607,963	55.8
Douglas	11,389	154	742	311	42	878,867	75.4
Franklin	43,745	1,477	1,221	558	143	664,875	83.6
Grant	156,999	3,369	2,929	956	169	1,074,074	62.6
Lincoln	22,706	940	1,412	814	14	1,233,377	83.4
Spokane	25,821	2,430	5,623	1,033	1,306	643,377	57.0
Walla Walla	24,358	1,131	1,356	910	208	700,560	86.2
Whitman	15,721	3,213	908	527	83	1,328,337	96.1
Average	40,635	1,757	1,904	787	238	910,945	76.3
Cascades							
Chelan	1,404	D[e]	836	104	105	112,023	6.0
Clark	16,068	1,993	3,433	1,362	1,396	70,694	17.6
Cowlitz	4,546	824	1,066	117	178	39,582	5.4
King	22,529	1,780	5,227	423	1,054	41,769	3.1
Kittitas	31,415	2,284	3,749	369	6	230,646	15.7
Klickitat	22,719	2,669	1,525	1,429	315	606,794	50.6
Lewis	31,917	1,658	2,891	660	442	130,950	8.5
Pierce	14,090	2,013	4,621	1,146	683	57,224	5.3
Skagit	36,059	766	1,394	403	294	113,821	10.2
Skamania	626	157	142	64	31	5,712	0.5
Snohomish	32,165	1,676	4,907	1,536	584	68,612	5.1
Whatcom	112,417	691	2,350	1,069	408	148,027	10.9
Yakima	230,275	10,786	5,616	3,130	685	1,678,984	61.1
Average	42,787	2,275	2,904	909	475	254,218	15.4
Other Western Washington Counties							
Clallam	5,744	1,071	929	304	493	22,372	2.0
Grays Harbor	10,543	574	808	141	281	53,594	4.4
Island	5,217	388	707	102	846	15,018	11.3
Jefferson	3,306	442	385	110	142	12,274	1.1
Kitsap	1,300	682	1,837	341	323	16,094	6.4
Mason	1,552	188	502	240	75	21,641	3.5
Pacific	7,108	D[e]	321	D[e]	D[e]	51,824	8.7
San Juan	2,333	2,731	347	148	820	17,145	15.3
Thurston	23,928	860	3,639	868	687	74,442	16.0
Wahkiakum	3,535	558	136	104	D[e]	12,386	7.3
Average	6,457	833	961	262	458	29,679	7.6

[a] Includes beef, dairy, and other cattle. Other cattle are defined as heifers, steers, bulls 500 pounds and over, and all calves under 500 pounds. Total numbers in the state for 2007 were estimated at 1,140,000 head (NASS 2007a).
[b] Includes sheep and lambs. Total numbers in the state for 2007 were estimated at 51,000 head (NASS 2007a).
[c] Includes angora, milk, and meat goats. Total numbers in the state for 2007 were estimated at 33,200 head (NASS 2007a).
[d] Farms are defined as any location from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.
[e] Figures are withheld in USDA (2004) to avoid disclosing data for individual farming operations.

Table 16. Numbers of cattle and sheep operations by size category and geographic region for Washington's 39 counties in 2002 (NASS 2004).

	Numbers of cattle operations[a,b]					Numbers of sheep operations[b,c]				
	Total operations	Extra small (<50 head)	Small (50-99 head)	Medium (100-499 head)	Large (≥500 head)	Total operations	Extra small (<25 head)	Small (25-99 head)	Medium (100-999 head)	Large (≥1,000 head)
Washington total	12,215	9,711	866	1,273	365	1,709	1,221	405	79	4
Percent of total	100%	80%	7%	10%	3%	100%	71%	24%	5%	<1%
Average no. per county	313	249	22	33	9	44	31	10	2	<1
Northeastern Washington										
Ferry	101	72	8	18	3	17	5	11	1	-
Okanogan	451	324	41	59	6	74	44	27	2	1
Pend Oreille	147	123	12	11	1	15	11	4	-	-
Stevens	569	441	66	60	2	53	38	13	1	1
Average	317	240	32	37	3	40	25	14	1	1
Southeastern Washington										
Asotin	101	55	16	27	3	7	4	2	1	-
Columbia	97	73	10	12	2	13	10	3	-	-
Garfield	71	38	11	16	6	11	6	4	1	-
Average	90	55	12	18	4	10	7	3	1	-
Columbia Basin										
Adams	172	114	15	29	14	20	13	4	3	-
Benton	468	422	23	18	5	68	48	15	5	-
Douglas	95	59	10	23	3	7	5	2	-	-
Franklin	211	137	17	32	25	36	17	16	3	-
Grant	516	353	43	82	38	66	41	15	10	-
Lincoln	211	115	37	53	6	28	17	11	-	-
Spokane	649	546	46	52	5	93	77	12	4	-
Walla Walla	239	192	24	18	5	54	41	12	1	-
Whitman	238	165	37	30	6	67	43	20	3	1
Average	311	234	28	37	12	49	34	12	3	-
Cascades										
Chelan	66	57	5	4	-	11	10	1	-	-
Clark	693	648	24	15	6	83	55	24	4	-

Table 16. Numbers of cattle and sheep operations by size category and geographic region for Washington's 39 counties in 2002 (NASS 2004).

	Numbers of cattle operations[a,b]					Numbers of sheep operations[b,c]				
	Total operations	Extra small (<50 head)	Small (50-99 head)	Medium (100-499 head)	Large (≥500 head)	Total operations	Extra small (<25 head)	Small (25-99 head)	Medium (100-999 head)	Large (≥1,000 head)
Cowlitz	261	247	8	4	2	29	21	6	2	-
King	418	351	19	36	12	89	65	23	1	-
Kittitas	339	242	30	55	12	64	47	15	2	-
Klickitat	267	168	36	58	5	61	43	10	8	-
Lewis	756	645	46	59	6	81	59	19	3	-
Pierce	629	594	17	14	4	90	74	14	2	-
Skagit	402	296	25	63	18	32	25	5	2	-
Skamania	35	30	4	1	-	6	4	2	-	-
Snohomish	561	485	12	45	19	73	51	20	2	-
Whatcom	813	502	66	183	62	58	52	6	-	-
Yakima	916	697	66	88	65	97	78	14	4	1
Average	472	382	28	48	16	60	45	12	2	-
Other Western Washington Counties										
Clallam	186	160	10	15	1	37	27	7	3	-
Grays Harbor	271	233	19	16	3	66	41	15	10	-
Island	166	152	6	4	4	25	20	5	-	-
Jefferson	76	57	10	7	2	11	5	4	2	-
Kitsap	168	166	2	-	-	49	39	10	-	-
Mason	73	65	3	5	-	16	16	-	-	-
Pacific	130	103	13	12	2	2	2	-	-	-
San Juan	81	72	3	6	-	77	41	30	6	-
Thurston	485	439	19	20	7	60	49	11	-	-
Wahkiakum	91	73	7	11	-	12	4	6	2	-
Average	173	152	9	10	2	36	24	9	2	-

[a] Includes beef, dairy, and other cattle. Other cattle are defined as heifers, steers, bulls 500 pounds and over, and all calves under 500 pounds.
[b] An operation is defined as any location from which $1,000 or more of livestock-related products were produced and sold, or normally would have been sold, during the census year.
[c] Includes sheep and lambs.

Other livestock that are vulnerable to wolf predation include goats, llamas, and horses. Inventories of these animals in Washington in 2002 were as follows: horses, nearly 76,000 head, most numerous in Spokane, Yakima, King, and Okanogan counties; goats, about 23,200 head, most numerous in Yakima, Benton, and Snohomish counties; and llamas, 12,700 head, most numerous in Clark, Spokane, and King counties (Table 15). Goats are the only livestock species to have significantly expanded in abundance over the past decade, with numbers more than doubling from 16,000 head in 1997 to 33,200 goats in 2007 (NASS 2004, 2007a). Horses, goats, llamas, and other livestock are kept mainly by hobby owners rather than for commercial production. Statewide sales figures totaled $18.6 million for horses (combined with small numbers of ponies, mules, burros, and donkeys) in 2002 (NASS 2004), but data does not exist for goats and llamas. Swine are excluded from this discussion because they have not been depredated by wolves in neighboring states and are therefore not considered at risk.

Many livestock producers in Washington rely entirely on private land for their annual operations, whereas some depend on a combination of private land and public land grazing leases. In these latter cases, animals are typically kept on private land during the winter, with most calving and lambing occurring in late winter or early spring. During the warmer months, livestock are taken to grazing allotments on public lands, many of which occur in more remote locations with rougher topography and natural vegetative cover. Livestock are then gathered in the fall, with young shipped to market and breeding stock returned to private land for winter.

About 3.36 million acres in 1,333 active grazing leases currently exist on public lands in Washington (Table 17). The majority of leased acreage occurs on national forest lands, with smaller amounts on lands owned or managed by the Washington Department of Natural Resources, U.S. Bureau of Land Management, and WDFW. Overall, grazing occurs on about 24.9% of the lands owned or managed by these four agencies combined. By far the most leases occur in eastern Washington and are used by cattle. Average lease size is considerably larger on national forest lands (14,109 acres per lease) than on other agency lands (WDNR, 967 acres per lease or permit range; BLM, 986 acres per lease; WDFW, 1,761 acres per lease). On Forest Service lands, considerable variation exists in the percent of land designated as grazing leases within each national forest, ranging from a high of 52.7% in Colville National Forest to 0% in Mt. Baker-Snolqualmie and Olympic National Forests (Table 17). Numbers of active leases on national forests have declined substantially over the past 15 years primarily because of economic and social reasons (W. Gaines, pers. comm.).

Producers can lose livestock to a variety of natural and non-natural causes, including disease, weather, birthing problems, and predation. In Washington, death losses from all causes totaled 44,000 cattle and calves in 2005 and 5,000 sheep and lambs in 2004 (Table 18). These represented 4.1% of all cattle and calves and 10.9% of all sheep and lambs raised in the state. Ninety-four percent of cattle and calf death losses were non-predator related and were valued at $28.7 million (Table 18). For sheep and lambs, 54% of death losses were non-predator related and were valued at $293,000. Predators (primarily coyotes and cougars) killed an estimated 2,500 cattle and calves worth $1.53 million and 2,300 sheep and lambs worth $192,000 (Table 18).

<u>Wolf Depredation on Ranch Animals</u>

Background information on this topic appears in Chapter 4, Sections A and B.

Compensation Programs for Wolf-Related Losses and Deterrence

Several compensation programs currently exist or are under consideration in the western United States to help producers recover some of the costs associated with wolf predation. These are described in Chapter 4, Section C.

Table 17. Numbers and acreages of active grazing leases by livestock category on lands owned by the U.S. Forest Service, U.S. Bureau of Land Management, Washington Department of Natural Resources, and WDFW in Washington.

	Cattle		Sheep		Unassigned by species		Total		Percent of Agency Land[a]
Agency	No.	Acreage	No.	Acreage	No.	Acreage	No.	Acreage	
Forest Service[b]									
Okanogan N. F.	69	770,563	0	0	1	11,427	70	781,990	45.7
Colville N. F.	52	714,990	0	0	1	2,333	53	717,323	59.8
Wenatchee N. F.	14	147,937	10	266,108	0	0	24	414,045	18.6
Gifford Pinchot N. F.	3	188,531	0	0	0	0	3	188,531	13.8
Umatilla N. F.[c]	5	85,010	0	0	0	0	5	85,010	27.3
Mt. Baker-Snolqualmie	0	0	0	0	0	0	0	0	0
Olympic N.F.	0	0	0	0	0	0	0	0	0
Subtotal	143	1,907031	10	266,108	2	13,760	155	2,186,899	23.8
Washington DNR[d]									
Southeast	0	0	0	0	458	449,130	458	449,130	47.0
Northeast	0	0	0	0	404	393,194	404	393,194	69.7
Pacific Cascade	0	0	0	0	5	152	5	152	<0.1
Northwest	0	0	0	0	2	120	2	120	<0.1
South Puget Sound	0	0	0	0	2	30	2	30	<0.1
Olympic	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	871	842,626	871	842,626	27.3
Bureau of Land Mgmt.[e]									
Eastern Washington	271	265,024	2	4,635	1	606	274	270,265	63.7
Western Washington	0	0	0	0	0	0	0	0	0
Subtotal	271	265,024	2	4,635	1	606	274	270,265	63.5
WDFW[f]									
Eastern Washington	30	57,337	0	0	0	0	30	57,337	7.6
Western Washington	3	765	0	0	0	0	3	765	1.4
Subtotal	33	58,102	0	0	0	0	33	58,102	7.2
Total	447	2,230,157	12	270,743	874	856,992	1,333	3,357,892	24.9

[a] Allotment coverage as a percent of the total land area owned or managed by the agency within each subcategory.
[b] Data for 2004-2007 provided by J. Begley, U.S. Forest Service.
[c] Data presented for Umatilla National Forest represent land coverage within Washington only.
[d] Data for 2011 provided by P. Ryan, Washington Department of Natural Resources. Data are listed according to WDNR region and include both grazing leases and permit ranges. Although leases and permit ranges are not specified according to type of livestock, almost all livestock using these lands are cattle.
[e] Data for 2010 provided by D. Peterson, U.S. Bureau of Land Management. The dividing line between eastern and western Washington is the crest of the Cascades Mountains.
[f] Data for June 2011. Data include both lands owned and lands controlled. The dividing line between eastern and western Washington is the crest of the Cascades Mountains.

Table 18. Annual death losses of livestock from different causes and their monetary values for Washington in 2004-2005 (NASS 2005, 2006).

Causes of losses	Cattle[a,b]	Calves[a]	Sheep[a]	Lambs[a]
Non-predator losses (no. of head)				
Digestive problems	4,000	5,200	200	100
Respiratory problems	3,000	8,500	200	200
Metabolic problems	2,600	300	100	100
Mastitis	1,400	-	-	-
Other diseases	1,200	400	-	-
Calving/lambing problems	1,300	3,200	200	-
Lameness/injury	2,400	300	-	-
Weather-related	300	800	-	-
Old age	-	-	800	-
Theft	300	-	-	-
Poisoning	100	-	-	-
Other non-predator[c]	1,400	700	400	100
Unknown non-predator[d]	2,100	2,000	200	100
Total non-predator losses	20,100	21,400	2,100	600
Value of all non-predator losses ($)	20,703,000	8,025,000	258,000	35,000
Predator losses (no. of head)				
Coyotes	-	600	500	1,000
Dogs	-	-	100	300
Cougars and bobcats	200	600	200	-
Bears	-	-	-	100
Other predators	300	300	100	-
Unknown predators[e]	400	100	-	-
Total predator losses	900	1,600	900	1,400
Value of all predator losses ($)	927,000	600,000	111,000	81,000
Losses from all causes (no. of head)	21,000	23,000	3,000	2,000
Value of all losses ($)	21,630,000	8,625,000	369,000	116,000

[a] Data for cattle and calves are from 2005; data for sheep and lambs are from 2004. Cattle include beef and dairy cattle as well as cattle in feedlots.
[b] Cattle are defined here as all cows, bulls, steers, and heifers weighing over 500 pounds.
[c] Includes accidents, fire, starvation, dehydration, etc.
[d] Exact cause of death was unidentifiable.
[e] Species of predator was not determined.

Economic Concerns of Washington's Ranching Industry over Wolves

The reestablishment of wolves in Washington will affect some ranchers living in or near wolf-occupied areas through impacts to their livestock and/or property management (Unsworth et al. 2005). Concerns about possible economic impacts that have been expressed by ranchers include:

1) Depredation of ranch animals, including possible deaths and injuries of cattle, sheep, dogs, and other ranch animals resulting from wolf attacks.

2) Possible non-lethal physiological impacts on ranch animals, including possible weight loss, stress, and lower birth rates in ranch animals resulting from the presence of wolves nearby.

3) Changes in forage use, if ranchers needed to move livestock more often or had to move them to alternative grazing sites to avoid depredation.

4) Need for additional labor, if they had to increase supervision of ranch animals and invest time in reporting depredation losses.

5) Increased expenditures, including purchasing of replacement stock and proactive non-lethal control measures, such as herding and guarding dogs, fencing, fladry, and noise deterrents, as well as increased wear on vehicles and fuel use.

6) That ranches affected disproportionately by wolves might go out of business or experience reduced market values.

In many cases, wolf-related losses may cause disproportionately greater financial hardship for extra small or small producers (which comprise the large majority of the cattle and sheep operations in Washington; see Section B) than for larger producers.

In addition to these possible costs, some positive impacts for livestock operations could result from wolf presence. These could include reducing populations of coyotes and other predators, thereby reducing predation on livestock by those species. Improved forage conditions for livestock could result if elk and deer populations were redistributed off ranch properties by wolves; however, if elk and deer were moved onto grazing land by wolf presence, then there could be negative impacts to livestock forage availability.

Wool, meat, and other products can be marketed for higher prices when certified as being raised using "predator friendly" practices (Predator Friendly 2008). Under this approach, livestock producers commit to not kill wolves and other predators during their ranching operations and instead deal with conflicts using non-lethal means. Although operators may incur some additional losses in their herds or flocks, higher prices for the product are intended to offset the difference. The number of producers using this type of marketing remains quite small, but there is potential for expansion.

Predicting Losses of Ranch Animals in Washington Due to Wolves

Predicting the numbers of ranch animals that might be killed annually in Washington as wolves become reestablished is difficult because of the many uncertainties over where and how many wolves will eventually inhabit the state, the frequency that they will interact with livestock, problems in determining actual versus confirmed numbers of livestock killed, and ongoing improvements in the adaptive management responses of ranchers and wildlife agencies. Nevertheless, this section presents some rough estimates of confirmable losses and their monetary value that might be expected to occur based on analyses of depredation data from Idaho, Montana, and Wyoming for 1987 to 2007 (Table 5). To obtain these estimates, separate regression lines were fitted to the loss data for cattle, sheep, and dogs from each state (Figure 18). Low and high estimates of losses for Washington were then derived for four population size categories (50, 100, 200, and 300) of wolves using the shallowest and steepest of the three regression lines for Idaho, Montana, and Wyoming, respectively. These population size categories roughly correspond to the following numbers of packs and successful breeding pairs, as described in Table 19: 50 wolves, 5-8 packs, and 5-7 successful breeding pairs; 100 wolves, 9-16 packs, and 8-13 successful breeding pairs; 200 wolves, 18-33 packs, and 12-21 successful breeding pairs; 300 wolves, 27-49 packs, and 19-34 successful breeding pairs.

The projections of depredations presented here assume that interactions between livestock and wolves in Washington will be similar to those in neighboring states. However, this assumption must be viewed cautiously because of differences in livestock numbers (especially the lower number of sheep in Washington) and distribution, husbandry methods, availability of natural prey, land use, and human densities. In addition, these projections represent average expected losses per year and do not demonstrate the annual variation in depredations that commonly occurs in Idaho, Montana, and Wyoming.

Low and high hypothetical predictions of confirmable annual losses of ranch animals for Washington are presented in Table 19 for each of four population size categories of wolves. Total populations of 50 and 100 wolves are expected to depredate very small numbers of livestock. Fifty wolves may kill about 1-6 cattle and 7-16 sheep per year, with annual take perhaps doubling for 100 wolves. Larger wolf populations will likely kill greater numbers of livestock, with projections of 6-28 cattle and 20-60 sheep killed annually by 200 wolves, and 12-67 cattle and 22-92 sheep killed annually if 300 wolves became reestablished (Table 19). However, sheep losses are expected to be on the low end of these estimates because sheep numbers are much smaller in Washington than in Idaho, Montana, and Wyoming (see NASS 2004). Even at a population of 300 wolves, these levels of depredations represent 4% or less of the annual predator-caused death losses experienced by Washington cattle and sheep producers. Depredations on horses, other livestock, and guarding/herding dogs are expected to be minor for each of the wolf population size categories.

Table 19 presents estimates of the annual monetary worth of ranch animals that may be depredated by wolves in Washington in the future under different wolf population sizes ranging from 50-300 wolves. To determine this value, average monetary values (in current dollars for 2007) of livestock and dogs were assigned as follows:

- **Cattle** - $669 per head, based on the average fall (September to November) value of 600-pound calves using Washington auction prices for 500- to 600-pound steer calves during 2004-2007 (data from Livestock Market Information Center; J. S. Neibergs, pers. comm.). This represents the earning potential of the animal rather than its value at the time of death. Calf value is used because calves are expected to be the age class of cattle most commonly killed by wolves (Chapter 4, Section A).

- **Sheep** - $137 per head, based on the average value of sheep sold across all size and weight classes in Washington in 2007 (NASS 2007c). This represents the earning potential of the animal rather than its value at the time of death.

- **Horses** - $1,775 per animal, based on an average value in 2004 of $1,620 for ranch horses reported by Unsworth et al. (2005) and converted to current dollars for 2007.

- **Dogs** - $625 per animal, based on the approximate cost of a 6-month-old guarding dog (Great Pyrenees, Akbash, or Great Pyrenees-Akbash cross) in Idaho, Montana, and Wyoming in 2008 (J. Timberlake, pers. comm.).

Figure 18. Relationships between confirmed losses of (a) cattle, (b) sheep, and (c) dogs and minimum fall wolf numbers in Idaho, Montana, and Idaho through 2007 (plotted from data in Table 5).

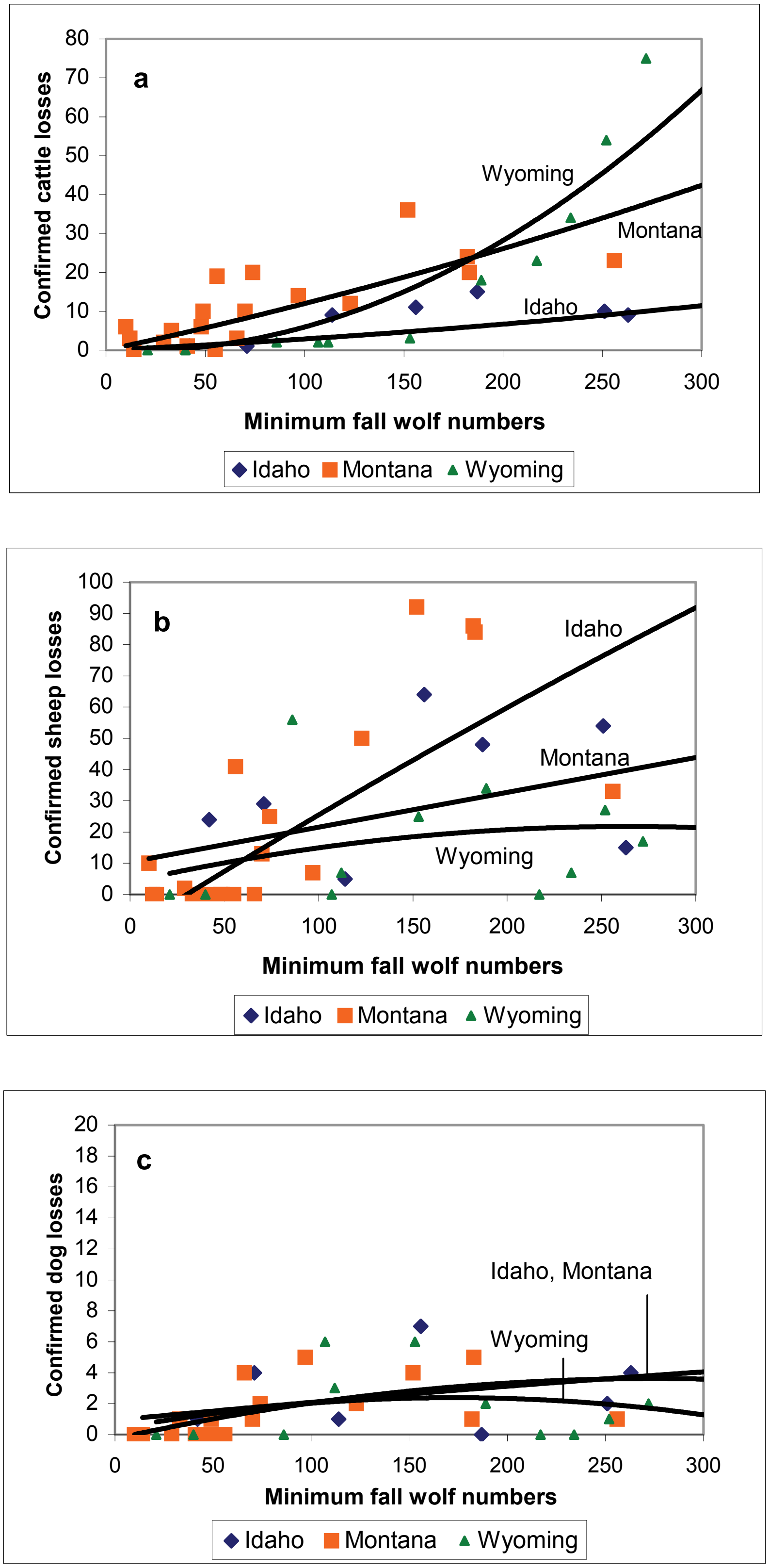


Table 19. Predicted estimates of confirmable depredations of livestock and domestic dogs and their estimated monetary values (in current dollars for 2007) for four different future population size categories of wolves in Washington. Because of the absence of biological and depredation data on wolves living in Washington, numbers presented here should be considered as very rough hypothetical estimates.

	Population size category			
Future number of wolves present	50	100	200	300
Estimated no. of future confirmed cattle depredations per year[a]	1-6	2-12	6-28	12-67
Total value of losses per year[b]	$669-8,028	$1,338-16,056	$4,014-37,464	$8,028-89,646
Estimated no. of future confirmed sheep depredations per year[a]	7-16	14-35	20-60	22-92
Total value of losses per year[b]	$960-2,190	$1,920-4,795	$2,740-8,220	$3,010-12,600
Estimated no. of future confirmed horse and other livestock depredations per year[a]	0-1	0-1	0-2	0-2
Total value of losses per year[b]	$0-1,775	$0-1,775	$0-3,550	$0-3,550
Estimated no. of future confirmed dog depredations per year[a]	1-2	2	2-3	1-4
Total value of losses per year[b]	$625-1,250	$1,250	$1,250-1,875	$625-2,500
Total value of all future confirmed losses per year	$2,254-13,243	$4,508-23,876	$8,004-51,109	$11,663-108,296

[a] Numbers represent the estimated numbers of livestock and dogs that might be confirmed as being killed annually by different sizes of wolf populations. Confirmed losses are those determined by USDA Wildlife Services, WDFW, or another authorized entity. Unconfirmed kills are excluded from these estimates.

[b] Numbers represent the combined estimated monetary value of all losses annually per category in current dollars for 2007. Average values per species are described in the text. For cattle, the maximum value of losses is doubled to reflect the value of compensation payments that would be required if all losses occur on grazing sites of 100 acres or more (Chapter 4, Section G).

For smaller populations of 50 and 100 wolves, the annual monetary value of confirmed losses of livestock and ranch dogs (including the higher compensation payments for cattle killed on grazing sites of 100 acres or more; Chapter 4, Section G) is expected to range from about $2,254-13,243 and $4,508-23,876, respectively. Monetary losses are expected to increase as wolf populations become larger and are projected to reach an estimated $11,663-108,296 for about 300 wolves (Table 19). As noted above, these values are probably overestimated because not all cattle losses are expected to occur on grazing sites of 100 acres or more and because sheep losses are expected to be at the lower end of the range of estimates presented here. Overall, most of the monetary value of losses is expected to result from cattle deaths, especially when larger wolf populations are present.

For comparison, Table 20 provides a summary of average annual payments of compensation payments made to livestock producers in other wolf recovery areas and states during different stages of wolf recovery. These might correspond to wolf population numbers or breeding pairs of wolves at different stages of recovery in Washington.

Table 20. Average total payments per year for confirmed and probable livestock losses due to wolf predation by wolf population size category during early recovery phases in the northern Rocky Mountain recovery region, Wisconsin, and Michigan where data was available for payments and numbers of wolves and breeding pairs of wolves.

	Northern Rocky Mountain Recovery Region			States		
Wolf population size category	Northwestern Montana[a]	Central Idaho[a]	Greater Yellowstone Area[a]	Montana [b,c]	Wisconsin[d,e,f]	Michigan[d,f]
No. wolves[g,h]						
0-25	$1,593				$67	
25-50	$1,908	$4,777	$1,221		$231	
50-75	$4,749	$4,169			$900	
75-100	$7,250		$11,498		$1,775	
100-125	$11,344	$6,380	$6,982			
125-150	$6,495				$3,600	$613
150-175	$17,320	$17,711				$400
175-200		$23,163	$19,667		$2,198	
200-225			$26,850		$13,472	$850
225-250	$24,612				$3,030	$2,200
250-275		$7,904	$39,162		$2,309	
275-300	$19,622[g]	$9,807		$83,000		$3,649
300-325			$29,938	$141,462		$4,720
325-350			$74,390		$18,266	
No. breeding pairs[g,h]						
1	$865				NA	NA
2	$2,150				NA	NA
3	$4,100	$4,777			NA	NA
4	$2,615		$1,221		NA	NA
5	$6,912				NA	NA
6	$5,187	$4,169	$6,347		NA	NA
7	$4,145				NA	NA
8			$7,616		NA	NA
9			$11,498		NA	NA
10		$15,751			NA	NA
11	$6,495				NA	NA
12	$14,332				NA	NA
13			$26,850			
14		$8,855	$19,667			

[a] Defenders of Wildlife (2009).
[b] Reflects payments made by Defenders of Wildlife from January - April 15, 2008 and by the state of Montana from April 15 and December 31, 2008 (including 100% for both confirmed and probable).
[c] Reflects payments made by the state of Montana in 2009.
[d] Ruid et al. (2009).
[e] Payments corresponding to numbers of successful breeding pairs were not available for Wisconsin and Michigan.
[f] Total claims paid for wolf depredations losses, minus payments for dogs, chickens, and farmed deer in order to compare with livestock definition in WDFW wolf conservation and management plan.
[g] Wydeven et al. (2009b).
[h] USFWS et al. (2011).

Physiological Impacts on Livestock

In addition to depredation, the presence of wolves near livestock may cause behavioral changes in livestock that result in physical effects (Howery and DeLiberto 2004, Lehmkuhler et al. 2007). Livestock may gain less weight because wolves force them away from suitable grazing habitat and water sources or because of greater energy expenditures due to wolf-related agitation and movement. These problems may also lower birthrates by reducing conception levels and causing miscarriages. Recent studies have shown that cattle increase their movements and avoid grazing sites of high quality in response to wolf presence (Laporte et al. 2010, Muhly et al. 2010b). While these responses imply increased energetic costs to the cattle involved, they have not yet been proven to cause reductions in weight gain and reproduction. Both problems can also result from other causes, such as poor forage or weather conditions, making it difficult to measure the true impacts of wolves. Because of these uncertainties, this analysis does not attempt to quantify the economic impacts of such outcomes.

Changes in Grazing Methods

Some ranchers may feel compelled to modify their grazing methods in an effort to avoid problems with wolves. This could involve herding or hauling livestock to different portions of grazing allotments, which in some instances may result in penalties from land management agencies for violating allotment grazing plans. Avoidance of wolves may lead some ranchers to bring livestock off the range prematurely or to provide supplemental feeding to delay turnout. Estimates of the extent and frequency of these activities do not exist for other areas with wolves, such as Idaho, Montana, and Wyoming. Therefore, this analysis does not attempt to quantify the economic impacts of modifying grazing activities in response to the reestablishment of wolves in Washington.

Need for Additional Ranch Labor

Ranchers and their employees frequently spend additional time managing livestock operations to avoid depredations by wolves. This can include increased supervision of herds, moving livestock to different grazing areas, implementing non-lethal techniques to reduce conflicts, treating injured livestock, and checking animals for pregnancy that may have aborted due to wolves (Unsworth et al. 2005, Lehmkuhler et al. 2007). These activities may require that less time be spent on other important activities such as ranch maintenance and improvement. Some ranchers may hire additional employees specifically to herd livestock when wolves are in the area. Estimates of the extent and frequency of these types of responses are not available for neighboring states. Therefore, this analysis does not attempt to quantify these future costs for Washington.

To receive compensation for depredations, ranchers also spend time contacting wildlife agents, waiting for them to inspect a kill, completing the necessary paperwork, and conducting any further correspondence or negotiations to ensure payment. Thompson (1993) estimated that for each confirmed and probable kill, this process required an average of 10 hrs of time by a rancher or an employee. Based on hourly wage rates of $11.07 for livestock workers in Washington (NASS 2007b), each confirmed or probable wolf kill would require that a rancher spend on average $110 preparing compensation claims. However, this figure is an underestimate for two reasons (Unsworth et al. 2005). First, it does not consider the higher wages of ranch managers, who are probably more likely to fill out compensation claims. Second, it does not consider time spent by ranchers investigating unconfirmed kills, although these would require less time because they do not qualify for compensation and therefore do not result in claims being filed.

Additional Expenditures on Ranch Supplies

Some ranchers may devote extra resources to protecting their livestock from wolves. Non-lethal control methods may require the purchasing of fencing, non-lethal munitions, electronic hazing devices, fladry, or other equipment, as well as additional herding and guarding dogs and associated supplies (Bangs et al. 2006, Shivik 2006, Stone et al. 2008). Increased efforts to inspect livestock on ranges with wolves, haul livestock to different grazing sites, and remove livestock carcasses likely require greater use of fuel and increased wear on ranch vehicles. Ranchers may need to buy camping equipment to outfit herdsmen or range riders for remaining on the range with livestock. Livestock agitated by wolves may damage fencing, which then needs to be repaired. Cost estimates for these types of expenditures do not exist for other areas with wolves, such as Idaho, Montana, and Wyoming. Therefore, this analysis does not attempt to calculate the economic costs for material acquisitions and costs.

Property Value Impacts

Some ranchers believe that ranches disproportionately affected by wolf depredation may be forced out of business and that the market values of ranches experiencing wolf impacts will be reduced because of the perception that these properties are of lower desirability (Unsworth et al. 2005). There is no confirmed evidence of either of these situations occurring in Idaho, Montana, or Wyoming (S. Nadeau, pers. comm.; C. Sime, pers. comm., M. Jimenez, pers. comm.), therefore neither is expected to occur in Washington. Furthermore, the presence of wolves has not resulted in the implementation of any endangered species-related restrictions on the uses of private land in Idaho, Montana, or Wyoming that might result in lowered land values. Such restrictions are also not expected to occur in Washington.

Positive Impacts from Wolf Reestablishment

Most of the potential economic impacts from wolves represent costs to ranchers and farmers. However, wolves may also benefit some livestock operations by reducing the abundance of coyotes, thereby lowering coyote predation on livestock. Coyotes were responsible for 40% of the confirmed calf death losses (valued at $225,000), 56% of the sheep death losses ($62,000), and 71% of the lamb death losses ($58,000) in Washington in 2004 or 2005 (Table 18). Another possible benefit could come from wolves redistributing elk and deer on ranchlands and grazing allotments, potentially resulting in reduced use of grass and other forage and thereby leaving more food for livestock. Both of these scenarios have been detected in natural habitats at Yellowstone National Park (Chapter 6, Section A) and could possibly occur in Washington. An additional potential benefit is that wolf predation may reduce the occurrence of some diseases in wild ungulates (Chapter 5, Section A), which could reduce disease transmission to livestock present in the same locations (Stronen et al. 2007). None of these benefits have been quantified in economic terms for any location, making it difficult to place a value on them. Many coyote-caused losses probably occur in parts of the state that are unlikely to be recolonized by wolves. The benefits from these three impacts would probably be localized and relatively minor.

Summary

Reestablishment of wolves in Washington will likely result in differing costs for livestock producers living in or near occupied wolf range, with some producers more affected than others. Financial impacts to individual producers will depend not only on the numbers of depredations experienced but also on non-lethal physiological impacts on livestock, increased expenditures on ranch supplies, and additional labor needs. This analysis provides cost approximations only for confirmed losses of ranch animals and time spent preparing compensation claims. For populations of 50-300 wolves, these costs together could range from several thousand dollars to possibly more than $110,000 annually for producers as a whole in the state. Costs of other impacts are not quantified in this analysis due to a lack of adequate information. These costs would be partially offset by compensation payments for confirmed and probable wolf-caused livestock deaths. The Defenders of Wildlife Proactive Carnivore Conservation Fund is available to help defray the costs of non-lethal deterrents for small numbers of producers in Washington.

Wolf numbers between 50 and 100 animals should pose little detriment to the state's livestock industry as a whole. At these population levels, the vast majority of producers will probably experience few if any annual costs, whereas a few individual producers could be more affected. As wolf populations become larger and more widely distributed, financial impacts to more producers are likely.

C. Big Game Hunting

Healthy and abundant prey populations are important for maintaining hunting opportunities that contribute to many local economies in Washington, especially in more rural regions. The challenge for wildlife managers is to manage for healthy ungulate population levels that also sustain wolves, other carnivores, harvest opportunities for the public, and subsistence and ceremonial needs of treaty tribes.

Big Game Hunting Statistics for Washington

Hunting, especially for big game, is an important recreational activity in Washington. The 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, which is based on household interviews nationwide, estimated that 187,000 residents of Washington, or 3.8% of the state's population aged 16 years old and older, purchased hunting licenses (for either big or small game, or both; USFWS and USCB 2008). This is below the national average of 5.5% of the population aged 16 years and older. An estimated 182,000 hunters hunted in Washington in 2006, with an estimated 179,000 residents and 3,000 non-residents participating. Hunters spent nearly 2.13 million days hunting for all species in the state in 2006. Washington residents spent an additional 285,000 hunting days, or 12% of their total effort, hunting outside of the state. These numbers are slightly lower than those derived from WDFW's data files, which indicate that about 196,000 residents and 4,900 non-residents bought hunting licenses, special permits, and special hunt applications in 2006. However, these figures include buyers who did not actually participate in hunting during the year.

Big game hunting represents some of the most highly valued hunting in Washington, with an estimated 90% of hunters hunting ungulates in 2006 (USFWS and USCB 2008). By comparison, only an estimated 23% and 11% of hunters sought small game and migratory birds, respectively. Seventy-nine percent of total hunter days involved big game hunting, 14% small game hunting, and 7% migratory birds in 2006.

Deer and elk hunting are the predominate forms of big game hunting in Washington, both in terms of the number of hunters participating and total days spent hunting. Numbers of deer hunters and deer hunting days have averaged about 141,500 and 845,000 per year, respectively, during the past decade (WDFW 1997-2006). Despite some sizeable yearly increases and decreases, deer hunter numbers remained almost stable (increase of 0.7%) from 1997 to 2006, whereas hunting days decreased 18.8% (Figures 19, 20). Deer harvest has remained robust, averaging 38,100 deer annually during the past decade, which included a 47% increase from 1998 to 2004 (Figure 21). Hunter success rates (i.e., combined for general and special permit seasons, all weapon types, and antlered and antlerless harvest) closely tracked harvest trends during this decade, with success averaging 27.0% and strongly increasing from 1998 (20.3%) to 2004 (30.4%) (Figure 21). Annual harvest data for each type of deer are available only from 2001 to 2006, when an average of 14,082 black-tailed deer, 13,709 white-tailed deer, and 12,584 mule deer were killed per year. During the past decade, combined deer harvests were highest in WDFW's eastern (30% of the statewide harvest) and southwestern (25%) regions, and lowest in the south-central (9%) and North Puget Sound (6%) regions (Figures 22, 23).

For elk, numbers of hunters and hunting days have averaged about 74,400 and 412,400 per year, respectively, during the past decade in Washington. Both figures have shown net increases of 15.4% and 19.0%, respectively, during this period, although both have been in gradual decline since 2000 (Figures 19, 20). Despite these declines, elk harvest has remained strong, averaging 7,390 animals annually over the past decade. Harvests were lowest in 1997 (4,919 elk) and 1998 (5,858 elk), but have varied between about 7,100 and 8,700 animals since then, with a 48.6% increase occurring between 1998 and 2003 (Figure 21). Overall hunter success rates (i.e., combined for general and special permit seasons, all weapon types, and antlered and antlerless harvest) tracked harvest trends during this decade, with success averaging 10.1% overall and increasing from an average of 8.4% in 1997-1999 to an average of 10.8% in 2000-2006 (Figure 21). Elk harvests were highest in WDFW's south-central (37% of the statewide harvest) and southwestern (37%) regions, and lowest in the North Puget Sound (2%) and north-central (1%) regions (Figures 22, 23).

Hunting opportunities for moose, bighorn sheep, and mountain goats in Washington are far more limited than for deer and elk. All three species are hunted only through special permit drawings, with fewer than 100 licenses issued annually for each (Figure 24). Numbers of licenses issued since 1997 have increased for moose and sheep, but have decreased for goats. Numbers of hunter days per species are also small, totaling fewer than 900 days per year for moose with an increasing trend over the past decade, fewer than 300 days per year for goats and declining, and fewer than 200 days per year for sheep and increasing (Figure 25). During the past decade, annual harvests have numbered fewer than 100 moose and are increasing, fewer than 40 sheep and are increasing, and fewer than 40 goats and are decreasing (Figure 26). Hunter success rates have reached 80-100% for all three species in nearly every year since 1997 (Figure 27).

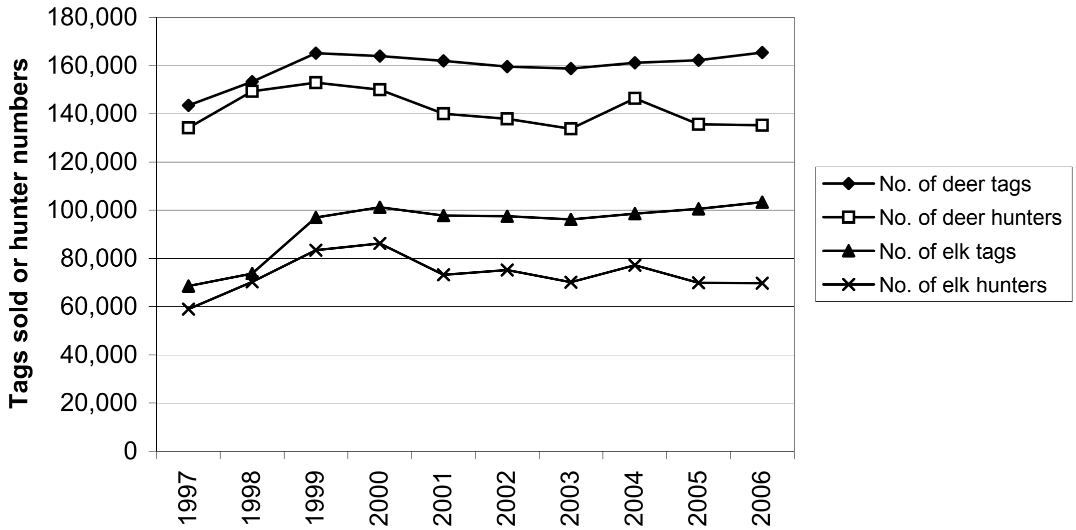


Figure 19. Trends in numbers of tags sold and hunters participating in general deer and elk seasons (all weapons) statewide in Washington, 1997-2006.

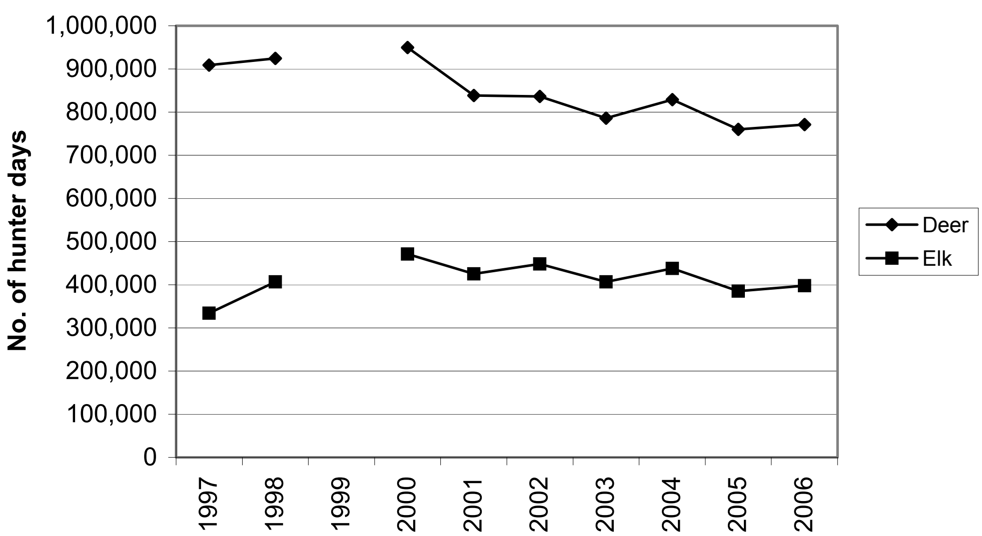


Figure 20. Trends in numbers of hunter days during general deer and elk seasons (all weapons) statewide in Washington, 1997-2006 (excluding 1999).

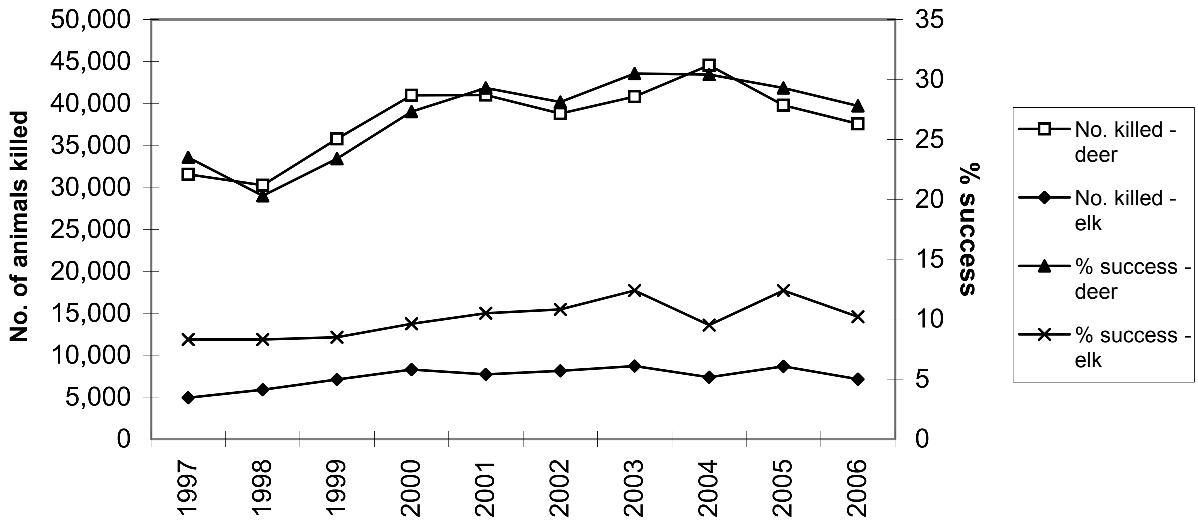


Figure 21. Trends in statewide numbers of deer and elk killed and hunter success during general and permit seasons (all weapons) combined in Washington, 1997-2006.

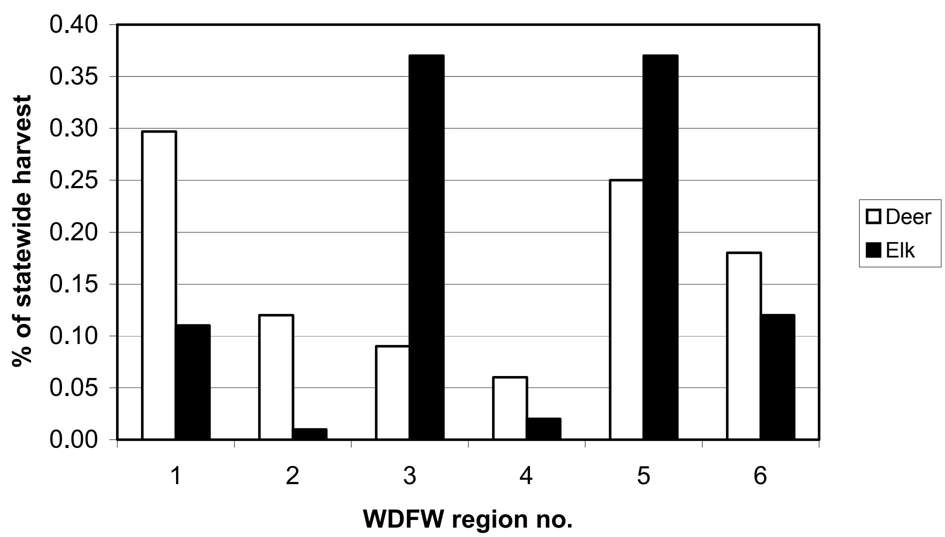


Figure 22. Percent of statewide deer and elk harvest (all weapons) according to WDFW region number, 1997-2006. Region boundaries are depicted in Figure 23.

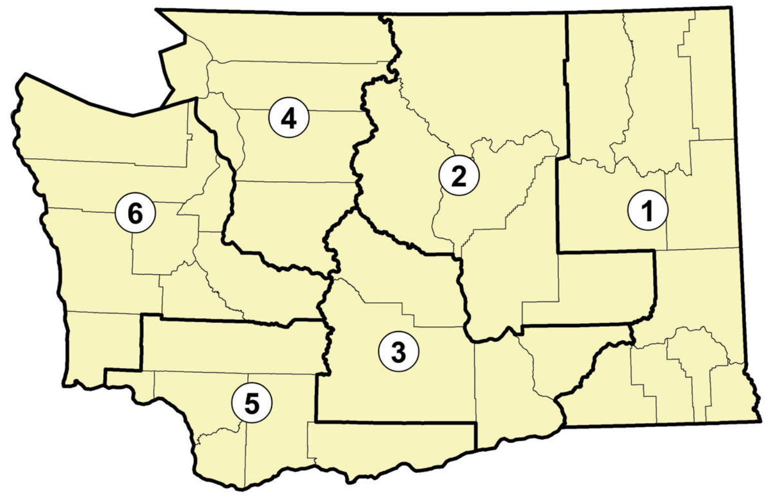


Figure 23. Map of WDFW's six administrative regions. Map numbers correspond to designated region numbers.

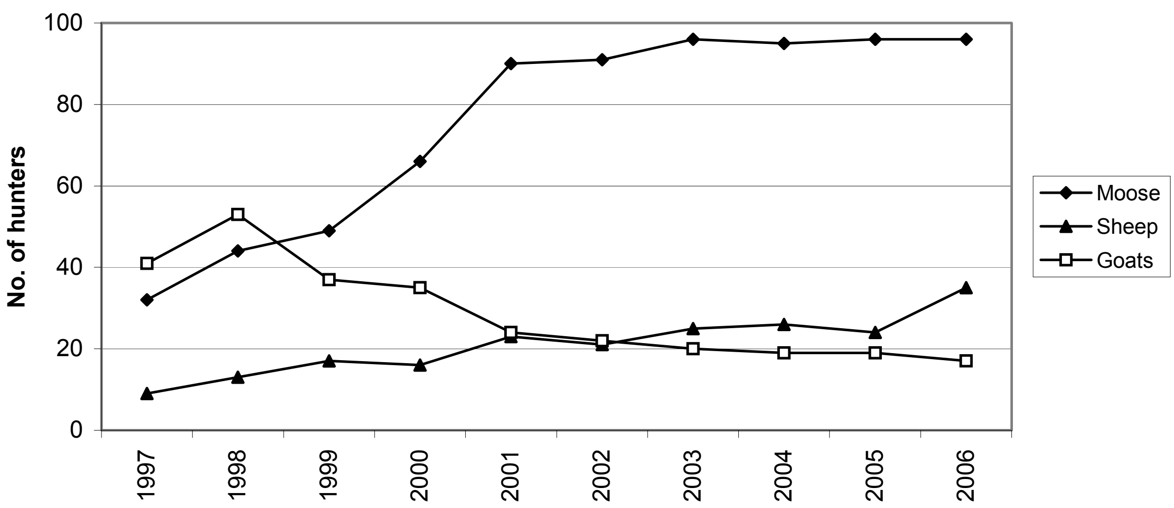


Figure 24. Trends in hunter numbers for moose, bighorn sheep, and mountain goats in Washington, 1997-2006.

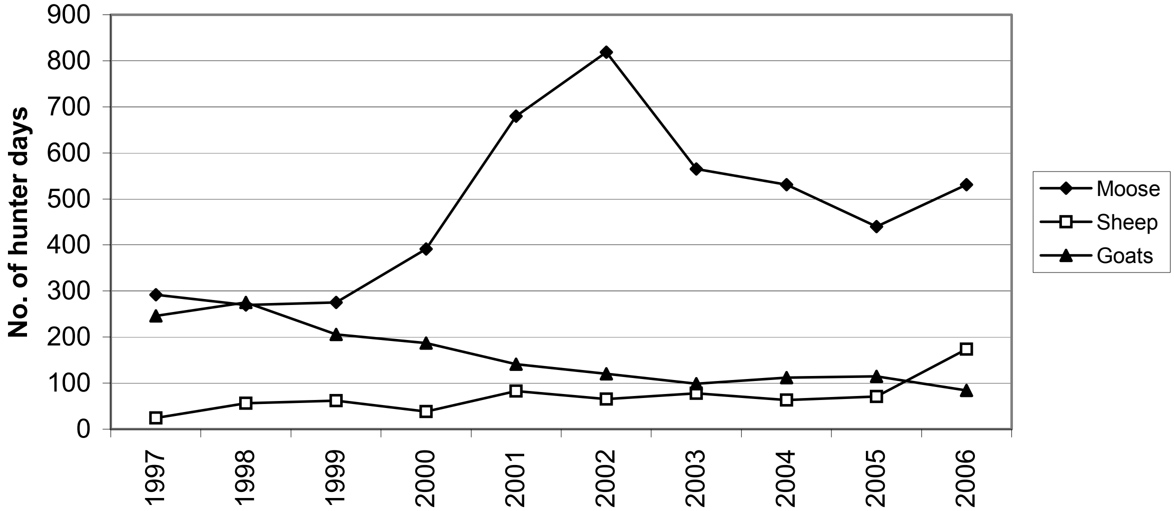


Figure 25. Trends in numbers of hunter days for moose, bighorn sheep, and mountain goats in Washington, 1997-2006.

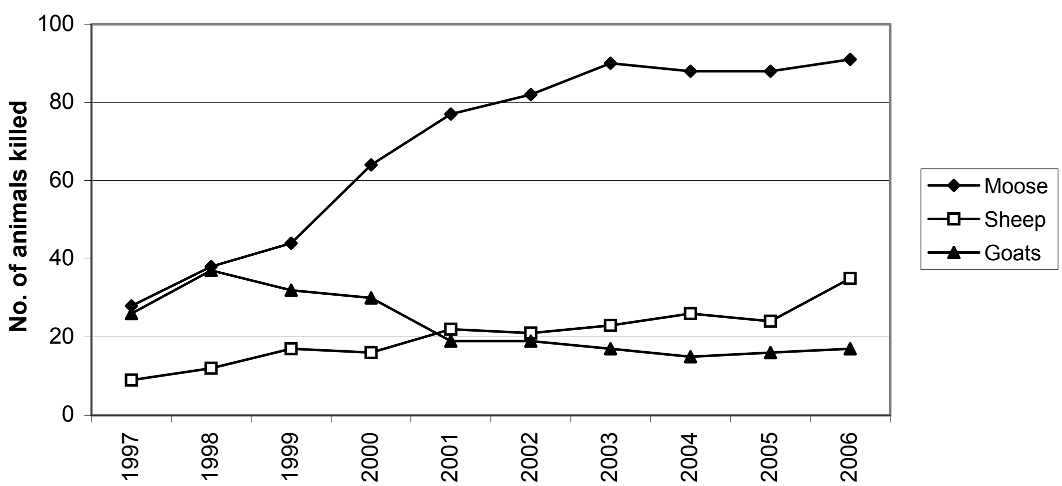


Figure 26. Trends in hunter harvest of moose, bighorn sheep, and mountain goats in Washington, 1997-2006.

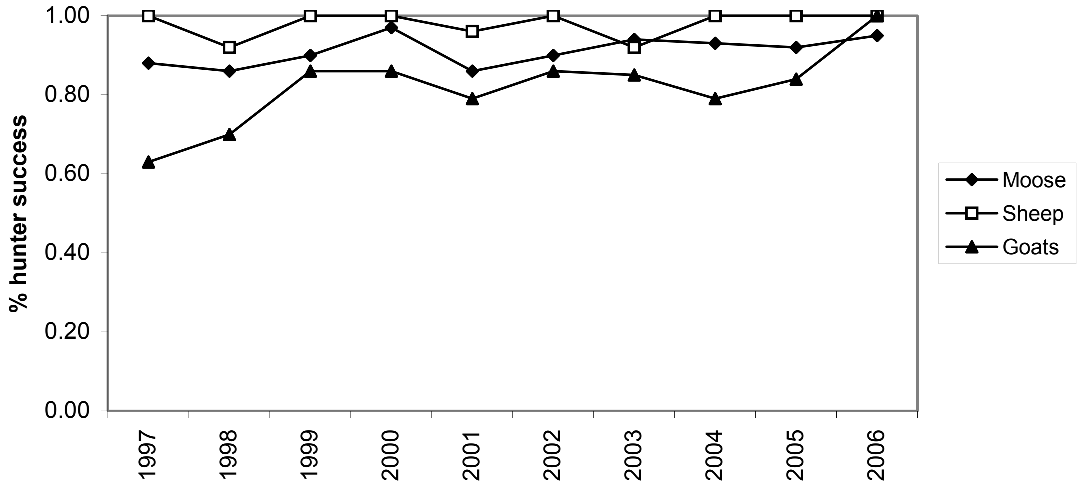


Figure 27. Trends in hunter success for moose, bighorn sheep, and mountain goats in Washington, 1997-2006.

Hunter Expenditures in Washington

Washington's hunting community spent an estimated $313 million on hunting-related expenses in 2006 (Table 21; USFWS and USCB 2008). This corresponds to an average of $1,598 per hunter per year or about $147 per hunter day. Equipment and trip-related costs accounted for about 60% and 24% of all expenses, respectively (Table 21). Hunting-related expenditures in 2006 were strongly skewed toward big game (86% of total expenditures), with smaller amounts for small game (5%), migratory birds (4%), and others (USFWS and USCB 2008).

Washington attracts few out-of-state hunters compared with nearby states. Non-resident hunters comprise fewer than 2% of the hunters and about 0.1% of the hunter days expended in Washington, whereas in 10 other western states (excluding California and Hawaii), non-residents comprise on average 28% (range = 8-51%) of the hunters and 20% (range = 3-48%) of the hunter days expended (Figure 28; USFWS and USCB 2007). Washington's non-resident license fees are competitive with other states and the state has no special restrictions limiting the number of out-of-state hunters. However, out-of state big-game hunters are more likely to visit other western states such as Idaho, Colorado, Wyoming, and Montana, where larger ungulate populations, land mass, and lower human populations allow for more opportunity, higher success rates, and better overall hunting value. As a result, non-resident hunters contribute less to Washington's economy than they do to other western states' economies.

Table 21. Estimated total expenditures by hunters and average expenditures per hunter for all types of hunting combined in Washington in 2006 (from USFWS and USCB 2008).

Category of expenditure	Total amount	Average amount per hunter[a]
Food and lodging	$33,083,000	$169
Transportation	36,528,000	186
Other trip costs (land use fees, guide fees, heating and cooking fuel, other)	4,622,000	24
Total trip related	74,233,000	379
Hunting equipment (guns, ammunition, bows, dogs, other)	66,625,000	340
Auxiliary equipment (clothing, processing and taxidermy, optics, camping equipment, other)	44,120,000	225
Special equipment (boats, campers, cabins, trail bikes, other)	77,994,000	398
Total equipment	188,739,000	963
Other items (land leasing and ownership, licenses, other)	50,163,000	256
Total expenditures	$313,134,000	$1,598

[a] Based on an estimated total of 196,000 resident and non-resident hunters hunting each year in Washington. This number presumably includes some people who spent money on hunting activities and equipment, but did not actually hunt.

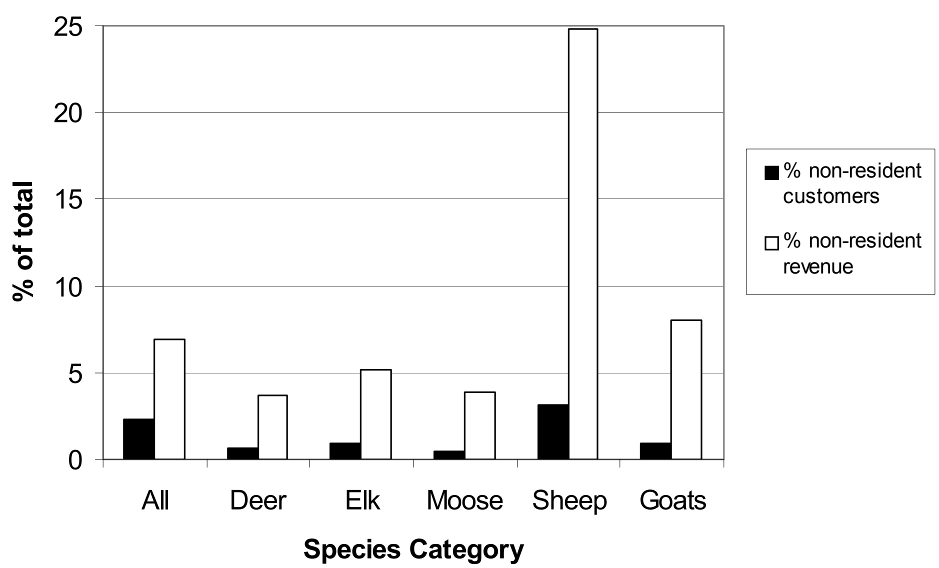


Figure 28. Representation of non-resident hunters as a percentage of total hunting customers in Washington and their contribution to WDFW hunting revenues, according to species and averaged for fiscal years 2002-2007. Customers are defined as anyone buying a hunting license or applying for a special permit, with no individual counted more than once. Some customers may not have hunted during the year. Revenue figures are based on fees collected for licenses, permits, and applications, but exclude monies from auctions and raffles.

Hunting Revenue for WDFW

Revenues generated by WDFW's hunting program totaled about $13.3 million in fiscal year 2007 and have expanded 9.8% since 2002 (Figure 29). License and other sales involving deer and elk are the two largest sources of hunting-related revenue for the agency and have also gradually increased since 2002 (6.8% for deer, 11.4% for elk; Figure 29). The existence of multi-species combination licenses makes it difficult to determine revenue generated by each species, but estimates based on the full cost of each license type involving these species indicate that deer hunting provides WDFW with more revenue than elk hunting (Figure 29). Revenues associated with both species have gradually increased since 2002. The agency derives considerably smaller amounts of revenue from the hunting of bighorn sheep, moose, and mountain goats (Figure 30). Revenues have been expanding for each of these species since 2002, especially for sheep.

About 7% of total WDFW hunting revenues is derived from non-resident hunters (Figure 28). For big game species, non-resident hunters contribute about 4% (for deer and moose) to 25% (for bighorn sheep) of the hunting revenues gathered per species by the agency.

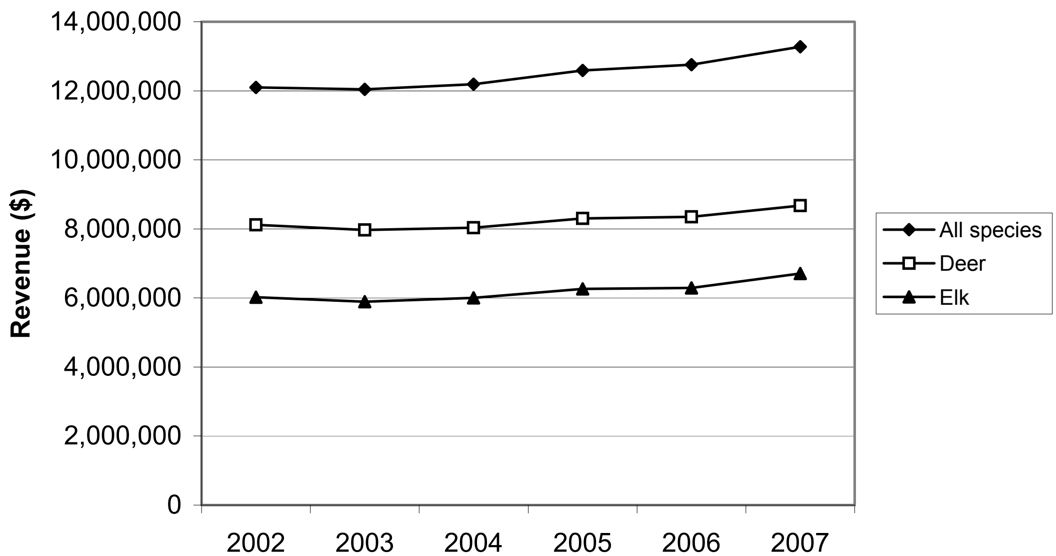


Figure 29. Trends in hunting revenues generated by the WDFW hunting program for all species combined (i.e., big game, small game, and migratory birds) and separately for deer and elk for fiscal years 2002-2007. Revenue figures come from both general and special permit seasons, and include monies collected from license fees, permit fees, application fees, raffles, and auctions. Revenues for deer and elk hunting overlap because they are summed from the full values of all license types (including multi-species combination licenses) involving each particular species.

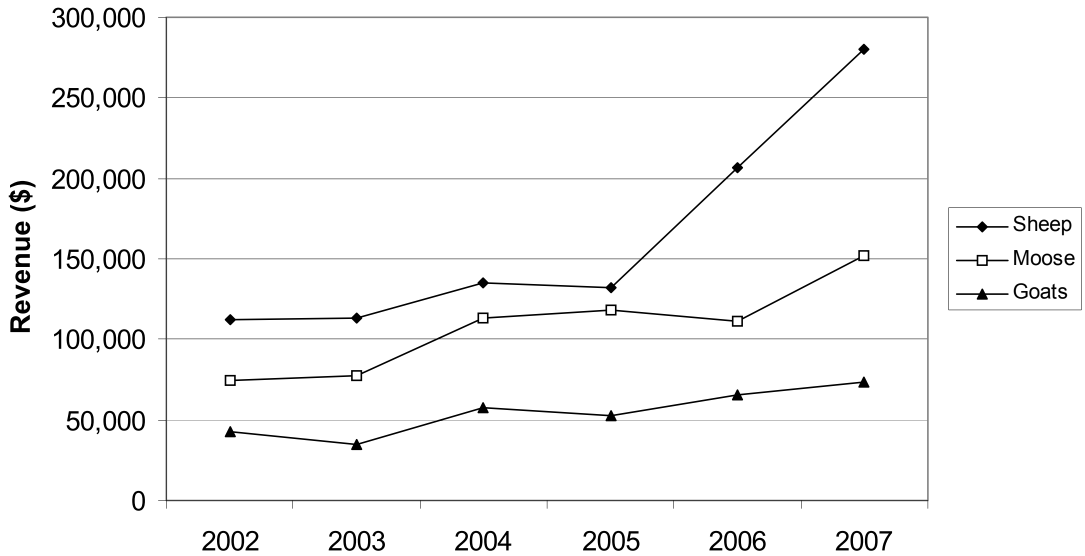


Figure 30. Trends in hunting revenues generated by WDFW for bighorn sheep, moose, and mountain goats for fiscal years 2002-2007. Revenue figures include monies collected from permit fees, application fees, raffles, and auctions.

Guided Hunting

Commercial outfitters are primarily small independently owned businesses offering a variety of guided services (e.g., river running, fishing, hunting, camping, trail riding, packing, hiking, biking, climbing, and outdoor photography trips) to paying clients. Lodging is also provided by some outfitters. Outfitted trips usually qualify as a form of sustainable tourism because of their low impact on the environment and local culture, while helping to generate income and employment and benefiting the conservation of local ecosystems.

Washington's outfitter industry is considerably smaller than in some neighboring states such as Montana (see Nickerson et al. 2007) and Idaho, but quantified information on the size and economic contributions of outfitting in Washington is lacking. Detailed information is also lacking on the industry's client base, types of services rendered, and use of public versus private lands.

The Washington Outfitters and Guides Association (WOGA) represents a number of outfitting companies in the state, with membership currently totaling 29 companies (WOGA 2007). Nearly all members market multiple activities to clients, including 26 companies offering non-fishing and non-hunting activities, 12 offering hunting (mostly big game), 11 offering fishing, and nine offering river running and other water-related activities. Outfitter activities in general tend to be concentrated in eastern Washington (G. Ulin, pers. comm.). Among WOGA outfitters, north-central Washington (northeastern Cascades and the Okanogan), south-central Washington (southeastern Cascades), and Puget Sound are the three main regions of operation (WOGA 2007). Washington residents are thought to represent the majority, perhaps 60-67%, of the customer base for in-state outfitters (G. Ulin, pers. comm.). The establishment of several new companies during the past few years suggests that the industry as a whole is slowly growing.

Summer trips offering fishing, packing, camping, and other family- or group-related outdoor activities are the largest source of revenue for most land-based outfitters in Washington (G. Ulin, pers. comm.). Hunting trips are of lower importance as a source of income for most outfitters.

Hound Hunting

Hunting with hounds was allowed for three game species in Washington through 2010, including cougars in a pilot study for six counties (Pend Oreille, Stevens, Ferry, Okanogan, Chelan, and Klickitat), raccoons statewide, and black bears causing timber damage in western Washington (by permit only). An estimated 500-700 hunters participated in these forms of hound hunting (D. Martorello, pers. comm.). Hound hunting for cougars was not reauthorized in 2011, but continues for raccoons and black bears. Hound hunters typically employ two to five dogs per party. Hounds can be either registered purebreds (e.g., Black & Tan, Walker, Redbone) or of mixed ancestry. Monetary values per dog range from several hundred dollars to more than $5,000, but average about $2,500 (D. Martorello, pers. comm.). Wisconsin is the only state that offers compensation for non-guarding/herding (i.e., hunting and other pet) dogs killed or injured by wolves.

Recent Impacts of Wolves on Big Game Hunting in Other States

Summaries of wolf-related impacts on big game populations in other states are presented in Chapter 5, Section B.

To date, wolves have not resulted in any sizable losses of hunter opportunity in Montana, although seasons for antlerless elk in some locations (e.g., north Yellowstone, Gallatin, West Fork of the Bitterroot) have been reduced or eliminated to compensate for mortality from multiple sources including wolves and other factors causing lowered herd productivity (MFWP 2007b; C. Sime, pers. comm.). Many parts of the state offer liberal opportunities for elk harvest, including two-thirds of the hunting districts in southwestern Montana, all of which support wolves (J. Gude, pers. comm.). However, lethal wolf control in many of these areas to reduce conflicts with livestock may keep local wolf densities low enough to minimize impacts on elk herds. Wolf impacts on deer and other ungulates have not been well documented to date (C. Sime, pers. comm.). Montana Fish, Wildlife & Parks has not experienced any declines in hunting generated revenue, license sales, or hunter success on a statewide level because of wolf presence (C. Sime, pers. comm.).

Wolf impacts on big game hunting in Idaho have not been well quantified. IDFG (2010a) recently reported that 23 of 29 elk management zones in Idaho were within or above management goals for female elk, suggesting that harvestable surpluses of elk remain in most areas of the state. At least two elk management units (e.g., Lolo, Sawtooth) where wolves were the primary cause of death of female elk (IDFG 2010a) have experienced reductions in hunter harvest and participation since 2005 (Rachael 2010). IDFG (2008) speculated that wolf predation may be causing reductions in elk harvest in some parts of the state, even where elk populations are not declining, by changing the behavior and habitat use of elk during the hunting season. As observed elsewhere (Creel and Winnie 2005, Mao et al. 2005), Idaho's elk may now be spending more time in forested areas, on steeper slopes, and at higher elevations than before wolf reintroductions, making it more difficult for hunters to find animals. Changes in herding behavior and movement rates (Proffitt et al. 2009) may also affect hunting success. Wolves are believed to be a main factor in the recent decline of moose in the Lolo zone, but their impact on moose abundance in other parts of Idaho is not well known (J.

Rachael, pers. comm.). Moose populations in some areas may be more directly affected by habitat changes, harvest levels, or other causes (S. Nadeau, pers. comm.). The impact of wolves on deer and other ungulates in the state appears negligible (J. Rachael, pers. comm.; S. Nadeau, pers. comm.).

Big game revenue and tag sales to resident and non-resident hunters have remained stable in recent years for the Idaho Department of Fish and Game (B. Compton, pers. comm.; S. Nadeau, pers. comm.). Some hunters have indicated that they would not return to their hunting areas because of real or perceived impacts of wolves, but whether this has produced significant changes in hunter activity has been difficult to assess. Hound hunting permit sales have also remained level or slightly increased in the state (S. Nadeau, pers. comm.).

In Wyoming, at present, there are no definitive data showing decreased hunter harvest or opportunity due to wolf predation on elk or moose (WGFC 2008).

Mexican gray wolves were reintroduced to a portion of western New Mexico and eastern Arizona beginning in 1998 and numbered 44-50 animals by 2004 and 2005. Unsworth et al. (2005) reported that this level of abundance caused no measurable changes in elk harvest or outfitter income between 1998 and 2004, and that numbers of elk and deer hunters and hunter days to the area actually increased. Elk and deer populations declined in the area during this period, but this was likely due to changes in forage conditions and game management decisions rather than predation by wolves.

In the Great Lakes states, where about 4,000 wolves occur, white-tailed deer populations are thriving and continue to be managed at relatively high densities with numbers often above local management goals (DelGiudice et al. 2009). Annual hunter harvest has remained high, averaging 96,000 deer in Minnesota, 148,000 deer in Wisconsin, and 73,300 deer in Michigan. Wolves have been estimated to reduce the pre-harvest deer populations in Minnesota, Wisconsin, and Michigan by <15%, <1.8%, and about 1.3%, respectively (DelGiudice et al. 2009). Mech and Nelson (2000) concluded that wolf predation did not influence hunter harvest of deer in most areas of Minnesota, but did exert a negative impact in locations with low deer densities.

Summary

The possible impacts of wolf predation on ungulate populations are debated by both the general public and the scientific community (see Chapter 5, Section A). Big game hunters in Washington are concerned that wolves will cause declining ungulate populations and opportunities for hunting. As described in Chapter 5, many factors affect the population sizes and trends of elk, deer, and other big game species, including habitat quantity and quality, severe weather, levels of hunter harvest, predation, and disease. These factors vary locally, further complicating efforts to determine the effects of wolf predation on ungulate populations and hunter success. Predicting wolf-related impacts that may occur in Washington in the future is especially difficult because of the many uncertainties involving where and how rapidly wolves become reestablished, their eventual abundance and diet composition, prey species behavior and population changes, hunter responses, and other influences.

Despite these limitations, this plan offers some general approximations of wolf predation levels on ungulates that might occur in Washington (see Chapter 5, Section E). Total populations of 50 and

100 wolves are expected to have minor overall impacts on ungulate populations. Fifty wolves may kill about 425-630 elk and 700-1,050 deer per year, with annual take doubling for 100 wolves (see Table 13 for an explanation of these estimates). These levels of predation could result in noticeable effects on elk and deer abundance in some localized areas occupied by wolf packs, but should not have broad-scale impacts. These levels of loss potentially represent 1-2% of the state's elk population and less than 1% of the combined deer population. With larger populations of wolves, greater numbers of ungulates would be removed annually, with perhaps 1,700-3,800 elk and 2,800-6,300 deer taken if 200-300 wolves became reestablished (Table 13). Predation levels on moose are also difficult to estimate, but may be significant if wolves become numerous in northeastern Washington. Wolf take of bighorn sheep and mountain goats is expected to be minor.

Populations of 50 to 100 wolves should have few negative effects on big game hunting in Washington, as demonstrated by the relatively small estimated take of ungulates noted above. As in the Yellowstone region (Creel and Winnie 2005, Mao et al. 2005, Proffitt et al. 2009), wolves may also cause some redistribution of game, which could make these species somewhat less vulnerable to harvest. However, these impacts together would be restricted to the relatively few areas occupied by packs during the initial recovery stages and would probably not reduce statewide harvests of elk and deer by more than 1-3%. If these outcomes discouraged a similar proportion of hunters from hunting, then big game-related hunting expenditures in the state, including the revenues generated by WDFW, could decrease by a comparable amount (about $100,000 to 300,000 annually). Whether or not the loss of a small percent of the state's elk and deer would affect hunter participation and by how much is unknown. Some outfitters catering to hunters would perhaps be negatively affected, but because this industry is small in Washington, the overall financial impact would be small. If some non-resident hunters decided not to hunt in Washington, this effect would be negligible because non-resident elk and deer hunters comprise a small fraction of total hunters in the state (Figure 28). If cougar hunting with hounds resumes in the future, losses of hounds to wolves are not expected to exceed one or two animals per year, as noted in Idaho and Montana (S. Nadeau, pers. comm.; C. Sime, pers. comm.), where much larger wolf populations exist.

Larger wolf populations would be expected to have greater impacts on game and hunting opportunity, but such impacts become increasingly difficult to predict or measure. To accommodate larger elk and deer losses from wolves, reductions in antlerless take and perhaps other restrictions such as shortened hunting seasons or reduced availability of special permits may be needed in some areas where wolves become common. Given the stable or increasing numbers of hunters, tag sales, numbers of animals killed, levels of hunter success, and amount of revenue generated in association with elk and deer hunting in Washington during the past decade (Figures 19, 21, 29), there appears to be some capacity for the state to accommodate the game losses caused by wolves.

In the future, there could be revenue generated for WDFW if wolves recover to the point that they are delisted, reclassified as a game species, and eventually become hunted. Revenue could be generated through special permit application sales, auctions, and raffles. It is unknown how much revenue would be generated from these sources. Such sales might be similar to those obtained for bighorn sheep, moose, and mountain goats during most of the past decade (Figure 30), an estimated $50,000 to $150,000 per year, or could be higher. The one-year hunting seasons for wolves in Idaho and Montana in 2009-2010 generated about $450,000 (31,400 licenses sold) and $326,000 (15,603 licenses sold), respectively, in revenue (USFWS et al. 2010, IDFG 2011). Revenue in Washington would depend on the number of wolf licenses sold, cost per license, number of wolves allowed to be taken, and the geographic extent of the season. This analysis would be developed in a post-delisting management plan.

The presence of wolves may provide an additional benefit for some hunters by enhancing their overall hunting experience. The possibility of seeing or hearing wolves, finding wolf tracks or a wolf kill, or hunting among wolves could give considerable enjoyment to these hunters.

D. Wildlife Tourism

Ecotourism, or travel to natural areas for environmentally responsible outdoor experiences, is one of the fastest growing segments of the overall world tourism industry. Wildlife viewing is a large part of this business and is hugely popular in the United States.

According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, more than 71 million Americans 16 years old and older (31% of the U.S residents in this age bracket) participated in wildlife watching activities (i.e., observing, feeding, photographing, etc.; includes fish viewing) in 2006 (USFWS and USCB 2007). Of these, almost 23 million people took trips more than one mile from their homes specifically to see wildlife. Participation in wildlife viewing increased 8% nationally from 2001 to 2006, in contrast to fishing and hunting, which fell 12% and 4%, respectively. Wildlife watchers spent nearly $46 billion in 2006, or about $650 per participant, with trip-related expenditures increasing 38% between 2001 and 2006. Seventy percent (16.2 million people) of the wildlife watchers traveling away from home observed, fed, or photographed land mammals, with 56% (12.8 million people) specifically interested in large mammals such as deer, bears, and coyotes. Eighty-three percent of wildlife watchers traveling away from home did so in their home state; 33% visited other states.

In Washington during 2006, an estimated 2.33 million people 16 years old and older participated in some form of wildlife watching, which ranked the state 11th in the nation for participation (USFWS and USCB 2007, 2008). About 2.00 million participants were state residents (40% of the state's total population in this age group), with the remainder being non-residents. An estimated 628,000 residents and 331,000 non-residents in this age group traveled more than one mile away from home to view wildlife in Washington during the year. Residents spent an estimated 8.0 million days (88% of the total; average of 12.7 days per person) and non-residents spent an estimated 1.1 million days (12%; average of 3.4 days per person) watching wildlife away from home in the state during the year. Washington residents spent an additional 1.48 million days watching wildlife in other states in 2006. Overall, wildlife watchers outnumbered hunters and anglers combined by nearly three times in Washington.

Annual spending in Washington by resident and non-resident wildlife watchers on travel, food, lodging, equipment, and other goods and services totaled an estimated $1.5 billion in 2006, ranking the state seventh in the nation behind California, Florida, Texas, Michigan, Georgia, and New York (USFWS and USCB 2007, 2008). About $595 million was spent during the year on equipment, $442 million on trip-related costs, and $466 million on other costs (Table 22). Annual spending by wildlife watchers in the state rose 53% from 2001 to 2006 (USFWS and USCB 2003, 2007, 2008). Participants spent an average of $645 per person in 2006 (Table 22). Overall, wildlife watchers outspent hunters and anglers combined by 5% ($1.43 billion vs. $1.36 billion) in Washington

(USFWS and USCB 2008). Wildlife viewing generated an estimated 22,439 jobs in Washington in 2001 (USFWS 2003). However, revenue to WDFW for wildlife conservation and management generated by wildlife watchers is minimal.

Wolf-Related Tourism in North America

Commercial wolf watching has grown in significance in North America over the past several decades, especially in the lower 48 states, and has resulted in regional economic benefits. Yellowstone National Park has become the premier wolf viewing location on the continent, with a thriving and rapidly growing wolf-watching business since the species was reintroduced in 1995 and 1996. Visitor surveys in 2005 showed that the opportunity to see or hear wolves increased annual rates of park visitation by almost 4% and spending on lodging, food, and other services by an estimated $35.5 million among people coming from outside Wyoming, Montana, and Idaho (Duffield et al. 2006, 2008). Wolves have joined grizzly bears as the marquee species most sought after at Yellowstone, with about 44% of visitors hoping to see wolves (Duffield et al. 2008). Many wolf-watchers at the park are repeat visitors. Even visitors who fail to see wolves are often satisfied with their experiences through hearing wolves, seeing their tracks and scat, or simply knowing that wolves were nearby (Montag et al. 2005). Duffield et al. (2008) estimated that more than 300,000 visitors saw wolves at the park in 2005 alone.

National Park Service officials had originally expected Yellowstone's wolves to be far more secretive and less visible, as at Isle Royale (Michigan) and Denali (Alaska) National Parks, and therefore did not anticipate these levels of recreational and economic impacts. However, the park's wolves

Table 22. Estimated total expenditures and average expenditures per participant for all types of wildlife-watching activities in Washington in 2006, including both those around the home and away from home (from USFWS and USCB 2007, 2008). Estimates are for state residents and non-residents combined.

Category of expenditure	Total amount	Average amount per participant[a]
Food and lodging	$227,721,000	$98
Transportation	157,045,000	67
Other trip costs (boating costs, guide/outfitter fees, public and private land use fees, equipment rental, other)	56,886,000	24
Total trip related	441,652,000	189
Wildlife-watching equipment (wildlife feed, cameras, binoculars, hiking equipment, other)	262,335,000	113
Auxiliary equipment (camping equipment, other)	29,797,000	13
Special equipment (off-road vehicles, campers, boats, other)	302,574,000	130
Total equipment	594,706,000	255
Other items (land leasing and ownership, plantings around homes that benefit wildlife, membership dues, contributions, literature, other)	465,953,000	200
Total expenditures	$1,502,311,000	$645

[a] Based on an estimated total of 2,331,000 wildlife-watching participants in Washington.

quickly became accustomed to roads, traffic, and people, and readily occupied more open terrain. The local tourism industry and business community seized the opportunity by offering guided trips to find wolves. Guides explain wolf behavior and biology, and increase the likelihood of visitors seeing wolves. More than 50 organizations now offer wolf trips (Kirkwood 2006) and at least one tour company advertises a 97% success rate in seeing animals. Wolves are more easily observed from fall through spring and therefore help attract visitors to the region during the months of lowest visitation. Most wolf watching in the greater Yellowstone area remains within the national park itself. Outfitters and guides in outlying areas, where wolves are also thriving on both public and private lands, haven't been as successful in organizing as many wolf-watching trips.

In other parts of North America, wolf-related tourism has expanded in different ways:

- The International Wolf Center in Ely, Minnesota, brings about $3 million per year to the area and creates as many as 66 jobs in tourism-related businesses and other industries (Schaller 1996). The center, which specializes in wolf education and tourism, opened in 1993 on the edge of the Boundary Waters Canoe Area Wilderness in the heart of the largest wolf population in the lower 48 states. A 2004 survey showed that a third of all tourists to northeastern Minnesota visited the center, resulting in a major economic benefit for the surrounding two-county area. Visitation totaled 42,000 people in 2005.

- After red wolves were reintroduced to northeastern North Carolina in 1987 and grew to an estimated population of 100 by 2005, a study found interest in developing a fledgling wolf tourism business (Lash and Black 2005). Weekly wolf howling tours at the Alligator River National Wildlife Refuge drew about 900 visitors from across the country in 2005. A planned Red Wolf Visitor and Education Center, partnered with existing nature tourism activities (e.g., hiking, fishing, other wildlife viewing) in the Outer Banks region is estimated to potentially attract over 25,000 households annually, boost tourism by up to 19%, and bring in about $37.5 million in direct and indirect tourist spending to North Carolina (Lash and Black 2005).

- Wolf howling expeditions in Algonquin Provincial Park in Ontario, Canada, where dense forest cover makes wolves more likely to be heard than seen, have drawn more than 2,000 participants every summer since 1963, contributing almost $1.9 million to Ontario's yearly economy (Bowman and Eagle 2004).

- The 1998 reintroduction of Mexican gray wolves to eastern Arizona and western New Mexico, including the Gila and Apache National Forests, has triggered wolf-related tours by the Arizona Heritage Alliance, Grand Canyon Chapter of the Sierra Club, and other private parties (Unsworth et al. 2005). The lack of comprehensive annual visitation estimates for the area's national forests prior to the arrival of wolves makes it impossible to measure wolf-related increases in tourist numbers and expenditures.

- Wolf-related tourism has the potential to succeed in central Idaho (Druzin 2007), but remains in the very early stages of development. Hunting outfitters have teamed up with environmental interpreters to give visitors glimpses of wolves in the Frank Church River of No Return Wilderness and the Sawtooth National Recreation Area. One outfitter (M. Branson, Wind River Outfitters) who guides hunters north of the Salmon River in the

Wilderness believes that wolves have made it harder to hunt elk, but that their presence adds to the mystique of the Idaho wilderness that his customers are willing to pay for (Barker 2008). According to this outfitter, some hunters find wolf encounters to be the high point of their trips. Wolves have also made this company's summer pack trips more popular.

- Several private landowners have shown recent interest in developing small-scale wolf watching at locations in western Montana away from Yellowstone and Glacier National Parks (C. Sime, pers. comm.). In these cases, landowners have the potential to attract high paying clients by offering opportunities to see wolves and enjoy the outdoors away from the more crowded conditions of the national parks. If successful, these enterprises would broaden the economic benefits of viewing wolves to a larger geographic portion of the state.

Summary

As with the other economic outcomes discussed in this chapter, Washington's ability to develop a viable wolf-related tourism industry will depend on where and how many wolves eventually become reestablished in the state, their behavior, and human behavior in response to them. However, Washington appears to have potential for receiving at least modest economic benefits from wolf watching for the following reasons:

1) Wildlife watching is already a highly popular activity among Washington's residents and visitors, as shown by the number of participants and money generated (USFWS and USCB 2007, 2008). As a result, the state has one of the larger wildlife-watching constituencies in the nation. Specific interest in viewing wolves is demonstrated by a 2008 telephone survey of 805 Washington residents 18 years old and older that found that 54% of respondents would travel to see or hear wild wolves in the state (Duda et al. 2008a).

2) As noted in locations such as Yellowstone National Park, wolves undoubtedly would be highly popular among wildlife watchers in Washington, providing that animals can be seen or heard, or that other evidence (tracks, scat) of their presence can be encountered on a fairly reliable basis.

3) Large population centers in the greater Seattle, Portland, Vancouver, B.C., and Spokane areas provide nearby sources of tourists. Each is within several driving hours of at least one area where wolf recovery is expected to occur (i.e., the northern Cascades, southern Cascades, northeastern Washington, and the Blue Mountains) and within a day's driving distance of the entire state. Depending on the quality of viewing, visitors from outside the Pacific Northwest will also likely come to Washington to see wolves.

4) Washington includes large amounts of public land administered primarily by the U.S. Forest Service, National Park Service, and other federal and state agencies. Not only are these lands conducive to wolf recovery, but as seen elsewhere in North America, public land ownership lends itself to wolf-related tourism much better than private land ownership.

5) Outfitting and guiding businesses in Washington already include wildlife-viewing recreational activities that provide the infrastructure needed to expand into commercial wolf viewing and listening.

6) Washington offers many high quality outdoor activities (e.g., fishing, hunting, hiking, camping, river running, viewing of other wildlife, and visiting national parks, national forests, and federal and state wildlife areas) in a scenic setting that would be complementary to wolf watching and help attract visitors to areas supporting wolves.

Although difficult to estimate, the experiences of Minnesota and Ontario (where money values have been calculated) suggest that Washington could reasonably expect to derive economic benefits of perhaps several million dollars annually from wolf-related activities by the time the species could be delisted. Larger wolf populations in the state would likely expand viewing opportunities and economic benefits. Depending on the extent to which communities and wildlife-viewing guiding businesses use these opportunities, Washington could conceivably develop a sizable wolf-related tourist industry.

The economic gain from wolf tourism has the potential to offset or exceed the combined costs of livestock depredation and reduced hunting opportunities. Monies generated by wolf watching would largely go to the counties where wolf recovery is most likely to occur, such as those in northeastern and southeastern Washington and those along the Cascades. This would benefit many of the more rural counties among these that have lower median household incomes and higher unemployment than elsewhere in the state (see OFM 2007b, WSDOT 2008).

To achieve this potential, Washington will need to have some areas where wolves are safe from harassment, and are therefore less afraid of people and more likely to use open terrain. The state has at least two locations that could potentially offer good wolf viewing. Mt. St. Helens National Volcanic Monument features a large open volcanic plain created by the 1980 eruption of Mt. St. Helens. The plain and its sizable elk herd are easily viewed from various places along Johnson Ridge (including the Forest Service's Johnson Ridge Observatory) and elsewhere. The Methow Valley in Okanogan County supports large wintering deer herds in open habitats on both public and private lands, and could attract wolves at that time of the year. Both of these locations are already popular tourist destinations, so it may be difficult to quantify the economic benefits derived solely from wolf viewing.

Wolf-based tourism also has some potential in other areas of the state (e.g., some national forest lands) where wolves are not frequently seen, but are regularly present and relatively safe from harassment. Modest numbers of visitors without high expectations might still be attracted to such areas in hopes of possibly seeing or hearing a wolf or finding wolf sign. Wolf tourism in such locations could be developed in various innovative ways, such as through the use of remote cameras and websites, tracking and howling trips, or even development of a wolf visitor center similar to that in Minnesota, where deeply wooded terrain also makes wolves difficult to see.

Offsetting these projected benefits to tourism, wolf presence may possibly scare some visitors away from visiting national forests and other wildland areas through fears over personal safety. However, this problem has not been reported in other localities with wolves in the lower 48 states. Additionally, any substantial wolf-related declines in the viewability of elk, deer, and other ungulates, caused either by changes in behavior or population declines, could possibly lower the viewing opportunities for these species in some localized areas. The extent of lost revenues from this impact is difficult to project.

E. Forest Products Industry

Overview of the Forest Products Industry in Washington

The total value of Washington's forest products industry (including lumber, wood products, paper, and wood-related manufacturing production) was $15.9 billion in 2006 (WFPA 2007), which represented an estimated 5.4% of the state's economic output. Washington is the second largest producer of softwood lumber in the nation, accounting for 13% of total U.S. production.

More than half (52%, 22.1 million acres) of Washington is forested (WFPA 2007). Sixty-four percent (14.3 million acres) of the state's forestlands are managed by federal, state, tribal, county, and municipal concerns, with the U.S. Forest Service being by far the largest holder (58%, 8.2 million acres) among these. The rest (36%, 7.9 million acres) are privately owned, of which 59% (4.6 million acres) are considered industrial forestlands. In total, 73% (16.2 million acres) of the state's forests are used commercially. From 2000 to 2005, 71% of the timber harvested in Washington came from private forestland, whereas just 2% originated from federal land (WFPA 2007). About 7 billion board feet of lumber were harvested annually in the late 1980s, but this figure has declined to about 4 billion board feet since the mid-1990s due to federal and state policy changes. Based on timber tax revenues, the 15 largest timber-producing counties in the state in 2006 were (in order) Lewis, Grays Harbor, Pacific, Cowlitz, Clallam, Pierce, Stevens, Mason, Jefferson, Thurston, Klickitat, Skagit, King, Snohomish, and Clark counties (WSDOR 2007). Thirteen of these counties are located in western Washington.

Summary

Wolves are habitat generalists, but in the western United States occur most frequently in forests (USFWS 2009). Wolves are also fairly tolerant of moderate amounts of human disturbance, even in the vicinity of active wolf dens (Thiel et al. 1998, Frame et al. 2007). Hence, restrictions on land use practices have not been necessary to achieve wolf conservation in Idaho, Montana, and Wyoming (USFWS 2009). For these reasons, wolf reestablishment in Washington is not expected to result in the imposition of any land use restrictions to protect and conserve wolves other than those that occasionally may be needed to temporarily protect den sites from malicious or careless destruction during the denning period (see Chapter 8).

In neighboring states with wolves, no restrictions have been placed on the forest products industry regarding timber management and logging to protect wolves. On private forestlands in Washington, no restrictions are anticipated with the possible exception of delaying timber harvests near occupied den sites until after the completion of the denning season. The Washington Department of Natural Resources currently has a provision under the Washington State Forest Practices Act Critical Habitats Rule for threatened and endangered species (WAC 222-16-080) for gray wolves. Forest practices on state and private land where harvesting, road construction, or site preparation is proposed within 1 mile of a known active wolf den, documented by WDFW, between the dates of March 15 and July 30, or 0.25 mile from the den at other times of the year, are designated as a Class IV-Special and require an extra 14 days of review, and are subject to State Environmental Policy Act (SEPA) review. The rule was established in 1992, but much has been learned since then about habitat issues involving wolves in neighboring states. This newer information suggests that the rule should be reviewed and perhaps modified to reflect current knowledge.

On public forestlands, WDFW has no legal authority to implement timber harvest and other land use restrictions on land it does not manage; land management agencies can and may adopt seasonal or area restrictions independently from WDFW. However, experience in Idaho, Montana, and Wyoming has shown that no restrictions, other than those occasionally needed to temporarily prevent excessive disturbance of occupied den sites, have been necessary to conserve wolves.

In summary, wolf reestablishment in Washington is anticipated to have no economic impact on the state's forest products industry.

F. Other Potential Economic Impacts

In addition to concerns over potential hunting-related impacts, commercial outfitters in Washington have expressed concern that agency-dictated area closures related to wolf presence (especially during the denning period) may preclude access to or through some desirable areas on federal and state lands (G. Ulin, pers. comm.). They have expressed concerns that even temporary closures under this scenario could result in significant financial impacts to affected outfitters. As described elsewhere in this plan (Chapter 8; Chapter 14, Section E), very few area closures of this type have occurred in Idaho, Montana, or Wyoming, and few, if any, are expected in Washington. However, WDFW has no legal authority over land it does not manage; land management agencies can and may adopt seasonal or area restrictions independently from WDFW. Thus, there is minor potential for wolf-related area closures to occur in the state. However, if this should occur, it would be of a temporary nature and the number of areas affected would likely be very small, hence few outfitting companies are expected to be impacted.

15. LITERATURE CITED

Adamire, B. 1985. Wolf bounties paid by the Clallam County auditor's office, 1906-1929. Unpublished records from Clallam County, Port Angeles.

Adams, J. R., L. M. Vucetich, P. W. Hedrick, R. O. Peterson, and J. A. Vucetich. 2011. Genomic sweep and potential genetic rescue during limited environmental conditions in an isolated wolf population. Proceedings of the Royal Society B doi:10.1098/rspb.2011.0261.

Adams, L. G., B. W. Dale, and L. D. Mech. 1996. Wolf predation of caribou calves in Denali National Park, Alaska. Pages 245-260 *in* L. N. Carbyn, S. H. Fritts, and D. R. Seip, eds. Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, University of Alberta, Edmonton, Alberta.

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 170:1-25.

Akcakaya, H. R. 2002. RAMAS GIS: linking spatial data with population viability analysis (version 4.0). Applied Biomathematics, Setauket, New York.

Akenson, J., H. Akenson, and H. Quigley. 2005. Effects of wolf introduction on a cougar population in the central Idaho wilderness. Mountain Lion Workshop 8:177-187.

Almack, J. A. and S. H. Fitkin. 1998. Grizzly bear and gray wolf investigations in Washington State, 1994-1995. Washington Department of Fish and Wildlife, Olympia, Washington.

Almberg, E. S., L. D. Mech, D. W. Smith, J. W. Sheldon, and R. L. Crabtree. 2009. A serological survey of infectious disease in Yellowstone National Park's canid community. PLoS ONE 4:e7042.

Anonymous. 1990. Two gray wolf pack discovered in northern Washington. Endangered Species Technical Bulletin 15(6):6.

Anthony, R. G., J. A. Estes, M. A. Ricca, A. K. Miles, and E. D. Forsman. 2008. Bald eagles and sea otters in the Aleutian Archipelago: indirect effects of trophic cascades. Ecology 89:2725-2735.

Arjo, W. M. and D. H. Pletscher. 1999. Behavioral responses of coyotes to wolf recolonization in northwestern Montana. Canadian Journal of Zoology 77:1919-1927.

Arjo, W. M., D. H. Pletscher, and R. R. Ream. 2002. Dietary overlap between wolves and coyotes in northwestern Montana. Journal of Mammalogy 83:754-766.

Asa, C., P. Miller, M. Agnew, J. A. R. Rebolledo, S. L. Lindsey, M. Callahan, and K. Bauman. 2007. Relationship of inbreeding with sperm quality and reproductive success in Mexican gray wolves. Animal Conservation 10:326-331.

Aspi, J., E. Roininen, M. Ruokonen, I. Kojola, and C. Vila. 2006. Genetic diversity, population structure, effective population size and demographic history of the Finnish wolf population. Molecular Ecology 15:1561-1576.

Atwood, T. C. and E. M. Gese. 2010. Importance of resource selection and social behavior to partitioning of hostile space by sympatric canids. Journal of Mammalogy 91:490-499.

Atwood, T. C., E. M. Gese, and K. E. Kunkel. 2007. Comparative patterns of predation by cougars and recolonizing wolves in Montana's Madison Range. Journal of Wildlife Management 71:1098-1106.

Ausband, D. E. 2010. Pilot study report for using biofence to manipulate wolf pack movements in central Idaho. Available online at: <http://www.umt.edu/mcwru/personnel/ausband/default.aspx>

Ausband, D. E., J. Holyan, and C. Mack. 2009a. Longevity and adaptability of a reintroduced gray wolf. Northwestern Naturalist 90:44-47.

Ausband, D.E., M. S. Mitchell, K. Doherty, P. Zager, C. M. Mack, and J. Holyan. 2010. Surveying predicted rendezvous sites to monitor gray wolf populations. Journal of Wildlife Management 74:1043-1049.

Ausband, D., M. Mitchell, A. Mynsberge, C. Mack, J. Stenglein, and L. Waits. 2009b. Developing wolf population monitoring techniques. University of Montana, the Nez Perce Tribe, University of Idaho, Idaho Department of Fish and Game, Montana Fish, Wildlife and Parks, and U.S. Fish and Wildlife Service.

Backus, P. 2008. State set to take over wolf kill payments. Missoulian 2008(February 19).

Ballard, J. 2009. Elk hunting forecast. Rocky Mountain Elk Foundation, Missoula, Montana. <http://www.rmef.org/Hunting/Features/Articles/2009Forecast.htm>

Ballard, W. B., J. S. Whitman, and D. J. Reed. 1990. Population dynamics of moose in south-central Alaska. Wildlife Monographs 114:1-49.

Ballard, W. B., L. N. Carbyn, and D. W. Smith. 2003. Wolf interactions with non-prey. Pages 259-271 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

Bangs, E. E. and J. Shivik. 2001. Managing wolf conflict with livestock in the northwestern United States. Carnivore Damage Prevention News No. 3(July):2-5.

Bangs, E. E., T. N. Bailey, and M. F. Portner. 1989. Survival rates of adult female moose on the Kenai Peninsula, Alaska. Journal of Wildlife Management. 53:557-563.

Bangs, E. E., J. A. Fontaine, M. D. Jimenez, T. J. Meier, E. H. Bradley, C. C. Niemeyer, D. W. Smith, C. M. Mack, V. Asher, and J. K. Oakleaf. 2005b. Managing wolf/human conflict in the northwestern United States. Pages 340-356 *in* R. Woodroffe, S. Thirgood, and A. Rabinowitz, editors. People and wildlife: coexistence or conflict? Cambridge University Press, Cambridge, United Kingdom.

Bangs, E., J. Fontaine, T. Meier, C. Niemeyer, M. Jimenez, D. Smith, C. Mack, V. Asher, L. Handegard, M. Collinge, R. Krischke, C. Sime, S. Nadeau, and D. Moody. 2004. Restoration and conflict management of the gray wolf in Montana, Idaho, and Wyoming. Transactions of the North American Wildlife and National Resources Conference 69:89-105.

Bangs, E. E., S. H. Fritts, J. A. Fontaine, D. W. Smith, K. M. Murphy, C. M. Mack, and C. C. Niemeyer. 1998. Status of gray wolf restoration in Montana, Idaho, and Wyoming. Wildlife Society Bulletin 26:785-798.

Bangs, E., M. Jimenez, C. Niemeyer, J. Fontaine, M. Collinge, R. Krischke, L. Handegard, J. Shivik, C. Sime, S. Nadeau, C. Mack, D. Smith, V. Asher, and S. Stone. 2006. Non-lethal and lethal tools to manage wolf-livestock conflict in the northwestern United States. Proceedings of the Vertebrate Pest Conference 22:7-16.

Bangs, E., M. Jimenez, C. Niemeyer, T. Meier, V. Asher, J. Fontaine, M. Collinge, L. Handegard, R. Krischke, D. Smith, and C. Mack. 2005a. Livestock guarding dogs and wolves in the northern Rocky Mountains of the United States. Carnivore Damage Prevention News 8:32-39.

Barber-Meyer, S. M., L. D. Mech, and P. J. White. 2008. Elk calf survival and mortality following wolf restoration to Yellowstone National Park. Wildlife Monographs 169:1-30.

Barber-Meyer, S. M., P. J. White, and L. D. Mech. 2007. Survey of selected pathogens and blood parameters of northern Yellowstone elk: wolf sanitation effect implications. American Midland Naturalist 158:369-381.

Barker, R. 2008. 13 years on, wolves have changed friends and foes alike. Idaho Statesman 2008(January 27).

Barnowe-Meyer, K. K., P. J. White, T. L. Davis, D. W. Smith, R. L. Crabtree, and J. A. Byers. 2010. Influence of wolves and high-elevation dispersion on reproductive success of pronghorn (*Antilocapra americana*). Journal of Mammalogy 91:712-721.

BCMELP (British Columbia Ministry of Environment, Lands, and Parks). 1988. Wolf: wildlife distribution mapping, big game series. [Map]. Integrated Management Branch, Wildlife Branch, British Columbia Ministry of Environment, Lands, and Parks, Victoria, British Columbia.

Becker, S. A. 2008. Habitat selection, condition, and survival of Shiras moose in northwest Wyoming. M.S. thesis, University of Wyoming, Laramie, Wyoming.

Beebe, L. no date. Wilderness trails and a dream: the story behind the Olympic Game Farm. Olympic Graphic Arts, Forks, Washington.

Beier, P. 1991. Cougar attacks on humans in the United States and Canada. Wildlife Society Bulletin 19: 403-412.

Bensch, S., H. Andrén, B. Hansson, H. C. Pedersen, H. Sand, D. Sejberg, P. Wabakken, M. Åkesson, and O. Liberg. 2006. Selection for heterozygosity gives hope to a wild population of inbred wolves. PLoS ONE 1(1): e72.

Berger, J. and D. W. Smith. 2005. Restoring functionality in Yellowstone with recovering carnivores: gains and uncertainties. Pages 100-109 *in* J. C. Ray, K. H. Redford, R. S. Steneck, and J. Berger, editors. Large carnivores and the conservation of biodiversity. Island Press, Washington, D.C.

Berger, J., P. B. Stacey, L. Bellis, and M. P. Johnson. 2001. A mammalian predator-prey imbalance: grizzly bear and wolf extinction affect avian neotropical migrants. Ecological Applications 11:947-960.

Berger, K. M. and M. M. Conner. 2008. Recolonizing wolves and mesopredator suppression of coyotes: impacts on pronghorn population dynamics. Ecological Applications 18:599-612.

Berger, K. M. and E. M. Gese. 2007. Does interference competition with wolves limit the distribution and abundance of coyotes? Journal of Animal Ecology 76:1075-1085.

Berger, K. M., E. M. Gese, and J. Berger. 2008. Indirect effects and traditional trophic cascades: a test involving wolves, coyotes, and pronghorn. Ecology 89:818-828.

Bergerud, A. T. and J. B. Snider. 1988. Predation in the dynamics of moose populations: a reply. Journal of Wildlife Management 52:559-564.

Bernatowicz, J. A. 2010. Deer status and trend report: Region 3. Pages 34-36 *in* Washington Department of Fish and Wildlife. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.

Bernatowicz, J. A. and M. Livingston. 2010. Elk status and trend report: Region 3. Pages 78-82 *in* Washington Department of Fish and Wildlife. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.

Beschta , R. L. 2005. Reduced cottonwood recruitment following extirpation of wolves in Yellowstone's Northern Range. Ecology 86:391-403.

Beschta , R. L. and W. J. Ripple. 2008. Wolves, trophic cascades, and rivers in the Olympic National Park, USA. Ecohydrology 1:118-130.

Beschta , R. L. and W. J. Ripple. 2009. Large predators and trophic cascades in terrestrial ecosystems of the western United States. Biological Conservation 142:2401-2414.

Beschta , R. L. and W. J. Ripple. 2010. Recovering riparian communities with wolves in northern Yellowstone, U.S.A. Restoration Ecology 18:380-389.

Beyer, D. E., Jr., R. O. Peterson, J. A. Vucetich, and J. H. Hammill. 2009. Wolf population changes in Michigan. Pages 65-85 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Blackfeet Tribal Business Council. 2008. Blackfeet Tribe wolf management plan. Blackfeet Tribal Business Council, Browning, Montana. <http://www.fws.gov/mountain-prairie/species/mammals/wolf/>

Boertje, R. D., M. A. Keech, D. D. Young, K. A. Kellie, and C. T. Seaton. 2009. Managing for elevated yield of moose in interior Alaska. Journal of Wildlife Management 73:314-327.

Boertje, R. D., P. Valkenburg, and M. E. McNay. 1996. Increases in moose, caribou, and wolves following wolf control in Alaska. Journal of Wildlife Management 60:474-489.

Boitani, L. 2003. Wolf conservation and recovery. Pages 317-340 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

Boitani, L., P. Cucci, and E. Raganella-Pelliccioni. 2010. Ex-post compensation payments for wolf predation on livestock in Italy: a tool for conservation? Wildlife Research 37:722-730.

Booth, E. S. 1947. Systematic review of the land mammals of Washington. Ph.D. thesis, State College of Washington, Pullman, Washington.

Boutin, S. 1992. Predation and moose population dynamics: a critique. Journal of Wildlife Management 56:116-127.

Bowman, M. E. and P. F. G. Eagles. 2004. Tourism spending in Algonquin Provincial Park. *In* N. W. P. Munro, P. Deardon, T. B. Herman, K. Beazley, and S. Bondrup-Nielsen, editors. Making ecosystem based management work: connecting managers and researchers. Proceedings of the Fifth International Conference on Science and Management of Protected Areas, Science and Management of Protected Areas Association, Wolfville, Nova Scotia. <http://www.sampaa.org/publications/conference-proceedings-1991-2000/2003-proceedings/economic-analysis-protected-areas/Bowman%20and%20Eagles%202004.pdf/view>

Boyd, D., and G. K. Neale. 1992. An adult cougar (*Felis concolor*) killed by gray wolves (*Canis lupus*) in Glacier National Park, Montana. Canadian Field-Naturalist 106: 524-525.

Boyd, D. K and D. H. Pletscher. 1999. Characteristics of dispersal in a colonizing wolf population in the central Rocky Mountains. Journal of Wildlife Management 63:1094-1108.

Boyd, D. K., S. H. Forbes, D. H. Pletscher, and F. W. Allendorf. 2001. Identification of Rocky Mountain gray wolves. Wildlife Society Bulletin 29:78-85.

Boyd, D., P. C. Pacquet, S. Donelon, R. R. Ream, D. H. Pletscher, and C. C. White. 1995. Transboundary movements of a recolonizing wolf population in the Rocky Mountains. Pages 135-140 *in* L. Carbyn, S. Fritts, and D. Seip, editors. Ecology and management of wolves in a changing world. Canadian Circumpolar Institute, University of Alberta, Edmonton, Alberta.

Boyd, D. K., R. R. Ream, D. H. Pletscher, and M. W. Fairchild. 1993. Variation in denning and parturition dates of a wild gray wolf, *Canis lupus*, in the Rocky Mountains. Canadian Field-Naturalist 107:359-360.

Boyd, D., R. Ream, D. Pletscher, and M. Fairchild. 1994. Prey taken by colonizing wolves and hunters in the Glacier National Park area. Journal of Wildlife Management 58:289-295.

Boyd-Heger, D. K. 1997. Dispersal, genetic relationships, and landscape use by colonizing wolves in the central Rocky Mountains. Ph.D. dissertation, University of Montana, Missoula, Montana. 184 pp.

Bradley, E. H. and D. H. Pletscher. 2005. Assessing factors related to wolf depredation of cattle in fenced pastures in Montana and Idaho. Wildlife Society Bulletin 33:1256-1265.

Bradley, E. H., D. H. Pletscher, E. E. Bangs, K. E. Kunkel, D. W. Smith, C. M. Mack, T. J. Meier, J. A. Fontaine, C. C. Niemeyer, and J. D. Jimenez. 2005. Evaluating wolf translocation as a

nonlethal method to reduce livestock conflicts in the northwestern United States. Conservation Biology 19:1498-1508.
Brainerd, S. M., H. Andrén, E. E. Bangs, E. H. Bradley, J. A. Fontaine, W. Hall, Y. Iliopoulos, M. D. Jimenez, E. A. Jozwiak, O. Liberg, C. M. Mack, T. J. Meier, C. C. Niemeyer, H. C. Pedersen, H. Sand, R. N. Schultz, D. W. Smith, P. Wabakken, and A. P. Wydeven. 2008. The effects of breeder loss in wolves. Journal of Wildlife Management 72:89-98.
Brook, B. W., L. W. Traill, and C. J. A. Bradshaw. 2006. Minimum viable population sizes and global extinction risk are unrelated. Ecology Letters 9:375-382.
Buskirk, S. W. 1999. Mesocarnivores of Yellowstone. Pages 165-187 *in* T. W. Clark, A. P. Curlee, S. C. Minta, and P. M. Kareiva, editors. Carnivores in ecosystems: the Yellowstone experience. Yale University Press, New Haven, Connecticut.
Cahalane, V. H. 1939. The evolution of predator control policy in the national parks. Journal of Wildlife Management 3:229-237.
Callahan, J. 2011. Public opinion on wolves and wolf management in Washington. Unpublished report, San Jose State University, San Jose, California.
Cameron, A. B. 1949. Letter to Victor B. Scheffer, September 5, 1949. Unpublished document on file at Washington Department of Fish and Wildlife, Olympia, Washington.
Campbell, B. H., B. Altman. E. E. Bangs, D. W. Smith, B. Csuti, D. W. Hays, F. Slavens, K. Slavens, C. Schultz, and R. W. Butler. 2006. Restoring wildlife populations. Pages 351-373 *in* D. Apostal and M. Sinclair, editors. Restoring the Pacific Northwest: the art and science of ecological restoration in Cascadia. Island Press, Washington, D.C.
Carbyn, L. N. 1982. Coyote population fluctuations and spatial distribution in relation to wolf territories in Riding Mountain National Park, Manitoba. Canadian Field-Naturalist 96:176-183.
Cariappa, C. A., J. K. Oakleaf, W. B. Ballard, and S. W. Breck. 2011. A reappraisal of the evidence for regulation of wolf populations. Journal of Wildlife Management 75:726-730.
Carrera, R., W. Ballard, P. Gipson, B. T. Kelly, P. R. Krausman, M. C. Wallace, C. Villalobos, and D. B. Webster. 2008. Comparison of Mexican wolf and coyote diets in Arizona and New Mexico. Journal of Wildlife Management 72:376-381.
Carroll, C. 2007. Application of habitat models to wolf recovery planning in Washington. Unpublished report.
Carroll, C., M. K. Phillips, C. A. Lopez-Gonzalez, and N. H. Schumaker. 2006. Defining recovery goals and strategies for endangered species: the wolf as a case study. BioScience 56:25-37.
Carroll C., M. K. Phillips, N. H. Schumaker, and D. W. Smith. 2003. Impacts of landscape change on wolf restoration success: planning a reintroduction program based on static and dynamic spatial models. Conservation Biology 17:536–548.
Christianson, D. and S. Creel. 2010. A nutritionally mediated risk effect of wolves on elk. Ecology 91:1184-1191.
Church, B. 1996. Wolves in Washington: an overview of the history, present status, and potential future for wolves in Olympic National Park and the North Cascade Mountains. Wolf Haven International, Tenino, Washington.
Cockle, R. 2008. Idaho wolf spotted in northeast Oregon. The Oregonian 2008(January 25).
Confederated Salish and Kootenai Tribes Tribal Wildlife Management Program. 2009. Northern gray wolf management plan for the Flathead Indian Reservation. Confederated Salish and Kootenai Tribes Tribal Wildlife Management Program, Pablo, Montana. <http://www.fws.gov/mountain-prairie/species/mammals/wolf/>
Conover, M. R. 2001. Resolving human-wildlife conflicts: the science of wildlife damage management. CRC Press, Boca Raton, Florida.

Crabtree, R. L., and J. W. Sheldon. 1999. The ecological role of coyotes on Yellowstone's Northern Range. Yellowstone Science 7:15-23.

Creel, S. and J. J. Rotella. 2010. Meta-analysis of relationships between human offtake, total mortality and population dynamics of gray wolves (*Canis lupus*). PLoS ONE 5(9):e12918.

Creel, S. and J. A. Winnie. 2005. Responses of elk herd size to fine-scale spatial and temporal variation in the risk of predation by wolves. Animal Behavior 69:1181-1189.

Creel, S., J. A. Winnie, Jr., and D. Christianson. 2009. Glucocorticoid stress hormones and the effect of predation risk on elk reproduction. Proceedings of the National Academy of Sciences 106:12388-12393.

Cross, P. C., E. K. Cole, A. P. Dobson, W. H. Edwards, K. L. Hamlin, G. Luikart, A. D. Middleton, B. M. Scurlock, and P. J. White. 2010. Probable causes of increasing brucellosis in free-ranging elk of the Greater Yellowstone Ecosystem. Ecological Applications 20:278-288.

Cunningham, J. 2009. Hunting season/quota change supporting information: species, elk; region, 3; hunting district, 310; year, 2009. Montana Fish, Wildlife & Parks, Helena, Montana.

Cyr, D. L. and S. B. Johnson. 2006. First aid for bee and insect stings. National Ag Safety Database and University of Maine Cooperative Extension, Maine. <http://nasdonline.org/document/962/d000800/first-aid-for-bee-and-insect-stings.html>

Dale, B. W., L. G. Adams, and R. T. Bowyer. 1994. Functional response of wolves preying on barren-ground caribou in a multiple-prey ecosystem. Journal of Animal Ecology 63:644-652.

Dalquest, W. W. 1948. Mammals of Washington. University of Kansas Publications, Museum of Natural History 2:1-444.

Darimont, C. T., P. C. Paquet, and T. E. Reimchen. 2008. Spawning salmon disrupt trophic coupling between wolves and ungulate prey in coastal British Columbia. BMC Ecology 8:14 (12 pp).

Darimont, C. T., P. C. Paquet, and T. E. Reimchen. 2009. Landscape heterogeneity and marine subsidy generate extensive intrapopulation niche diversity in a large terrestrial vertebrate. Journal of Landscape Ecology 78:126-133.

Darimont, C. T., M. H. H. Price, N. N. Winchester, J. Gordon-Walker, and P. C. Paquet. 2004. Predators in natural fragments: foraging ecology of wolves in British Columbia's central and north coast archipelago. Journal of Biogeography 31:1867-1877.

Darimont, C. T., T. E. Reimchen, and P. C. Paquet. 2003. Foraging behavior by gray wolves on salmon streams in coastal British Columbia. Canadian Journal of Zoology 81:349-353.

Dean, R., S. Werbelow, and B. Holz. 2003. A note about the effects of introduced wolves on the operations of elk feedgrounds in western Wyoming. Proceedings of the Western States and Provinces Deer and Elk Workshop 5:23-29.

DelGiudice, G. D., J. Fieberg, M. R. Riggs, M. Carstensen Powell, and W. Pan. 2006. A long-term age-specific survival analysis of female white-tailed deer. Journal of Wildlife Management 70:1556-1568.

DelGiudice, G. D., K. R. McCaffery, D. E. Beyer, Jr., and M. E. Nelson. 2009. Prey of wolves in the Great Lakes region. Pages 155-173 in A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

DelGiudice, G. D., M. R. Riggs, P. Joly, and W. Pan. 2002. Winter severity, survival, and cause-specific mortality of female white-tailed deer in north-central Minnesota. Journal of Wildlife Management 66:698-717.

Demma, D. J. and L. D. Mech. 2009. Wolf use of summer territory in northeastern Minnesota. Journal of Wildlife Management 73:380-384.

Dietsch, A. M., T. L. Teel, M. J. Manfredo, S. A. Jonker, and S. Pozzanghera. 2011. State report for Washington from the research project entitled "Understanding People in Places." Project Report for the Washington Department of Fish and Wildlife. Department of Human Dimensions of Natural Resources, Colorado State University, Fort Collins, Colorado. <http://wdfw.wa.gov/publications/pub.php?id=01190>

Douglas, D. 1914. Journal kept by David Douglas during his travels in North America, 1823-1827, together with a particular description of thirty three species of American oaks and eighteen species of *Pinus*. William Wesley & Son, London.

DOW (Defenders of Wildlife). 2009. All wolf compensation payments paid by Defenders to ranchers in the Northern Rockies and Southwest. Defenders of Wildlife, Washington, D.C. <http://www.defenders.org/programs_and_policy/wildlife_conservation/solutions/wolf_compensation_trust/index.php>

Druzin, H. 2007. Experts, environmentalists, hunters aren't sure if wolf tourism is doable in Idaho. Idaho Statesman 2007(July 13).

Duda, M. D., T. Beppler, S. J. Bissell, A. Criscione, B. Hepler, J. B. Herrick, M. Jones, A. Ritchie, C. L. Schilli, T. Winegord, and A. Lanier. 2008a. Public opinion on hunting and wildlife management in Washington. Responsive Management, Harrisonburg, Virginia. <http://wdfw.wa.gov/publications/pub.php?id=00433>

Duda, M. D., T. Beppler, S. J. Bissell, A. Criscione, B. Hepler, J. B. Herrick, M. Jones, A. Ritchie, C. L. Schilli, T. Winegord, and A. Lanier. 2008b. Hunters' opinions on wildlife management and other hunting issues in Washington. Responsive Management, Harrisonburg, Virginia. <http://wdfw.wa.gov/publications/pub.php?id=00433>

Duffield, J. and C. Neher. 1996. Economics of wolf recovery in Yellowstone National Park. Transactions of the North American Wildlife and Natural Resources Conference 61:285-292.

Duffield, J. W., C. J. Neher, and D. A. Patterson. 2006. Integrating landscape-scale economic and ecological models in the Greater Yellowstone Area: application to wolf recovery. Pages 53-58 *in* A. W. Biel, editor. Greater Yellowstone public lands: a century of discovery, hard lessons, and bright prospects. Proceedings of 8th Biennial Conference on the Greater Yellowstone Ecosystem, Yellowstone National Park, Wyoming.

Duffield, J. W., C. J. Neher, and D. A. Patterson. 2008. Wolf recovery in Yellowstone: park visitor attitudes, expenditures, and economic impacts. Yellowstone Science 16(1):20-25.

Duman, B. 2001. Differentiating Great Lakes Area native wild wolves from dogs and wolf-dog hybrids. Earth Voices LLC, Howell, Michigan. 35 pp.

Eberhardt, L. L., P. J. White, R. A. Garrott, and D. B. Houston. 2007. A seventy-year history of trends in Yellowstone's northern elk herd. Journal of Wildlife Management 71:594-602.

Edge, J. L., D. E. Beyer, Jr., J. L. Belant, M. J. Jordan, and B. J. Roell. 2011. Livestock and domestic dog predations by wolves in Michigan. Human-Wildlife Interactions 5:66-78.

Edson, J. M. 1931. Again the big-game of the Mount Baker district, Washington. Murrelet 12:50-53.

Erb, J. 2008. Distribution and abundance of wolves in Minnesota, 2007-08. Minnesota Department of Natural Resources, Grand Rapids, Minnesota.

ERFC (Economic and Revenue Forecast Council). 2007a. Washington state economic climate study. Washington State Economic and Revenue Forecast Council, Olympia, Washington. <http://www.erfc.wa.gov/publications/documents/climate2007.pdf>

ERFC (Economic and Revenue Forecast Council). 2007b. Washington economic and revenue forecast. Report Number 30(4), Economic and Revenue Forecast Council, Olympia, Washington. <http://www.erfc.wa.gov/publications/documents/nov07pub.pdf>

Estes, J. A. and D. O. Duggins. 1995. Sea otters and kelp forests in Alaska: generality and variation in a community ecological paradigm. Ecological Monographs 65:75-100.

Fitkin, S. and J. Heinlen. 2010. Deer status and trend report: Region 2. Pages 16-19 *in* Washington Department of Fish and Wildlife. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.

Flather, C. H., G. D. Hayward, S. R. Beissinger, and P. A. Stephens. 2011. Minimum viable populations: is there a 'magic number' for conservation practitioners? Trends in Ecology and Evolution 26:307-316.

Forbes, S. H. and D. K. Boyd. 1996. Genetic variation of naturally colonizing wolves in the central Rocky Mountains. Conservation Biology 10:1082-1090.

Forbes, S. H. and D. K. Boyd. 1997. Genetic structure and migration in native and reintroduced Rocky Mountain wolf populations. Conservation Biology 11:1226-1234.

Foreyt, W. J., M. L. Drew, M. Atkinson, and D. McCauley. 2009. *Echinococcus granulosus* in gray wolves and ungulates in Idaho and Montana, USA. Journal of Wildlife Diseases 45:1208-1212.

Fowler, P. and P. Wik. 2010a. Elk status and trend report: Region 1, PMU 13 – GMUs 145, 149, 154, 157, 162, 163, 166, 169, 172, 175, 178, 181, 186. Pages 74-77 *in* Washington Department of Fish and Wildlife. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.

Fowler, P. and P. Wik. 2010b. Bighorn sheep status and trend report: Region 1, Blue Mountains. Pages 138-146 *in* Washington Department of Fish and Wildlife. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.

Frame, P. F., H. D. Cluff, and D. S. Hik. 2007. Response of wolves to experimental disturbance at homesites. Journal of Wildlife Management 71:316-320.

Fredrickson, R. J., P. Siminski, M. Wolf, and P. H. Hedrick. 2007. Genetic rescue and inbreeding depression in Mexican wolves. Proceedings of the Royal Society, Series B 274:2365-2371.

Fritts, S. H. and L. N. Carbyn. 1995. Population viability, nature reserves, and the outlook for gray wolf conservation in North America. Restoration Ecology 3:26-28.

Fritts, S. H. and L. D. Mech. 1981. Dynamics, movements, and feeding ecology of a newly protected wolf population in northwestern Minnesota. Wildlife Monographs 80:1-79.

Fritts, S. H., E. E. Bangs, J. A. Fontaine, W. G. Brewster, and J. F. Gore. 1995. Restoring wolves to the northern Rocky Mountains of the United States. Pages 107-125 *in* L. Carbyn, S. Fritts, and D. Seip, editors. Ecology and management of wolves in a changing world. Canadian Circumpolar Institute, University of Alberta, Edmonton, Alberta.

Fritts, S. H., E. E. Bangs, and J. F. Gore. 1994. The relationship of wolf recovery to habitat conservation and biodiversity in northwestern United States. Landscape and Urban Planning 28:23-32.

Fritts, S. H., W. J. Paul, and L. D. Mech. 1984. Movements of translocated wolves in Minnesota. Journal of Wildlife Management 48:709-721.

Fritts, S. H., W. J. Paul, and L. D. Mech. 1985. Can relocated wolves survive? Wildlife Society Bulletin 13:459-463.

Fritts, S. H., W. J. Paul, and L. D. Mech, and D. P. Scott. 1992. Trends and management of wolf-livestock conflicts in Minnesota. U.S. Fish and Wildlife Service, Resource Publication 181.

Fritts, S. H., R. O. Stephenson, R. D. Hayes, and L. Boitani. 2003. Wolves and humans. Pages 289-316 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

Fuller, T. K. 1989. Population dynamics of wolves in north-central Minnesota. Wildlife Monographs 105:1-41.

Fuller, T. K., L. D. Mech, and J. F. Cochrane. 2003. Wolf population dynamics. Pages 161-191 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

Gaines, W. L., G. K. Neale, and R. H. Naney. 1995. Response of coyotes and gray wolves to simulated howling in north-central Washington. Northwest Science 69:217-222.

Gaines, W. L., P. Singleton, and A. L. Gold. 2000. Conservation of rare carnivores in the North Cascades Ecosystem, western North America. Natural Areas Journal 20:366-375.

Garrott, R. A., J. A. Gude, E. J. Bergman, C. Gower, P. J. White, and K. L. Hamlin. 2005. Generalizing wolf effects across the Greater Yellowstone Area: a cautionary note. Wildlife Society Bulletin 33:1245-1255.

Gasaway, W. C., R. D. Boertje, D. V. Grangaard, D. G. Kellyhouse, 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 120:1-59.

Gehring, T. M., B. E. Kohn, J. L. Gehring, and E. M. Anderson. 2003. Limits to plasticity in gray wolf, *Canis lupus*, pack structure: conservation implications for recovering populations. Canadian Field-Naturalist 117:419-423.

Gehring, T. M., K. C. VerCauteren, M. L. Provost, and A. C. Cellar. 2010a. Utility of livestock-protection dogs for deterring wildlife from cattle farms. Wildlife Research 37:715-721.

Gehring, T. M., K. C. VerCauteren, and J.-M. Landry. 2010b. Livestock protection dogs in the 21st century: is an ancient tool relevant to modern conservation challenges? Bioscience 60:299-308.

Gibson, J. R. 1985. Farming the frontier: the agricultural opening of the Oregon Country, 1786-1846. University of Washington Press, Seattle, Washington.

Gipson, P. S., E. E. Bangs, T. N. Bailey, D. K. Boyd, H. D. Cluff, D. W. Smith, and M. D. Jiminez. 2002. Color patterns among wolves in western North America. Wildlife Society Bulletin 30:821-830.

Griffin, K. A., M. Hebblewhite, H. S. Robinson, P. Zager, S. M. Barber-Meyer, D. Christianson, S. Creel, N. C. Harris, M. A. Hurley, D. H. Jackson, B. K. Johnson, W. L. Myers, J. D. Raithel, M. Schlegel, B. L. Smith, C. White, and P. J. White. 2011. Neonatal mortality of elk driven by climate, predator phenology and predator community composition. Journal of Animal Ecology doi: 10.1111/j.1365-2656.2011.01856.x.

Griffin, S. C., M. L. Taper, R. Hoffman, and L. S. Mills. 2008 The case of the missing marmots: are metapopulation dynamics or range-wide declines responsible? Biological Conservation 141:1293-1309.

Grooms, S. 2007. Ontario experiences cluster of wolf-human encounters. International Wolf 17(3):11-13.

Guenther, S. E. 1952. A wolf record for Washington state. Murrelet 33:14.

Haight, R. G., D. J. Mladenoff, and A. P. Wydeven. 1998. Modeling disjunct fray wolf populations in semi-wild landscapes. Conservation Biology 12:879-888.

Hairston, N. G., F. E. Smith, and L. B. Slobodkin.1960. Community, population control, and competition. American Naturalist 94:421-425.

Hamlin, K. L. and J. A. Cunningham. 2009. Monitoring and assessment of wolf-ungulate interactions and population trends within the Greater Yellowstone Area, southwestern Montana, and Montana statewide, final report. Montana Fish, Wildlife & Parks, Helena, Montana.

Hamlin, K. L., R. A. Garrott, P. J. White, and J. A. Cunningham. 2009. Contrasting wolf-ungulate interactions in the greater Yellowstone ecosystem. Pages 541-577 *in* R. A. Garrott, P. J. White, and F. G. R. Watson, editors. The ecology of large mammals in central Yellowstone: sixteen years of integrated field studies. Academic Press, San Diego, California.

Hansen, H. J. 1986. Wolves of northern Idaho and northeastern Washington. Montana Cooperative Wildlife Research Unit, U.S. Fish and Wildlife Service, Missoula, Montana.

Harding, A. R. 1909. Wolf and coyote trapping: an up-to-date wolf hunter's guide, giving the most successful methods of experienced "wolfers" for hunting and trapping these animals, also gives their habits in detail. A. R. Harding Publishing Company, Columbus, Ohio.

Harper, E. K., W. J. Paul, L. D. Mech, and S. Weisberg. 2008. Effectiveness of lethal, directed wolf-depredation control in Minnesota. Journal of Wildlife Management 72:778-784.

Harris, R. and R. Ream. 1983. A method to aid in discrimination of tracks from wolves and dogs. Canadian Wildlife Service Report Series 45:120-124.

Hart, J. 2008. USDA-Wildlife Services wolf damage management in Minnesota 2008. USDA-APHIS-Wildlife Services, Grand Rapids, Minnesota.

Hawley, J. E., T. M. Gehring, R. N. Schulz, S. T. Rossler, and A. P. Wydeven. 2009. Assessment of shock collars as nonlethal management for wolves in Wisconsin. Journal of Wildlife Management 73:518-525.

Hayes, R. D. and J. R. Gunson. 1995. Status and management of wolves in Canada. Pages 21-33 *in* L. N. Carbyn, S. H. Fritts, and D. R. Siep, editors. Ecology and conservation of wolves in a changing world. Occasional Publication Number 35, Canadian Circumpolar Institute, University of Alberta, Edmonton, Alberta.

Hayes, R. D. and A. S. Harestad. 2000. Wolf functional response and regulation of moose in the Yukon. Canadian Journal of Zoology 78:60-66.

Hayes, R. D., R. Farnell, R. M. P. Ward, J. Carey, M. Dehn, G. W. Kuzyk, A. M. Baer, C. L. Gardner, and M. O'Donoghue. 2003. Experimental reduction of wolves in the Yukon: Ungulate responses and management implications. Wildlife Monographs 152:1-35.

Heath, J. 1979. Memoirs of Nisqually. Ye Galleon Press, Fairfield, Washington.

Hebblewhite, M. 2005. Predation by wolves interacts with the North Pacific Oscillation (NPO) on a western North American elk population. Journal of Animal Ecology 74:226-233.

Hebblewhite, M. and E. H. Merrill. 2007. Multiscale wolf predation risk: does migration reduce risk? Oecologia 152:377-387.

Hebblewhite, M. and D. W. Smith. 2010. Wolf community ecology: ecosystem effects of recovering wolves in Banff and Yellowstone national parks. Pages 69-120 *in* M. Musiani, L. Boitani, and P. C. Paquet. The world of wolves: new perspectives on ecology, behavior, and management. University of Calgary Press, Calgary, Alberta.

Hebblewhite, M., E. H. Merrill, L. E. Morgantini, C. A. White, J. R. Allen, E. Bruns, L. Thurston, and T. E. Hurd. 2006. Is migratory behavior of montane elk herds in peril? The case of Alberta's Ya Ha Tinda elk herd. Wildlife Society Bulletin 34:1280-1294.

Hebblewhite, M., M. Musiani, and L. S. Mills. 2010. Restoration of genetic connectivity among northern Rockies wolf populations. Molecular Ecology 19:4383-4385.

Hebblewhite, M., D. H. Pletscher, and P. C. Paquet. 2002. Elk predation dynamics in areas with and without predation by recolonizing wolves in Banff National Park, Alberta. Canadian Journal of Zoology 80:789-799.

Herrero, S., A. Higgins, J. E. Cardoza, L. I. Hajduk, and T. S. Smith. 2011. Fatal attacks by American black bear on people: 1900-2009. Journal of Wildlife Management 75:596-603.

Hornocker, M. G. and T. K. Ruth. 1997. Cougar-wolf interaction in the North Fork of the Flathead River, Montana. Hornocker Wildlife Institute, Moscow, Idaho.

Houts, M. E. 1999. Modeling gray wolf habitat in the northern Rocky Mountains. M.S. thesis, University of Kansas, Lawrence, Kansas.
Houts, M. E. 2003. Using logistic regression to model wolf habitat suitability in the northern Rocky Mountains. World Wolf Congress, Banff, Alberta.
Howery, L. D. and T. J. DeLiberto. 2004. Indirect effects of carnivores on livestock foraging behavior and production. Sheep and Goat Research Journal 19:53-57.
Huggard, D. J. 1993. Prey selectivity of solves in Banff National Park. I. Prey species. Canadian Journal of Zoology 71:130-139.
Husseman, J. S., D. L. Murray, G. Power, C. Mack, C. R. Wenger, and H. Quigley. 2003. Assessing differential prey selection patterns between two sympatric large carnivores. Oikos 101:591-601.
IDFG (Idaho Department of Fish and Game). 2004. White-tailed deer management plan, 2005-2014. Idaho Department of Fish and Game, Boise, Idaho.
IDFG (Idaho Department of Fish and Game). 2008. Idaho wolf population management plan, 2008-2012. Idaho Department of Fish and Game, Boise, Idaho.
IDFG (Idaho Department of Fish and Game). 2010a. Study shows effects of predators on Idaho elk. Idaho Fish and Game News 22(2):1-4.
IDFG (Idaho Department of Fish and Game). 2010b. Idaho rule 10(j) proposal, Lolo zone. Idaho Department of Fish and Game, Boise, Idaho.
IDFG (Idaho Department of Fish and Game). 2011. Director's annual report to the commission, FY 2010. Idaho Department of Fish and Game, Boise, Idaho.
Jacoby, J. 2007. Local wolves not all lone. Baker City Herald 2007(December 4).
Jaffe, R. 2001. Winter wolf predation in an elk-bison system in Yellowstone National Park. M.S. thesis, Montana State University, Bozeman, Montana.
Jenkins, K. J. and B. F. Manley. 2008. A double observer method for reducing bias in faecal pellet surveys of forest ungulates. Journal of Applied Ecology 45:1339-1348.
Jimenez, M. D., V. J. Asher, C. Bergman, E. E. Bangs, and S. P. Woodruff. 2008. Gray wolves, *Canis lupus*, killed by cougars, *Puma concolor*, and a grizzly bear, *Ursus arctos*, in Montana, Alberta, and Wyoming. Canadian Field-Naturalist 122:76-78.
Jimenez, M. D., E. E. Bangs, M. Drew, S. Nadeau, V. J. Asher, and C. Sime. 2010b. Dog lice (*Trichodectes canis*) found on wolves (*Canis lupus*) in Montana and Idaho. Northwestern Naturalist 91:331-333.
Jimenez, M. D., E. E. Bangs, C. Sime, and V. J. Asher. 2010a. Sarcoptic mange found in wolves in the Rocky Mountains in western United States. Journal of Wildlife Diseases 46:1120-1125.
Johnson, M. L. and S. Johnson. 1952. Check list of mammals of the Olympic Peninsula. Murrelet 33:32-37.
Johnson, M. R., D. K. Boyd, and D. H. Pletscher. 1994. Serologic investigations of canine parvovirus and canine distemper in relation to wolf (*Canis lupus*) pup mortalities. Journal of Wildlife Diseases 30:270-273.
Karlsson, J. and M. Sjöström. 2007. Human attitudes towards wolves, a matter of distance. Biological Conservation 137:610-616.
Kaufman, M. J., N. Varley, D. W. Smith, D. R. Stahler, D. R. McNulty, and M. S. Boyce. 2007. Landscape heterogeneity shapes predation in a newly restored predator-prey system. Ecology Letters 10:690-700.
Kauffman, M. J., J. F. Brodie, and E. S. Jules. 2010. Are wolves saving Yellowstone's aspen? A landscape-level test of a behaviorally mediated trophic cascade. Ecology 91:2742-2755.
Keith, L. 1983. Population dynamics of wolves. Canadian Wildlife Service Report Series 45:66-77.
Kirkwood, S. 2006. Wolf & consequence. National Parks 2006(winter).

Kojola, I., S. Kaartinen, A. Hakala, S. Heikkinen, and H.-M. Voipio. 2009. Dispersal behavior and the connectivity between wolf populations in northern Europe. Journal of Wildlife Management 73:309-313.

Kortello, A. D., T. E. Hurd, and D. L. Murphy. 2007. Interactions between cougars (*Puma concolor*) and gray wolves (*Canis lupus*) in Banff National Park, Alberta. Ecoscience 14:214-222.

Kreeger, T. J. 2003. The internal wolf: physiology, pathology, and pharmacology. Pages 192-217 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

Krefting, L. W. 1969. The rise and fall of the coyote on Isle Royale. Naturalist 20:25-31.

Kroeger, T., F. Casey, and C. Haney. 2006. Reintroduction of the Mexican wolf (*Canis lupus baileyi*) to the southwestern United States: an economic perspective. Paper presented at the 18th Annual North American Wolf Conference, Chico Hot Springs, Montana.

Kunkel, K. and D. H. Pletscher. 1999. Species specific population dynamics of cervids in a multipredator ecosystem. Journal of Wildlife Management 63:1082-1093.

Kunkel, K. E., D. H. Pletscher, D. K. Boyd, R. R. Ream, and M. W. Fairchild. 2004. Factors correlated with foraging behavior in wolves in and near Glacier National Park, Montana. Journal of Wildlife Management 68:167-178.

Kunkel, K. E., T. K. Ruth, D. H. Pletscher, and M. G. Hornocker. 1999. Winter prey selection by wolves and cougars in and near Glacier National Park, Montana. Journal of Wildlife Management 63:901-910.

Lance, N. J., S. W. Breck, C. Sime, P. Callahan, and J. A. Shivik. 2010. Biological, technical, and social aspects of applying electrified fladry for livestock protection from wolves (*Canis lupus*). Wildlife Research 37:708-714.

Langley, R. L. and W. E. Morrow. 1997. Deaths resulting from animal attacks in the United States. Wilderness and Environmental Medicine 8:8-16.

Laporte, I., T. B. Muhly, J. A. Pitt, M. Alexander, and M. Musiani. 2010. Effects of wolves on elk and cattle behaviors: implications for livestock production and wolf conservation. PLoS ONE 5:e11954.

Larrison, E. J. 1947. Miscellaneous distributional notes for Washington. Murrelet 28:11-13.

Larsen, D. G., D. A. Gauthier, and R. L. Markel. 1989. Causes and rate of moose mortality in the southwest Yukon. Journal of Wildlife Management 53:548-557.

Larsen, T. and W. J. Ripple. 2006. Modeling gray wolf (*Canis lupus*) habitat in the Pacific Northwest, U.S.A. Journal of Conservation Planning 2:17-33.

Lash, G. Y. B. and P. Black. 2005. Red wolves: creating economic opportunity through ecotourism in rural North Carolina. Defenders of Wildlife, Washington, D.C.

Laufer, J. R. and P. T. Jenkins. 1989. A preliminary study of gray wolf history and status in the region of the Cascade Mountains of Washington State. Wolf Haven America, Tenino, Washington.

Layser, E. F. 1970. Sightings of wolves, Sullivan Lake Ranger District, Colville Nat. For., Pend Oreille Co., Wash. Pages 243-246 *in* Washington State Fish and Game Big Game Status Report 1974-1975, Olympia, Washington.

Lehmkuhler, J., G. Palmquist, D. Ruid, B. Willging, and A. Wydeven. 2007. Effects of wolves and other predators on farms in Wisconsin: beyond verified losses. Pub-ER-658 2007, Wisconsin Department of Natural Resources, Madison, Wisconsin.

Liberg, O., H. Andren, H.-C. Pedersen, H. Sand, D. Sejberg, P. Wabakken, M. Åkesson, and S. Bensch. 2005. Severe inbreeding depression in a wild wolf (*Canis lupus*) population. Biology Letters 1:17-20.

Lien, C. 2001. Exploring the Olympic Mountains: accounts of the earliest expeditions, 1878-1890. The Mountaineers Books, Seattle, Washington.
Linnell, J. D. C., R. Anderson, Z. Andersone, L. Balciauskas, J. C. Blanco, L, Boitani, S. Brainderd, U. Breitenmoser, I. Kojola, O. Liberg, J. Loe, H. Okarma, H. C. Pedersen, C. Promberger, H. Sand, E. J. Solberg, H. Valdmann, and P. Wabakken. 2002. The fear of wolves: a review of wolf attacks on humans. NINA Oppdragsmelding 731:1-65.
Linsley, N. C. 1889. The Pend d'Oreille country. Forest and Stream 33:227-228.
Mack, C. M. and K. Laudon. 1998. Idaho wolf recovery project: recovery and management of gray wolves in Idaho. Annual Report 1995-1998. Nez Perce Tribe, Department of Wildlife Management, Lapwai, Idaho. 19 pp.
MacNulty, D. R., D. W. Smith, J. A. Vucetich, L. D. Mech, D. R. Stahler, and C. Packer. 2009. Predatory senescence in ageing wolves. Ecology Letters 12:1-10.
Macy, P. P. 1934. Some notes on the animal life of Mount Rainier National Park, Washington. Murrelet 15:46-48.
Mao, J. S., M. S. Boyce, D. W. Smith, F. J. Singer, D. J. Vales, J. M. Vore, and E. H. Merrill. 2005. Habitat selection by elk before and after wolf reintroduction in Yellowstone National Park. Journal of Wildlife Management 69:1691-1707.
Martino, T. T. 1997. The wolf, the woman, the wilderness: a true story of returning home. NewSage Press, Troutdale, Oregon.
Martorello, D. A. 2010a. Bighorn sheep status and trend report: statewide. Pages 127-128 *in* Washington Department of Fish and Wildlife. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.
Martorello, D. A. 2010b. Mountain goat status and trend report: statewide. Pages 105-106 *in* Washington Department of Fish and Wildlife. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.
Mazur, K. 2011. Anticipating gray wolf re-colonization in Washington State: stakeholder frames of management perspectives. M.S. thesis, University of Washington, Seattle, Washington.
McCorquodale, S., P. Wik, P. Fowler, and T. Owens. 2010. Elk survival and mortality factors in the Blue Mountains of Washington, 2003-2006. Washington Department of Fish and Wildlife, Olympia, Washington.
McCorquodale, S. M., R. Wiseman, and C. L. Marcum. 2003. Survival and harvest vulnerability of elk in the Cascade Range of Washington. Journal of Wildlife Management 67:248-257.
McNay, M. E. 2002a. Wolf-human interactions in Alaska and Canada: a review of the case history. Wildlife Society Bulletin 30:831-843.
McNay, M. E. 2002b. A case history of wolf-human encounters in Alaska and Canada. Technical Bulletin 13, Alaska Department of Fish and Game, Juneau, Alaska.
McNay, M. E. 2007. A review of evidence and findings related to the death Kenton Carnegie on November 8, 2005 near Points North, Saskatchewan. Alaska Department of Fish and Game, Fairbanks, Alaska.
MDNR (Minnesota Department of Natural Resources). 2001. Minnesota wolf management plan. Division of Wildlife, Minnesota Department of Natural Resources, St Paul, Minnesota.
MDNR (Michigan Department of Natural Resources). 2008. Michigan wolf management plan. Division of Wildlife, Michigan Department of Natural Resources, Lansing, Michigan.
MDOL (Montana Department of Livestock). 2011. Livestock loss reduction & mitigation. Department of Livestock, Helena, Montana. <http://liv.mt.gov/LLB/default.mcpx>
Mech, L. D. 2001. Managing Minnesota's recovered wolves. Wildlife Society Bulletin 29:70-77.

Mech, L. D. 1970. The wolf: the ecology and behavior of an endangered species. Natural History Press, Garden City, New York.
Mech, L. D. 2007. Femur-marrow fat of white-tailed deer fawns killed by wolves. Journal of Wildlife Management 71:920-923.
Mech, L. D. and L. Boitani. 2003a. Wolf social ecology. Pages 1-34 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.
Mech, L. D. and L. Boitani. 2003b. Ecosystem effects of wolves. Pages 158-160 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.
Mech, L. D., and M. E. Nelson. 2000. Do wolves affect white-tailed buck harvest in northeastern Minnesota? Journal of Wildlife Management 64:129-136.
Mech, L. D. and R. O. Peterson. 2003. Wolf-prey relations. Pages 131-160 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.
Mech, L. D., S. M. Goyal, W. J. Paul, and W. E. Newton. 2008. Demographic effects of canine parvovirus on a free-ranging wolf population over 30 years. Journal of Wildlife Diseases 44:824-836.
Mech, L. D., E. K. Harper, T. J. Meier, and W. J. Paul. 2000. Assessing factors that may predispose Minnesota farms to wolf depredation on cattle. Wildlife Society Bulletin 28:623-629.
Merkle, J. A., D. R. Stahler, and D. W. Smith. 2009. Interference competition between gray wolves and coyotes in Yellowstone National Park. Canadian Journal of Zoology 87:56-63.
Messier, F. 1994. Ungulate population models with predation: a case study with the North American moose. Ecology 75:478–488.
Meyers, P. M. 2009. 2009 Columbian white-tailed deer population estimates. U.S. Fish and Wildlife Service, Julia Butler Hansen Refuge, Cathlamet, Washington.
MFWP (Montana Fish, Wildlife & Parks). 2003. Montana gray wolf conservation and management plan: final environmental impact statement. Montana Fish, Wildlife & Parks, Helena, Montana. <http://fwp.mt.gov/wildthings/management/wolf/management.html>
MFWP (Montana Fish, Wildlife & Parks). 2007a. Wolves and human safety. Montana Fish, Wildlife & Parks, Helena, Montana. <http://fwp.mt.gov/wildthings/wolf/human.html>
MFWP (Montana Fish, Wildlife & Parks). 2007b. Wolves and big game in Montana. Montana Fish, Wildlife & Parks, Helena, Montana. <http://fwp.mt.gov/wildthings/wolf/gamefaq.html#pop>
MFWP (Montana Fish, Wildlife & Parks). 2010. Montana rule 10(j) proposal, West Fork of the Bitterroot. Montana Fish, Wildlife & Parks, Helena, Montana.
Milne, D. G., A. S. Harestad, and K. Atkinson. 1989. Diets of wolves on northern Vancouver Island. Northwest Science 63:83-86.
Mitchell, M. S., D. E. Ausband, C. A. Sime, E. E. Bangs, J. A. Gude, M. D. Jimenez, C. M. Mack, T. J. Meier, M. S. Nadeau, and D. W. Smith. 2008. Estimation of successful breeding pairs for wolves in the northern Rocky Mountains, USA. Journal of Wildlife Management 72:881-891.
Mladenoff, D. J., M. K. Clayton, S. D. Pratt, T. A. Sickley, and A. P. Wydeven. 2009. Change in occupied wolf habitat in the northern Great Lakes region. Pages 119-138 *in* Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.
Mladenoff, D. J., R. G. Haight, T. A. Sickley, and A. P. Wydeven. 1997. Causes and implications of species restoration in altered ecosystems: a spatial landscape projection of wolf population recovery. BioScience 47:21-31.

Mladenoff, D. J., T. A. Sickley, R. G. Haight, and A. P. Wydeven. 1995. A regional landscape analysis and prediction of favorable gray wolf habitat in the northern Great Lakes region. Conservation Biology 9:279-294.

Mladenoff, D. J., T. A. Sickley, and A. P. Wydeven. 1999. Predicting gray wolf landscape recolonization: logistic regression models vs. new field data. Ecological Applications 9:37-44.

Montag, J. M., M. E. Patterson, and W. A. Freimund. 2005. The wolf viewing experience in the Lamar Valley of Yellowstone National Park. Human Dimensions of Wildlife 10:273–284.

Montag, J. M., M. E. Patterson, and B. Sutton. 2003. Political & social viability of predator compensation programs in the west: final project report. School of Forestry, University of Montana, Missoula, Montana.

Moore, D. A., W. M. Sischo, A. Hunter, and T. Miles. 2000. Animal bite epidemiology and surveillance for rabies postexposure prophylaxis. Journal of the American Veterinary Medicine Association 217:190-194.

Morehouse, A. T. and M. S. Boyce. 2011. From venison to beef: seasonal changes in wolf diet composition in a livestock grazing landscape. Frontiers in Ecology and the Environment 9:440-445.

Mowat, G. 2007. Large carnivore population review for the Kootenay Region. British Columbia Ministry of Environment, Kootenay Region, Nelson, British Columbia.

Muhly, T. B. and M. Musiani. 2009. Livestock depredation by wolves and the ranching economy in the northwestern U.S. Ecological Economics 68:2439-2450.

Muhly, T. B., M. Alexander, M. S. Boyce, R. Creasey, M. Hebblewhite, D. Paton, J. A. Pitt, and M. Musiani. 2010b. Differential risk effects of wolves on wild versus domestic prey have consequences for conservation. Oikos 119:1243-1254.

Muhly, T., C. C. Gates, C. Callaghan, and M. Musiani. 2010a. Livestock husbandry practices reduce wolf depredation risk in Alberta, Canada. Pages 261-286 *in* M. Musiani, L. Boitani, and P. C. Paquet. The world of wolves: new perspectives on ecology, behavior, and management. University of Calgary Press, Calgary, Alberta.

Muñoz-Fuentes, V., C. T. Darimont, P. C. Paquet, and J. A. Leonard. 2010. The genetic legacy of extirpation and re-colonization in Vancouver Island wolves. Conservation Genetics 11:547-556.

Muñoz-Fuentes, V., C. T. Darimont, R. K. Wayne, P. C. Paquet, and J. A. Leonard. 2009. Ecological factors drive differentiation in wolves from British Columbia. Journal of Biogeography 36:1516-1531.

Murie, A. 1935. Wildlife of the Olympics. Special Report, Wildlife Division, National Park Service, Department of the Interior, Port Angeles, Washington.

Murie, O. J. 1916-1917. Olympic Mts. notes of Olaus J. Murie, Jan. 3, 1916 to Mar. 3, 1917. Unpublished field notes on file at Washington Department of Fish and Wildlife, Olympia, Washington.

Murphy, K. 1998. The ecology of the cougar (*Puma concolor*) in the northern Yellowstone ecosystem: interactions with prey, bears, and humans. Ph.D. dissertation, University of Idaho, Moscow, Idaho.

Murray, D. L., D. W. Smith, E. E. Bangs, C. Mack, J. K. Oakleaf, J. Fontaine, D. Boyd, M. Jiminez, C. Niemeyer, T. J. Meier, D. Stahler, J. Holyan, and V. J. Asher. 2010. Death from anthropogenic causes is partially compensatory in recovering wolf populations. Biological Conservation 143:2514-2524.

Musiani, M., C. Mamo, L. Boitani, C. Callaghan, C. C. Gates, L. Mattei, E. Visalberghi, S. Breck, and G. Volpi. 2003. Wolf depredation trends and the use of fladry barriers to protect livestock in western North America. Conservation Biology 17:1538-1547.

Musiani, M., T. Muhly, C. C. Gates, C. Callaghan, M. E. Smith, and E. Tosani. 2005. Seasonality and reoccurrence of depredation and wolf control in western North America. Wildlife Society Bulletin 33:876-887.

Myers, W. L., L. C. Bender, P. E. Fowler, and B. R. Lyndaker. 1999a. Population parameters and trends. Pages 43-72 *in* W. L. Myers, editor. An assessment of elk population trends and habitat use with special reference to agricultural damage zones in the northern Blue Mountains of Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

Myers, W. L., W. Y. Chang, S. S. Germaine, W. M. Vander Haegen, and T. E. Owens. 2008. An analysis of deer and elk-vehicle collision sites along state highways in Washington state. Washington Department of Fish and Wildlife, Olympia, Washington.

Myers, W. L., B. Lyndaker, P. E. Fowler, and W. Moore. 1999b. Investigations of calf elk mortailities in southeast Washington. Progress Report, Washington Department of Fish and Wildlife, Olympia, Washington.

NASS (National Agricultural Statistical Service). 2004. 2002 census of agriculture: Washington, state and county data. Volume 1, Geographic Area Series, Part 47, AC-02-A-47. National Agricultural Statistics Service, U.S. Department of Agriculture, Washington, D.C. <http://www.agcensus.usda.gov/Publications/2002/index.asp>

NASS (National Agricultural Statistical Service). 2005. Sheep and goats death loss. National Agricultural Statistics Service, U.S. Department of Agriculture, Washington, D.C. <http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1628>

NASS (National Agricultural Statistical Service). 2006. Cattle death loss. National Agricultural Statistics Service, U.S. Department of Agriculture, Washington, D.C. <http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1625>

NASS (National Agricultural Statistical Service). 2007a. 2007 Washington agricultural bulletin. Washington Field Office, National Agricultural Statistical Service, U.S. Department of Agriculture, Olympia, Washington. <http://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Annual_Statistical_Bulletin/annual2007.pdf>

NASS (National Agricultural Statistical Service). 2007b. Farm labor. Report for November 2007, National Agricultural Statistical Service, U.S. Department of Agriculture, Washington, D.C. <http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1063>

NASS (National Agricultural Statistical Service). 2007c. Meat animals production, disposition, and income: 2006 summary. Report Mt An 1-1 (07), National Agricultural Statistical Service, U.S. Department of Agriculture, Washington, D.C. <http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1101>

National Centers for Disease Control and Prevention. 2003. Nonfatal dog bite-related injuries treated in hospital emergency departments – United States, 2001. Morbidity and Mortality Weekly Report 52:605-610.

National Research Council. 1997. Wolves, bears, and their prey in Alaska: biological and social challenges in wildlife management. National Academy Press, Washington, D.C.

Naughton-Treves, L., R. Grossberg, and A. Treves. 2003. Paying for tolerance: rural citizens' attitudes toward wolf depredation and compensation. Conservation Biology 17:1500-1511.

Nelson, J. 2009. Deer status and trend report: statewide. Pages 3-5 *in* Washington Department of Fish and Wildlife. 2009 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 271 pp.

Nelson, M. E. and L. D. Mech. 1986. Relationship between snow depth and gray wolf predation on white-tailed deer. Journal of Wildlife Management 50:471-474.

Nickerson, N., C. Oschell, L. Rademaker, and R. Dvorak. 2007. Montana's outfitting industry: economic impact and industry-client analysis. Research Report 2007-1, Institute for Tourism and Recreation Research, University of Montana, Montana. <http://www.foam-montana.org/downloads/MTOutfittingSurveyReport.pdf>

Nie, M. A. 2002. Wolf recovery and management as value-based political conflict. Ethics, Place and Environment 5:65-71.

NPS (National Park Service). 2003. Management of habituated wolves in Yellowstone National Park. National Park Service, Yellowstone National Park, Wyoming.

Oakleaf, J. K., C. Mack, and D. L. Murray. 2003. Effects of wolves on livestock calf survival and movements in central Idaho. Journal of Wildlife Management 67:299-306.

Oakleaf, J. K., D. L. Murray, J. R. Oakleaf, E. E. Bangs, C. M. Mack, D. W. Smith, J. A. Fontaine, M. D. Jimenez, T. J. Meier, and C. C. Niemeyer. 2006. Habitat selection by recolonizing wolves in the northern Rocky Mountains of the United States. Journal of Wildlife Management 70:554-563.

ODFW (Oregon Department of Fish and Wildlife). 2005. Oregon wolf conservation and management plan. Oregon Department of Fish and Wildlife, Salem, Oregon.

ODFW (Oregon Department of Fish and Wildlife). 2008. Hot topics: gray wolves. Oregon Department of Fish and Wildlife, Salem, Oregon. <http://www.dfw.state.or.us/Wolves/index.asp>

ODFW (Oregon Department of Fish and Wildlife). 2010. Oregon wolf conservation and management plan [updated version]. Oregon Department of Fish and Wildlife, Salem, Oregon.

OFM (Office of Financial Management). 2006. Forecast of the state population by age and sex: 1990 to 2030. Office of Financial Management, Olympia, Washington.

OFM (Office of Financial Management). 2007a. April 1 population of cities, towns, and counties used for allocation of selected state revenues, State of Washington. Office of Financial Management, Olympia, Washington.

OFM (Office of Financial Management). 2007b. Median household income estimates by county: 1989 to 2006 and projection for 2007. Office of Financial Management, Olympia, Washington.

OFM (Office of Financial Management). 2008. Counties with population density less than 100 persons per square mile. Office of Financial Management, Olympia, Washington.

OSC (Office of Species Conservation). 2011. Wolves. Office of Species Conservation, Governor's Office, Boise, Idaho. <http://species.idaho.gov/list/wolves.html>

Palmquist, J. 2002. The gray wolf in Washington: species status and possibilities for natural recovery. Wolf Haven International, Tenino, Washington.

Person, D. K. and A. L. Russell. 2009. Reproduction and den site selection by wolves in a disturbed landscape. Northwest Science 83:211-224.

Person, D. K., M. Kirchhoff, V. Van Ballenberghe, G. C. Iverson, and E. Grossman. 1996. The Alexander Archipelago wolf: a conservation assessment. General Technical Report PNW-GTR-384, Pacific Northwest Research Station, USDA Forest Service, Portland, Oregon.

Peterson, R. O. and P. Ciucci. 2003. The wolf as a carnivore. Pages 104-130 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

Peterson, R. O., N. J. Thomas, J. M. Thurber, J. A. Vucetich, and T. A. Waite. 1998. Population limitation and the wolves of Isle Royale. Journal of Mammalogy 79:828-841.

Pisano, R. 1979. Does the Cascade wolf survive? Oryx 15:185-190.

Pletscher, D. H., R. R. Ream, D. K. Boyd, M. W. Fairchild, and K. E. Kunkel. 1997. Population dynamics of a recolonizing wolf population. Journal of Wildlife Management 61:459-465.

Potvin, M. J., T. D. Drummer, J. A. Vucetich, D. E. Beyer, Jr., R. O. Peterson, and J. H. Hammill. 2005. Monitoring and habitat analysis for wolves in upper Michigan. Journal of Wildlife Management 69:1660-1669.

Proffitt, K. M., J. I. Grigg, K. L. Hamlin, and R. A. Garrott. 2009. Contrasting effects of wolves and human hunters on elk behavioral responses to predation risk. Journal of Wildlife Management 73:345-356.

Prugh, L. R., C. J. Stoner, C. W. Epps, W. T. Bean, W. J. Ripple, A. S. Laliberte, and J. S. Brashares. 2009. The rise of the mesopredator. BioScience 59:779-791.

Pynn, L. 2008. Wolves making comeback after century of bounties, poisoning. Vancouver Sun 2008(February 5).

Rachael, J. 2010. Project W-170-R-33 progress report, elk, Study I, Job 1. Idaho Department of Fish and Game, Boise, Idaho.

Räikkönen, J., J. A. Vucetich, R. O. Peterson, and M. P. Nelson. 2009. Congenital bone deformities and the inbred wolves (*Canis lupus*) of Isle Royale. Biological Conservation 142:1025-1031.

Ratti, J. T., M. Weinstein, J. M. Scott, P. Avsharian, A.-M. Gillesberg, C. A. Miller, M. M. Szepanski, and L. K. Bomar. 1999. Feasibility study on the reintroduction of gray wolves to the Olympic Peninsula. Department of Fish and Wildlife Resources and Idaho Cooperative Research Unit, University of Idaho, Moscow, Idaho.

Ray, C., M. Gilpin, and A. T. Smith. 1991. The effect of conspecific attraction on metapopulation dynamics. Biological Journal of the Linnaean Society 42:123-134.

Ray, V. F. 1933. The Sanpoil and Nespelem: Salishan peoples of northeastern Washington. University of Washington Publications in Anthropology 5:1–237.

Ream, R. R., M. W. Fairchild, D. K. Boyd, and D. H. Pletscher. 1991. Population dynamics and home range changes in a colonizing wolf population. Pages 349-366 *in* R. B. Keiter and M. S. Boyce, editors. The Greater Yellowstone Ecosystem: redefining America's wilderness heritage. Yale University Press, New Haven, Connecticut.

Reed, D. H., J. J. O'Grady, B. W. Brook, J. D. Ballou, and R. Frankham. 2003. Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates. Biological Conservation 113:23-34.

Rich, L. N. 2010. An assessment of factors influencing territory size and the use of hunter surveys for monitoring wolves in Montana. University of Montana, Missoula, Montana.

Ripple, W. J. and R. L. Beschta. 2004. Wolves and the ecology of fear: can predation risk structure ecosystems? BioScience 54:755-766.

Ripple, W. J. and R. L. Beschta. 2007. Restoring Yellowstone's aspen with wolves. Biological Conservation 138:514-519.

Robinson, M. J. 2005. Predatory bureaucracy: the extermination of wolves and the transformation of the West. University Press of Colorado, Boulder, Colorado.

Roell, B. J., D. E. Beyer, Jr., P. E. Lederle, D. H. Lonsway, and K. L. Sitar. 2010. Michigan wolf management 2009 report. Wildlife Division Report No. 3511, Michigan Department of Natural Resources & Environment, Lansing, Michigan.

Rooney, T. P. and D. P. Anderson. 2009. Are wolf-mediated trophic cascades boosting biodiversity in the Great Lakes region? Pages 205-215 *in* A. P. Wydeven, T. R. Van Deelen, and E. J.

Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Rosenheim, J. A. 2004. Top predators constrain the habitat selection games played by intermediate predators and their prey. Israel Journal of Zoology 50:129-138.

Ruid, D. B., W. J. Paul, B. J. Roell, A. P. Wydeven, R. C. Willging, R. L. Jurewicz, and D. H. Lonsway. 2009. Wolf-human conflicts and management in Minnesota, Wisconsin, and Michigan. Pages 279-295 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Ruth, T. K. 2004a. Ghost of the Rockies: the Yellowstone cougar project. Yellowstone Science 12:13-24.

Ruth, T. K. 2004b. Patterns of resource use among cougars and wolves in northwestern Montana and southeastern British Columbia. Ph.D. dissertation, University of Idaho, Moscow, Idaho.

Ruth, T. K. and P. C. Buotte. 2007. Cougar ecology and cougar carnivore interactions in Yellowstone National Park. Hornocker Wildlife Institute/Wildlife Conservation Society, Bozeman, Montana.

Ruth, T. K. and K. Murphy. 2010. Competition with other carnivores for prey. Pages 163-172 *in* M. Hornocker and S. Negri, editors. Cougar ecology and conservation. University of Chicago Press, Chicago, Illinois.

Sacks, J. J., M. Kresnow, and B. Houston. 1996. Dog bites: how big a problem? Injury Prevention 2:52-54.

Sand, H., P. Wabakken, B. Zimmermann, Ö. Johansson, H. C. Pedersen, and O. Liberg. 2008. Summer kills and predation pattern in a wolf-moose system: can we rely on winter estimates? Oecologica 156:53-64.

Schaller, D. T. 1996. The ecocenter as tourist attraction: Ely and the International Wolf Center. University of Minnesota, Minneapolis, Minnesota. <http://www.eduweb.com/schaller/IWCSummary.html>

Schanning, K. 2009. Human dimensions: public opinion research concerning wolves in the Great Lakes States of Michigan, Minnesota, and Wisconsin. Pages 251-265 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Scheffer, V. B. 1995. Mammals of the Olympic National Park and vicinity (1949). Northwest Fauna 2:5-133.

Schilowsky, R. 2009. 2009 big game hunting season recommendation summary. Wyoming Game and Fish Commission, Cheyenne, Wyoming.

Schumaker, N. H. 1998. A user's guide to the PATCH model. EPA/600/R-98/135, U.S. Environmental Protection Agency, Corvallis, Oregon.

Scott, B. M. V. and D. M. Shackleton. 1980. Food habits of two Vancouver Island wolf packs: a preliminary study. Canadian Journal of Zoology 58:1203-1207.

Servheen, C. and R. R. Knight. 1993. Possible effects of a restored gray wolf population on grizzly bears in the Greater Yellowstone Area. Pages 28-37 *in* R. S. Cook, editor. Ecological issues on reintroducing wolves into Yellowstone National Park. U.S. National Park Service Scientific Monograph Series NPS/NRYELL/NRSM-93-22.

Seton, E. T. 1929. Lives of game animals. Volume 1. Cats, wolves, and foxes. Doubleday, Doran and Co., New York.

Sheperd, J. and D. L. Base. 2010. Moose status and trend report: Region 1, GMUs 101, 105, 108, 111, 113, 117, 121, 124 W. Pages 163-167 *in* Washington Department of Fish and Wildlife.

2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.

Shivik, J. A. 2006. Tools for the edge: what's new for conserving carnivores. BioScience 56:253-259.

Shoshone and Arapaho Tribal Fish and Game Department. 2007. Wolf management plan for the Wind River Reservation. Shoshone and Arapaho Tribal Fish and Game Department, Ethete, Wyoming. <http://www.fws.gov/mountain-prairie/species/mammals/wolf/>

Sime, C. A., E. Bangs, E. Bradley, J. E. Steuber, K. Glazier, P. J. Hoover, V. Asher, K. Laudon, M. Ross, and J. Trapp. 2007. Gray wolves and livestock in Montana: a recent history of damage management. Proceedings of the Wildlife Damage Management Conference 12:16-35.

Sinclair, A. R. E. and R. P. Pech. 1996. Density dependence, stochasticity, compensation and predator regulation. Oikos 75:164-173.

Singleton, P. H., W. L. Gaines, and J. F. Lehmkuhl. 2002. Landscape permeability for large carnivores in Washington: a geographic information system weighted-distance and least-cost corridor assessment. Research Paper PNW-RP-549, Pacific Northwest Research Station, USDA Forest Service, Portland, Oregon.

Skogland, T. 1991. What are the effects of predators on large ungulate populations? Oikos 61:401-411.

Smith, D. W. 1998. Yellowstone wolf project: annual report, 1997. YCR-NR-98-2, National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming.

Smith, D. W. and E. Almberg. 2007. Wolf diseases in Yellowstone National Park. Yellowstone Science 15(2):17-19.

Smith, D. W. and G. Ferguson. 2005. The decade of the wolf: returning the wild to Yellowstone. Lyons Press, Guilford, Connecticut.

Smith, D. W., E. E. Bangs, J. K. Oakleaf, C. Mack, J. Fontaine, D. Boyd, M. Jimenez, D. H. Pletscher, C. C. Niemeyer, T. J. Meier, D. R. Stahler, J. Holyan, V. J. Asher, and D. L. Murray. 2010. Survival of colonizing wolves in the northern Rocky Mountains of the United States, 1982-2004. Journal of Wildlife Management 74:620-634.

Smith, D. W., T. D. Drummer, K. M. Murphy, D. S. Guernsey, and S. B. Evans. 2004. Winter prey selection and estimation of wolf kill rates in Yellowstone National Park, 1995-2000. Journal of Wildlife Management 68:153-166.

Smith, D. W., K. M. Murphy, and D. S. Guernsey. 2000. Yellowstone wolf project: annual report, 1999. YCR-NR-2000-01, National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming.

Smith, D. W., R. O. Peterson, and D. B. Houston. 2003. Yellowstone after wolves. BioScience 53:330-340.

Smith, D. W., D. R. Stahler, E. Albers, M. Mertz, L. Williamson, N. Ehlers, K. Cassidy, J. Irving, R. Raymond, E. Almberg, and R. McIntyre. 2009. Yellowstone Wolf Project: Annual Report, 2008. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming, YCR-2009-03.

Smith, D. W., D. R. Stahler, and D. S. Guernsey. 2006. Yellowstone Wolf project: Annual Report, 2005. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming, YCR-2006-04.

Smith, J. L., W. A. Michaelis, K. Sloan, J. Musser, and D. J. Pierce. 1994. An analysis of elk poaching losses, and other mortality sources in Washington using biotelemetry. Federal Aid in Wildlife Restoration Project Report, Washington Department of Fish and Wildlife, Olympia, Washington. 79 pp.

Sommers, A. P., C. C. Price, C. D. Urbigkit, and E. M. Peterson. 2010. Quantifying economic impacts of large-carnivore depredation on bovine calves. Journal of Wildlife Management 74:1425-1434.

Soulé, M. E., D. T. Bolger, A. C. Alberts, J. Wright, M. Sorice, and S. Hill. 1988. Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. Conservation Biology 2:75-91.

Stahler, D. R., D. W. Smith, and D. S. Guernsey. 2006. Foraging and feeding ecology of the gray wolf (*Canis lupus*): lessons from Yellowstone National Park, Wyoming, USA. Journal of Nutrition 36:1923S-1926S.

Stenglein, J. L., L. P. Waits, D. E. Ausband, P. Zager, and C. M. Mack. 2010. Efficient, noninvasive genetic sampling for monitoring reintroduced wolves. Journal of Wildlife Management 74:1050-1058.

Stone, S. A. 2009. Compensation and non-lethal deterrent programs: building tolerance for wolf restoration in the Rockies. Pages 141-158 *in* M. Musiani, L. Boitani, and P. C. Paquet (editors). A new era for wolves and people: wolf recovery, human attitudes, and policy. University of Calgary Press, Calgary, Alberta.

Stone, S. A., N. Fascione, C. Miller, J. Pissot, G. Schrader, and J. Timberlake. 2008. Livestock and wolves: a guide to nonlethal tools and methods to reduce conflicts. Defenders of Wildlife, Washington, D.C.

Stotyn, S. A. 2008. Ecological interactions of mountain caribou, wolves and moose in the north Columbia Mountains, British Columbia. M.S. thesis, University of Alberta, Edmonton, Alberta.

Stotyn, S. A., B. N. McLellan, R. Serrouya. 2007. Mortality sources and spatial partitioning among mountain caribou, moose, and wolves in the north Columbia Mountains, British Columbia. Report prepared for the Columbia Basin Fish and Wildlife Compensation Program, Nelson, British Columbia.

Stronen, A. V., R. K. Brook, P. C. Paquet, and S. Mclachlan. 2007. Farmer attitudes toward wolves: implications for the role of predators in managing disease. Biological Conservation 135:1-10.

Suckley, G. and J. G. Cooper. 1860. The natural history of Washington territory and Oregon, with much relating to Minnesota, Nebraska, Kansas, Utah, and California, between the thirty-sixth and forty-ninth parallels of latitude, being those parts of the final reports on the survey of the Northern Pacific Railroad route, relating to the natural history of the regions explored, with full catalogues and descriptions of the plants and animals collected from 1853 to 1860. Baillière Brothers, New York, New York.

Swenson, J.E., F. Sandegren, M. Heim, S. Brunberg, O. J. Sorensen, A. Soderberg, A. Bjarvall, R. Franzen, S. Wikan, P. Wabakken, and K. Overskaug. 1996. Er den skandinavisk bjornen farlig? NINA Oppdragsmelding 404:1-26.

Switalski, T. A. 2003. Coyote foraging ecology and vigilance in response to gray wolf reintroduction in Yellowstone National Park. Canadian Journal of Zoology 81:985-993.

Taylor, W. P. and W. T. Shaw. 1927. Mammals and birds of Mount Rainier National Park. National Park Service, Washington D.C.

Taylor, W. P. and W. T. Shaw. 1929. Provisional list of the land mammals of Washington. Occasional Papers of the Charles R. Conner Museum 2:1-32.

Tercek, M. T., R. Stottlemyer, and R. Renkin. 2010. Bottom-up factors influencing riparian willow recovery in Yellowstone National Park. Western North American Naturalist 70:387-399.

Thiel, R. P., S. Merril, and L. D. Mech. 1998. Tolerance by denning wolves, *Canis lupus*, to human disturbance. Canadian Field-Naturalist 112:340-342.

Thompson, I. D. and R. O. Peterson. 1988. Does wolf predation alone limit the moose population in Pukaskwa Park?: a comment. Journal of Wildlife Management 52:556-559.

Thompson, J. G. 1993. Addressing the human dimensions of wolf reintroduction: an example using estimates of livestock depredation and costs of compensation. Society and Natural Resources 6:165-179.

Thurber, J. M., R. O. Peterson, J. D. Woolington, and J. A. Vucetich. 1992. Coyote coexistence with wolves on the Kenai Peninsula, Alaska. Canadian Journal of Zoology 70:2494-2498.

Tompa, F. S. 1983. Status and management of wolves in British Columbia. Pages 20-24 *in* L. N. Carbyn, editor. Wolves in Canada and Alaska: their status, biology, and management. Canadian Wildlife Service Report Series 45:1-135.

Traill, L. W., C. J. A. Bradshaw, and B. W. Brook. 2007. Minimum viable population size: a meta-analysis of 30 years of published estimates. Biological Conservation 139:159-166.

Traill, L. W., B. W. Brook, R. R. Frankham, and C. J. A. Bradshaw. 2010. Pragmatic population viability targets in a rapidly changing world. Biological Conservation 143:28-34.

Trapp, J. R., P. Beier, C. Mack, D. R. Parsons, and P. C. Paquet. 2008. Wolf, *Canis lupus*, den site selection in the Rocky Mountains. Canadian Field-Naturalist 122:49-56.

Treves, A. 2008. Beyond recovery: Wisconsin's wolf policy 1980-2008. Human Dimensions of Wildlife 13:329-338.

Treves, A. and L. Naughton-Treves. 2005. Evaluating lethal control in the management of human-wildlife conflict. Pages 86-106 *in* R. Woodroffe, S. Thirgood, and A. Rabinowitz, editors. People and wildlife: conflict or coexistence? Cambridge University Press, New York.

Treves, A., R. R. Jurewicz, L. Naughton-Treves, R. A. Rose, R. C. Willging, and A. P. Wydeven. 2002. Wolf depredation on domestic animals in Wisconsin, 1976-2000. Wildlife Society Bulletin 30:231-241.

Treves, A., R. L. Jurewicz, L. Naughton-Treves, and D. S. Wolcove. 2009. The price of tolerance: wolf damage payments after recovery. Biodiversity Conservation 18:4003-4021.

Treves, A., K. A. Martin, J. E. Wiedenhoeft, and A. P. Wydeven. 2009. Dispersal of gray wolves in the Great Lakes region. Pages 191-204 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Treves, A., L. Naughton-Treves, E. K. Harper, D. J. Mladenoff, R. A. Rose, T. A. Sickley, and A. P. Wydeven. 2004. Predicting human-carnivore conflict: a spatial model derived from 25 years of data on wolf predation on livestock. Conservation Biology 18:114-125.

Troxell, P. S., K. A. Berg, H. Jaycox, A. L. Strauss, P. Struhsacker, and P. Callahan. 2009. Education and outreach efforts in support of wolf conservation in the Great Lakes region. Pages 297-309 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Unger, D. E., P. W. Keenlance, B. E. Kohn, and E. M. Anderson. 2009. Factors influencing homesite selection by gray wolves in northwestern Wisconsin and east-central Minnesota. Pages 175-189 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

United States Congress. 1929. Control of predatory animals. 70th Congress, Second session, House Document Number 497, U.S. Government Printing Office, Washington, D.C.

Unsworth, R., L. Genova, and K. Wallace. 2005. Mexican wolf Blue Range reintroduction project 5-year review: socioeconomic component. Final report, Division of Economics, U.S. Fish and

Wildlife Service, Arlington, Virginia. <http://www.fws.gov/southwest/es/mexicanwolf/pdf/MW5YRSocioeconomicsFinal20051231.pdf>

Urbigkit, C. and J. Urbigkit. 2010. A review: the use of livestock protection dogs in association with large carnivores in the Rocky Mountains. Sheep and Goat Research Journal 25:1-8.

USCB (U.S. Census Bureau). 2007. State and county quickfacts. <http://quickfacts.census.gov>

USFWS (U.S. Fish and Wildlife Service). 1987. Northern Rocky Mountain wolf recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

USFWS (U.S. Fish and Wildlife Service). 1994. The reintroduction of gray wolves to Yellowstone National Park and Central Idaho. Final Environmental Impact Statement. U.S. Fish and Wildlife Service, Denver, Colorado.

USFWS (U.S. Fish and Wildlife Service). 2000. Proposal to reclassify and remove the gray wolf from the list of endangered and threatened wildlife in portions of the conterminous United States. Federal Register 65(135):43449-43496.

USFWS (U.S. Fish and Wildlife Service). 2003. 2001 national and state economic impacts of wildlife watching: addendum to the 2001 national survey of fishing, hunting and wildlife-associated recreation. Report 2001-2, U.S. Fish and Wildlife Service, Washington, D.C. <http://library.fws.gov/FWSOpenAccess.html>

USFWS (U.S. Fish and Wildlife Service). 2005. Mexican wolf recovery program: progress report #8. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. <http://www.fws.gov/southwest/es/mexicanwolf/pdf/Mexican_Wolf_Recovery_Program_Annual_Progress_Report_2005.pdf>

USFWS (U.S. Fish and Wildlife Service). 2007a. Designating the northern Rocky Mountain population of gray wolf as a distinct population segment and removing this distinct population segment from the federal list of endangered and threatened wildlife. Federal Register 72(26):6106-6139.

USFWS (U.S. Fish and Wildlife Service). 2007b. Endangered and threatened wildlife and plants; proposed revision of special regulation for the central Idaho and Yellowstone area nonessential experimental populations of gray wolves in the northern Rocky Mountains. Federal Register 72(129):36942-36949.

USFWS (U.S. Fish and Wildlife Service). 2008a. Endangered and threatened wildlife and plants; final rule designating the northern Rocky Mountain population of gray wolf as a distinct population segment and removing this distinct population segment from the federal list of endangered and threatened wildlife. Federal Register 73(39):10514-10560.

USFWS (U.S. Fish and Wildlife Service). 2008b. Endangered and threatened wildlife and plants; designating the northern Rocky Mountain population of gray wolf as a distinct population segment and removing this distinct population segment from the federal list of endangered and threatened wildlife. Federal Register 73(209):63926-63932.

USFWS (U.S. Fish and Wildlife Service). 2009. Endangered and threatened wildlife and plants; final rule to identify the northern Rocky Mountain population of gray wolf as a distinct population segment and to revise the list of endangered and threatened wildlife. Federal Register 74(62):15123-15188.

USFWS (U.S. Fish and Wildlife Service). 2010a. Endangered and threatened wildlife and plants; reinstatement of protections for the gray wolf in the northern Rocky Mountains in compliance with a court order. Federal Register 75(206):65574-65579.

USFWS (U.S. Fish and Wildlife Service). 2010b. Lewis and Clark National Wildlife Refuge and Julia Butler Hansen Refuge for the Columbian White-tailed Deer draft comprehensive conservation plan and environmental impact statement. U.S. Fish and Wildlife Service, Ilwaco, Washington.

USFWS (U.S. Fish and Wildlife Service). 2011a. Endangered and threatened wildlife and plants; proposed rule to revise the list of endangered and threatened wildlife for the gray wolf (*Canis lupus*) in the eastern United States, initiation of status reviews for the gray wolf and for the eastern wolf (*Canis lycaon*). Federal Register 76(87):26086-26145.

USFWS (U.S. Fish and Wildlife Service). 2011b. Endangered and threatened wildlife and plants; reissuance of final rule to identify the northern Rocky Mountain population of gray wolf as a distinct population segment and to revise the list of endangered and threatened wildlife. Federal Register 76(87):25590-25592.

USFWS (U.S. Fish and Wildlife Service) and USCB (U.S. Census Bureau). 2003. 2001 national survey of fishing, hunting, and wildlife-associated recreation: Washington. FHW/01-WA Rev., U.S. Fish and Wildlife Service, Washington, D.C. <http://www.census.gov/prod/2003pubs/01fhw/fhw01-wa.pdf>

USFWS (U.S. Fish and Wildlife Service) and USCB (U.S. Census Bureau). 2007. 2006 national survey of fishing, hunting, and wildlife-associated recreation. FHW/06-NAT, U.S. Fish and Wildlife Service, Washington, D.C. <http://library.fws.gov/FWSOpenAccess.html>

USFWS (U.S. Fish and Wildlife Service) and USCB (U.S. Census Bureau). 2008. 2006 national survey of fishing, hunting, and wildlife-associated recreation: Washington. FHW/06-WA, U.S. Fish and Wildlife Service, Washington, D.C. <http://www.census.gov/prod/2008pubs/fhw06-wa.pdf>

USFWS (U.S. Fish and Wildlife Service), Nez Perce Tribe, National Park Service, and U.S.D.A. Wildlife Services. 2000. Rocky Mountain wolf recovery 1999 annual report. U.S. Fish and Wildlife Service, Helena, Montana. 23 pp.

USFWS (U.S. Fish and Wildlife Service), Nez Perce Tribe, National Park Service, and U.S.D.A. Wildlife Services. 2001. Rocky Mountain wolf recovery 2000 annual report. U.S. Fish and Wildlife Service, Helena, Montana. 35 pp.

USFWS (U.S. Fish and Wildlife Service), Nez Perce Tribe, National Park Service, Montana Fish, Wildlife & Parks, Idaho Fish and Game, and U.S.D.A. Wildlife Services. 2006. Rocky Mountain Wolf Recovery 2005 interagency annual report. C. A. Sime and E. E. Bangs, editors. U.S. Fish and Wildlife Service, Helena, Montana. 130 pp.

USFWS (U.S. Fish and Wildlife Service), Nez Perce Tribe, National Park Service, Montana Fish, Wildlife & Parks, Idaho Fish and Game, and U.S.D.A. Wildlife Services. 2007. Rocky Mountain wolf recovery 2006 interagency annual report. C. A. Sime and E. E. Bangs, editors. U.S. Fish and Wildlife Service, Helena, Montana. 235 pp.

USFWS (U.S. Fish and Wildlife Service), Nez Perce Tribe, National Park Service, Montana Fish, Wildlife & Parks, Blackfeet Nation, Confederated Salish and Kootenai Tribes, Idaho Fish and Game, and U.S.D.A. Wildlife Services. 2008. Rocky Mountain wolf recovery 2007 interagency annual report. C. A. Sime and E. E. Bangs, editors. U.S. Fish and Wildlife Service, Helena, Montana. 275 pp.

USFWS (U.S. Fish and Wildlife Service), Nez Perce Tribe, National Park Service, Montana Fish, Wildlife & Parks, Blackfeet Nation, Confederated Salish and Kootenai Tribes, Idaho Fish and Game, and U.S.D.A. Wildlife Services. 2009. Rocky Mountain wolf recovery 2008 interagency annual report. C. A. Sime and E. E. Bangs, editors. U.S. Fish and Wildlife Service, Helena, Montana.

USFWS (U.S. Fish and Wildlife Service), Nez Perce Tribe, National Park Service, Montana Fish, Wildlife & Parks, Blackfeet Nation, Confederated Salish and Kootenai Tribes, Idaho Fish and Game, and U.S.D.A. Wildlife Services. 2010. Rocky Mountain wolf recovery 2009 interagency annual report. C. A. Sime and E. E. Bangs, editors. U.S. Fish and Wildlife Service, Helena, Montana.

USFWS (U.S. Fish and Wildlife Service), Montana Fish, Wildlife & Parks, Nez Perce Tribe, National Park Service, Blackfeet Nation, Confederated Salish and Kootenai Tribes, Wind River Tribes, Washington Department of Wildlife, Oregon Department of Wildlife, Utah Department of Natural Resources, and U.S.D.A. Wildlife Services. 2011. Rocky Mountain wolf recovery 2010 interagency annual report. C. A. Sime and E. E. Bangs, editors. U.S. Fish and Wildlife Service, Helena, Montana.

Van Ballenberghe, V. and W. B. Ballard. 1994. Limitation and regulation of moose populations: the role of predation. Canadian Journal of Zoology 72:2071-2077.

Van Ballenberghe, V., A. W. Erickson, and D. Byman. 1975. Ecology of the timber wolf in northeastern Minnesota. Wildlife Monographs 43:1-43.

van Dijk, J., L. Gustavsen, A. Mysterud, R. May, Ø. Flagstad, H. Brøseth, R. Andersen, R. Andersen, H. Steen, and A. Landa. 2008. Diet shift of a facultative scavenger, the wolverine, following recolonization of wolves. Journal of Animal Ecology 77:1183–1190.

Varley, N. and M. S. Boyce. 2006. Adaptive management for reintroductions: updating a wolf recovery model for Yellowstone National Park. Ecological Modelling 193:315–339.

Vilà, C., A.-K. Sundqvist, Ø. Flagstad, J. Seddon, S. Björnerfeldt, I. Kojola, A. Casulli, H. Sand, P. Wabakken, and H. Ellegren. 2003. Rescue of a severely bottlenecked wolf (*Canis lupus*) population by a single immigrant. Proceedings of the Royal Society of London, Series B 270:91-97.

vonHoldt, B. M., D. R. Stahler, E. E. Bangs, D. W. Smith, M. D. Jimenez, C. M. Mack, C. C. Niemeyer, J. P. Pollinger, and R. K. Wayne. 2010. A novel assessment of population structure and gene flow in grey wolf populations of the northern Rocky Mountains of the United States. Molecular Ecology 19:4412-4427.

vonHoldt, B. M., D. R. Stahler, D. W. Smith, D. A. Earl, J. P. Pollinger, and R. K. Wayne. 2008. The genealogy and genetic viability of reintroduced Yellowstone gray wolves. Molecular Ecology 17:252-274.

Vucetich, J. A. and R. O. Peterson. 2009. Wolf and moose dynamics on Isle Royale. Pages 35-48 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Vucetich, J. A., D. W. Smith, and D. R. Stauber. 2005. Influence of harvest, climate and wolf predation on Yellowstone elk, 1961-2004. Oikos 111:259-270.

Vynne, S. J. 2009. Livestock compensation for the Mexican gray wolf: improving tolerance or increasing tension? Human Dimensions of Wildlife 14:456-457.

Watts, D. E., L. G. Butler, B. W. Dale, and R. D. Cox. 2010. The Ilnik wolf *Canis lupus* pack: use of marine mammals and offshore sea ice. Wildlife Biology 16:144-149.

Wayne, R. K. and C. Vilà. 2003. Molecular genetic studies of wolves. Pages 218-238 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

WDFW (Washington Department of Fish and Wildlife). 1997-2006. Game harvest reports. Washington Department of Fish and Wildlife, Olympia, Washington. <http://wdfw.wa.gov/hunting/harvest/>

WDFW (Washington Department of Fish and Wildlife). 2001a. Draft Selkirk elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 47 pp.
WDFW (Washington Department of Fish and Wildlife). 2001b. Blue Mountains elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 47 pp.
WDFW (Washington Department of Fish and Wildlife). 2002a. Yakima elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 69 pp.
WDFW (Washington Department of Fish and Wildlife). 2002b. North Cascade (Nooksack) elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 54 pp.
WDFW (Washington Department of Fish and Wildlife). 2002c. North Rainier elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 63 pp.
WDFW (Washington Department of Fish and Wildlife). 2002d. South Rainier elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 32 pp.
WDFW (Washington Department of Fish and Wildlife). 2005a. Washington's Comprehensive Wildlife Conservation Strategy. Washington Department of Fish and Wildlife, Olympia, Washington.
WDFW (Washington Department of Fish and Wildlife). 2005b. Olympic elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 52 pp.
WDFW (Washington Department of Fish and Wildlife). 2006a. Colockum elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 48 pp.
WDFW (Washington Department of Fish and Wildlife). 2006b. Mount St. Helens elk herd. Washington Department of Fish and Wildlife, Olympia, Washington. 52 pp.
WDFW (Washington Department of Fish and Wildlife). 2006c. 2006 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 257 pp.
WDFW (Washington Department of Fish and Wildlife). 2007. 2007 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 282 pp.
WDFW (Washington Department of Fish and Wildlife). 2008. 2009-2015 game management plan, July 2009-June 2015. Washington Department of Fish and Wildlife, Olympia, Washington. 136 pp.
WDFW (Washington Department of Fish and Wildlife). 2010a. Washington state deer management plan: white-tailed deer. Washington Department of Fish and Wildlife, Olympia, Washington. 124 pp.
WDFW (Washington Department of Fish and Wildlife). 2010b. 2010 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 279 pp.
WDFW (Washington Department of Fish and Wildlife). 2010c. Cougar outreach and education in Washington state. Washington Department of Fish and Wildlife, Olympia, Washington. 110 pp.
WDNR (Wisconsin Department of Natural Resources). 1999. Wisconsin wolf management plan. Wisconsin Department of Natural Resources, Madison, Wisconsin.
Webster, E. B. 1920. The king of the Olympics: Roosevelt elk and other mammals of the Olympic Mountains. Port Angeles, Washington.
WFPA (Washington Forest Products Association). 2007. Forest facts & figures. Washington Forest Products Association, Olympia, Washington. <http://www.wfpa.org/forest-facts/>
WGFC (Wyoming Game and Fish Commission). 2008. Final Wyoming gray wolf management plan. Wyoming Game and Fish Commission, Cheyenne, Wyoming.
WHCWG (Washington Wildlife Habitat Connectivity Working Group). 2010. Washington Connected Landscapes Project: Statewide analysis. Washington Department of Fish and Wildlife, and Transportation, Olympia, Washington.

White, P. A., and D. K. Boyd. 1989. A cougar (*Felis concolor*) kitten killed and eaten by gray wolves (*Canis lupus*) in Glacier National Park, Montana. Canadian Field-Naturalist 103:408-409.
White, P. J. and R. A. Garrott. 2005. Yellowstone's ungulates after wolves – expectations, realizations, and predictions. Biological Conservation 125:141-152.
White, P. J., R. A. Garrott, and L. L. Eberhardt. 2003. Evaluating the consequences of wolf recovery on northern Yellowstone elk. YCR-NR-2004-02, U.S. National Park Service, Yellowstone National Park, Wyoming.
White, P. J., R. A. Garrott, K. L. Hamlin, R. C. Cook, J. G. Cook, and J. A. Cunningham. 2011. Body condition and pregnancy in northern Yellowstone elk: evidence for predation risk effects? Ecological Applications 21:3-8.
White, P. J., T. O. Lemke, D. B. Tyers, and J. A. Fuller. 2008. Initial effects of reintroduced wolves *Canis lupus* on bighorn sheep *Ovis canadensis* dynamics in Yellowstone National Park. Wildlife Biology 14:138-146.
White, P. J., D. W. Smith, J. W. Duffield, M. Jimenez, T. McEneaney, and G. Plumb. 2005. Yellowstone after wolves: environmental statement predictions and ten-year appraisals. Yellowstone Science 13(1):34-41.
Wicker, K. J. 1996. An analysis of public testimonies on the reintroduction of wolves to the Greater Yellowstone ecosystem. M.S. thesis, Texas A&M University, College Station, Texas.
Wild, M. A., N. T. Hobbs, M. S. Graham, and M. W. Miller. 2011. The role of predation in disease control: a comparison of selective and nonselective removal on prion disease dynamics in deer. Journal of Wildlife Diseases 47:78-93.
Wild, M. A., M. W. Miller, and N. T. Hobbs. 2005. Could wolves control chronic wasting disease? Second International Chronic Wasting Disease Symposium, Madison Wisconsin. <http://www.cwd-info.org/index.php/fuseaction/resources.meetingsSymposia>
Wilkes, C. 1844. Narrative of the United States exploring expedition during the years 1838, 1839, 1840, 1841, 1842. Vol. IV. C. Sherman, Philadelphia, Pennsylvania.
Wilmers, C. C., R. L. Crabtree, D. W. Smith, K. M. Murphy, and W. M. Getz. 2003a. Trophic facilitation by introduced top predators: grey wolf subsidies to scavengers in Yellowstone National Park. Journal of Animal Ecology 72:909-916.
Wilmers, C. C., D. R. Stahler, R. L. Crabtree, D. W. Smith, and W. M. Getz. 2003b. Resource dispersion and consumer dominance: scavenging at wolf- and hunter-killed carcasses in Greater Yellowstone, USA. Ecology Letters 6:996-1003.
Wilmot, J. and T. W. Clark. 2005. Wolf restoration: a battle in the war over the West. Pages 138-173 *in* T. W. Clark, M. B. Rutherford, and D. Casey, editors. Coexisting with large carnivores: lessons from Greater Yellowstone. Island Press, Washington, D.C.
Winnie, J. A., Jr. and S. Creel. 2007. Sex-specific behavioral responses of elk to spatial and temporal variation in the threat of wolf predation. Animal Behavior 73:215-225.
Wittmer, H. U., B. N. McLellan, D. R. Seip, J. A. Young, T. A. Kinley, G. S. Watts, and D. Hamilton. 2005. Population dynamics of the endangered mountain ecotype of woodland caribou (*Rangifer tarandus caribou*) in British Columbia, Canada. Canadian Journal of Zoology 83:407-418.
WSDOR (Washington State Department of Revenue). 2007. Harvest statistics. Washington State Department of Revenue, Olympia, Washington. <http://dor.wa.gov/content/FindTaxesAndRates/OtherTaxes/Timber/forst_stat.aspx>
WSDOT (Washington State Department of Transportation). 2008. Unemployment rates by county in Washington State, 2006. Washington State Department of Transportation, Olympia, Washington.

Wydeven, A. P., R. L. Jurewicz, T. R. Van Deelen, J. Erb, J. H. Hammill, D. E. Beyer, Jr., B. Roell, J. E. Wiedenhoeft, and D. A. Weitz. 2009b. Gray wolf conservation in the Great Lakes region of the United States. Pages 69-93 *in* M. Musiani, L. Boitani, and P. C. Paquet, editors. A new era for wolves and people: wolf recovery, human attitudes, and policy. University of Calgary Press, Calgary, Alberta.

Wydeven, A. P., R. N. Schultz, and R. P. Thiel. 1995. Monitoring of a recovering gray wolf population in Wisconsin, 1979-1991. Pages 147-156 *in* L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Edmonton.

Wydeven, A. P.,A. Treves, B. Brost, and J. E. Wiedenhoeft. 2004. Characteristics of wolf packs in Wisconsin: Identification of traits influencing depredation. Pages 28-50 *in* N. Fascione, A. Delach, and M. E. Smith, editors. People and predators: from conflict to coexistence. Island Press, Washington, D.C.

Wydeven, A. P., T. R. Van Deelen, and E. J. Heske. 2009c. Wolf recovery in the Great Lakes region: what have we learned and where will we go now? Pages 331-337 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Wydeven, A. P., J. E. Wiedenhoeft, R. N. Schultz, and R. P. Thiel. 2008. Progress report of wolf population monitoring in Wisconsin for the period April-September 2007 & annual summaries for 2007. PUB-ER-633I 2008, Wisconsin Department of Natural Resources, Park Falls, Wisconsin.

Wydeven, A. P., J. E. Wiedenhoeft, R. N. Schultz, and R. P. Thiel. 2009d. Progress report of wolf population monitoring in Wisconsin for the period April-September 2008 & annual summaries for 2008. PUB-ER-634K 2009, Wisconsin Department of Natural Resources, Park Falls, Wisconsin.

Wydeven, A. P., J. E. Wiedenhoeft, R. N. Schultz, R. P. Thiel, and S. Boles. 2010. Status of the timber wolf in Wisconsin, performance report 1 July 2009 through 30 June 2010. Wisconsin Endangered Resources Report #139, Wisconsin Department of Natural Resources, Madison, Wisconsin.

Wydeven, A. P., J. E. Wiedenhoeft, R. N. Schultz, R. P. Thiel, R. L. Jurewicz, B. E. Kohn, and T. R. Van Deelen. 2009a. History, population growth, and management of wolves in Wisconsin. Pages 87-105 *in* A. P. Wydeven, T. R. Van Deelen, and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes region of the United States: an endangered species success story. Springer, New York, New York.

Wydeven, A. P., J. E. Wiedenhoeft, R. P. Thiel, R. N. Schultz, and S. R. Boles. 2009e. Progress report of wolf population monitoring in Wisconsin for the period October 2008-March 2009. PUB-ER-635L 2009, Wisconsin Department of Natural Resources Park Falls, Wisconsin.

Young, S. P. 1946. The wolf in North American history. Caxton Printers, Caldwell, Idaho.

Young, S. P. and E. A. Goldman. 1944. The wolves of North America. American Wildlife Institute, Washington, D.C.

Zender, S. and D. L. Base. 2006. Elk status and trend report: Region 1, Selkirk herd, GMUs 101, 105, 108, 111, 113, 117, 121, 124. Pages 68-70 *in* Washington Department of Fish and Wildlife. 2006 game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington. 257 pp.

PERSONAL COMMUNICATIONS

Jeff Allen
Policy Advisor
Idaho Governor's Office of Species Conservation
Boise, Idaho

Ed Bangs
Federal Wolf Coordinator
U.S. Fish and Wildlife Service
Helena, Montana

Jeff Bernatowicz
District Biologist
Washington Department of Fish and Wildlife
Yakima, Washington

Brad Compton
State Big Game Manager
Idaho Department of Fish and Game
Boise, Idaho

Scott Fitkin
District Biologist
Washington Department of Fish and Wildlife
Winthrop, Washington

Howard Ferguson
District Biologist
Washington Department of Fish and Wildlife
Spokane, Washington

Bill Gaines
Wildlife Biologist
U.S. Forest Service
Wenatchee, Washington

Suzanne Griffin
Ph.D. candidate
University of Montana
Missoula, Montana

Justin Gude
Wildlife Research & Technical Services Section Manager
Montana Fish, Wildlife and Parks
Helena, Montana

Patti Happe
Wildlife Branch Chief
Olympic National Park
Port Angeles, Washington

Brian Harris
Wildlife Biologist
B.C. Ministry of Environment
Penticton, British Columbia

Mike Jimenez
Wyoming Wolf Recovery Project Leader
U.S. Fish and Wildlife Service
Jackson, Wyoming

Robert Kuntz
Wildlife Biologist
North Cascades National Park
National Park Service
Sedro-Woolley, Washington

Russell Link
Regional Wildlife Program Manager
Washington Department of Fish and Wildlife
Mill Creek, Washington

Curt Mack
Wildlife Biologist
Nez Perce Nation
McCall, Idaho

Scott McCorquodale
Deer and Elk Specialist
Washington Department of Fish and Wildlife
Yakima, Washington

David Mech
Senior Research Scientist
U.S. Geological Survey
University of Minnesota
St. Paul, Minnesota

Russ Morgan
Wolf Coordinator
Oregon Department of Fish and Wildlife
LaGrande, Oregon

Garth Mowat
Senior Wildlife Biologist
B.C. Ministry of Environment, Kootenay Region
Nelson, British Columbia

Steve Nadeau
Wolf Coordinator (former)
Idaho Department of Fish and Game
Boise, Idaho

Jerry Nelson
Deer and Elk Section Manager
Washington Department of Fish and Wildlife
Olympia, Washington

John Pollinger
Geneticist
University of California, Los Angeles
Los Angeles, California

Jon Rachael
Wolf Coordinator
Idaho Department of Fish and Game
Boise, Idaho

Darrell Reynolds
Wildlife Biologist
B.C. Ministry of Environment
Sechelt, British Columbia

Cliff Rice
Mountain Goat Research Scientist
Washington Department of Fish and Wildlife
Olympia, Washington

Carolyn Sime
Wolf Coordinator
Montana Fish, Wildlife and Parks
Helena, Montana

Douglas W. Smith
Leader, Yellowstone Wolf Project
Yellowstone National Park, Wyoming

Suzanne A. Stone
Northern Rockies Representative
Defenders of Wildlife
Boise, Idaho

Janet Sutter
Natural Resource Scientist
Washington Department of Fish and Wildlife
Olympia, Washington

Jesse Timberlake
Northern Rockies Associate
Defenders of Wildlife
Boise, Idaho

George Ulin
President
Washington Outfitters and Guides Association
East Wenatchee, Washington

Dave Ware
Game Division Manager
Washington Department of Fish and Wildlife
Olympia, Washington

Jim Watson
Raptor Research Scientist
Washington Department of Fish and Wildlife
Concrete, Washington

Paul Wik
Fish and Wildlife Biologist
Washington Department of Fish and Wildlife
Clarkston, Washington

Roger Woodruff
State Director
USDA Wildlife Services
Olympia, Washington

Adrian Wydeven
Wolf Coordinator
Wisconsin Department of Natural Resources
Park Falls, Wisconsin

Steve Zender
District Biologist (former)
Washington Department of Fish and Wildlife
Chewelah, Washington

GLOSSARY OF TERMS

For the purposes of this conservation and management plan, the following definitions apply:

At-risk ungulate population – any federal or state listed ungulate population (e.g., Selkirk Mountain woodland caribou, Columbian white-tailed deer). An at-risk population would also include any ungulate population which falls 25% below its population objective for two consecutive years and/or if the harvest decreases by 25% below the 10-year average harvest rate for two consecutive years. In ungulate populations without numeric estimates and/or without management objectives, the Department will rely on other factors of information to assess a decline, such as harvest trends, hunter effort trends, sex and age ratios, and others.

Breeding pair – see Successful Breeding Pair.

Classify – to list or delist wildlife species to or from endangered, or to or from the protected wildlife subcategories threatened or sensitive.

Compensation – monetary payment to offset or replace the economic loss for a death or injury to livestock or guarding animals due to wolf activity.

Confirmed non-wild wolf depredation – any depredation where there is clear physical evidence that the predator was another species (e.g., coyote, black bear, cougar, bobcat, domestic dog), or a wolf hybrid, or pet wolf, as determined by USDA Wildlife Services, WDFW, or an authorized agency representative.

Confirmed wolf depredation – any depredation where there is reasonable physical evidence that the dead or injured livestock was actually attacked or killed by a wolf. Primary confirmation would ordinarily be the presence of bite marks and associated subcutaneous hemorrhaging and tissue damage, indicating that the attack occurred while the victim was alive, as opposed to simply feeding on an already dead animal. Spacing between canine tooth punctures, feeding pattern on the carcass, fresh tracks, scat, hairs rubbed off on fences or brush, and/or eyewitness accounts of the attack may help identify the specific species or individual responsible for the depredation. Predation might also be confirmed in the absence of bite marks and associated hemorrhaging (i.e., if much of the carcass has already been consumed by the predator or scavengers) if there is other physical evidence to confirm predation on the live animal. This might include blood spilled or sprayed at a nearby attack site or other evidence of an attack or struggle. There may also be nearby remains of other victims for which there is still sufficient evidence to confirm predation, allowing reasonable inference of confirmed predation on an animal that has been largely consumed. Determination will be made by WDFW or other authorized personnel.

Current market value – the value of livestock at the time it would have normally gone to market.

Delist – to change the classification of endangered, threatened, or sensitive species to a classification other than endangered, threatened, or sensitive.

Depredation – any death or injury of livestock, as defined in this plan, caused by a predator.

Dispersal – generally refers to the natural movement of an animal from one area to another.

Distinct population segment – a discrete and significant subgroup within a species that is treated as a species for purposes of listing under the federal Endangered Species Act.

Downlist – to change the classification of an endangered or threatened species to a lower classification (e.g., from endangered to threatened, or from threatened to sensitive).

Elk herd – defined as a population within a recognized boundary as described by a combination of Game Management Units established by WDFW. Ten defined elk herds occur in the state.

Endangered – as defined by Washington law, any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

Extinct – a wildlife species that no longer exists anywhere; it has died out entirely, leaving no living representatives.

Extirpated – a wildlife species that no longer occurs in the wild in Washington, but exists elsewhere.

Fladry – a method of non-lethal wolf deterrent that involves attaching numerous strips of flagging material along a fence or other device for the purpose of keeping wolves out of an area occupied by livestock.

Game animal – a wildlife species that can only be hunted as authorized by the Washington Fish and Wildlife Commission.

Guarding animals - any dog, llama, or other species actively used to defend livestock from predators.

Guarding dog – any dog actively used to defend livestock from predators.

Habituation – for wolves, this refers to individuals that have lost their natural fear of humans and human activities, which allows them to live in proximity to humans. This often occurs through repeated exposure to humans in non-threatening situations, especially where food has been made available.

Herding dog – any dog actively used to herd livestock.

Heterozygosity – refers to the desirable condition of maintaining genetic variation in populations through the retention of two different alleles at loci on chromosomes.

Hybrid – the offspring of a mating between a wolf and a dog, a wolf and a hybrid, a dog and a hybrid, or two hybrids.

In the act of attacking – actively biting, wounding, or killing.

Intraspecific – occurring within a species or involving members of one species.

Lethal control – management actions that result in the death of a wolf.

List – to change the classification status of a wildlife species to endangered, threatened, or sensitive.

Livestock – cattle, pigs, horses, mules, sheep, llamas, goats, guarding animals, and herding dogs.

Metapopulation – a set of partially isolated populations of the same species. The populations are able to exchange individuals and recolonize sites in which the species has recently become extirpated.

Native – any wildlife species naturally occurring in Washington for the purposes of breeding, resting, or foraging, excluding introduced species not found historically in the state. Native species are presumed to have been present in the state prior to the arrival of Euro-Americans.

Non-depredation – there is clear evidence that livestock died from or was injured by a cause other than predation, such as disease, inclement weather, or poisonous plants. This determination may be made even in instances where the carcass was subsequently scavenged by wolves. It will be made by WDFW or other authorized personnel.

Nongame animal – any species of fish or wildlife that is not hunted, fished, or trapped.

Non-lethal control – management actions designed to frighten or threaten wolves, but that do not result in the death of a wolf.

Pack of wolves – a group of wolves, usually consisting of a male, female, and their offspring from one or more generations. For purposes of monitoring, a pack is defined as a group of two or more wolves traveling together in winter.

Proactive management – non-lethal husbandry methods implemented to minimize the potential for wolf-livestock conflicts. These may include, for example, modified husbandry methods, light and noise scare devices, non-lethal munitions, fencing, fladry, guarding animals, and greater use of herders/riders.

Probable wolf depredation – there is sufficient evidence to suggest that the cause of death was depredation, but not enough to clearly confirm that the depredation was caused by a wolf. A number of other factors will help in reaching a conclusion, such as (1) any recently confirmed predation by wolves in the same or nearby area, and (2) any evidence (e.g., telemetry monitoring data, sightings, howling, fresh tracks, etc.) to suggest that wolves may have been in the area when the depredation occurred. All of these factors and possibly others would be considered in the investigator's best professional judgment. Determination will be made by WDFW or other authorized personnel.

Reintroduction – capturing and moving animals from one area to another, usually for the purpose of reestablishing a new population in an area that was formerly occupied. For this plan, reintroduction means moving wolves from locations outside of Washington to a site(s) inside Washington. Reintroduction is not being proposed for Washington.

Rendezvous site – a specific resting and gathering area occupied by wolf packs during summer and early fall after the natal den has been abandoned. A wolf pack will usually move from the natal den site to the first rendezvous site when the pups are 6-10 weeks of age (late May-early July). The first rendezvous site is usually within 1-6 miles of the natal den site. A succession of rendezvous sites are used by the pack until the pups are mature enough to travel with the adults (usually September or early October).

Sensitive – as defined by Washington law, any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

Significant portion of its range – that portion of a species' range likely to be essential to the long-term survival of the population in Washington.

Sink population – a subpopulation where mortality exceeds reproductive success and therefore has difficulty sustaining itself without continual immigration. Sink populations are generally found in lower quality habitats known as sink habitats.

Source population – a subpopulation whose reproductive success exceeds mortality and therefore produces young that emigrate to other subpopulations and unoccupied areas. Source populations are generally found in better quality habitats known as source habitats.

Species – as defined by Washington law, any group of animals classified as a species or subspecies as commonly accepted by the scientific community.

Successful breeding pair – an adult male and an adult female wolf with at least two pups surviving to December 31 of a given year, as documented under WDFW's established protocols.

Threatened – as defined by Washington law, any wildlife species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

Translocation – moving animals from one area to another for the purpose of establishing a new population.

Turbofladry – a method of non-lethal wolf deterrent that involves attaching numerous strips of flagging material along an electrified fence for the purpose of keeping wolves out of an area occupied by livestock.

Unconfirmed cause of death – any depredation where there is no clear evidence as to what caused the death of the animal, as determined by WDFW or other authorized personnel.

Unconfirmed depredation – any depredation where the predator responsible cannot be determined by WDFW or other authorized personnel.

Ungulate – any wild species of hoofed mammal, including deer, elk, moose, bighorn sheep, mountain goat, and caribou. Cattle, sheep, pigs, horses, and llamas are also ungulates, but are referred to as domestic livestock in this plan.

Unknown loss – with respect to compensation, the loss of livestock from an area with known wolf activity without a carcass as evidence. This would be based on historical records of livestock return rates prior to wolf presence/wolf depredation in the area.

Viable population – one that is able to maintain its size, distribution, and genetic variation over time without significant intervention requiring human conservation actions.

Wildlife – as defined by Washington law, "wildlife" means all species of the animal kingdom whose members exist in Washington in a wild state. This includes but is not limited to mammals, birds, reptiles, amphibians, fish, and invertebrates. The term "wildlife" does not include feral domestic mammals, old world rats and mice of the family Muridae of the order Rodentia, or those fish, shellfish, and marine invertebrates classified as food fish or shellfish by the director of WDFW. The term "wildlife" includes all stages of development and the bodily parts of wildlife members.

Wolf recovery/conservation region – any of three broad designated regions in Washington where wolves need to become reestablished to meet the conservation goals of this plan. The regions are illustrated in Figure 2.

Appendix A. Washington laws: Washington Administrative Code 232-12- 011. Wildlife classified as protected shall not be hunted or fished; Washington Administrative Code 232-12- 014. Wildlife classified as endangered species; Washington Administrative Code 232-12-297. Endangered, threatened and sensitive wildlife species classification; Revised Code of Washington 77.15.120. Endangered fish or wildlife – unlawful taking – penalty; and Revised Code of Washington 77.15.130. Protected fish or wildlife – unlawful taking – penalty.

WAC 232-12-011 Wildlife classified as protected shall not be hunted or fished.

Protected wildlife are designated into three subcategories: threatened, sensitive, and other.

(1) Threatened species are any wildlife species native to the state of Washington that are likely to become endangered within the foreseeable future throughout a significant portion of their range within the state without cooperative management or removal of threats. Protected wildlife designated as threatened include:

Common Name	**Scientific Name**
Mazama pocket gopher	*Thomomys mazama*
western gray squirrel	*Sciurus griseus*
Steller (northern) sea lion	*Eumetopias jubatus*
North American lynx	*Lynx canadensis*
ferruginous hawk	*Buteo regalis*
marbled murrelet	*Brachyramphus marmoratus*
green sea turtle	*Chelonia mydas*
loggerhead sea turtle	*Caretta caretta*
greater sage-grouse	*Centrocercus urophasianus*
sharp-tailed grouse	*Phasianus columbianus*

(2) Sensitive species are any wildlife species native to the state of Washington that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats. Protected wildlife designated as sensitive include:

Common Name	**Scientific Name**
gray whale	*Eschrichtius gibbosus*
common Loon	*Gavia immer*
peregrine falcon	*Falco peregrinus*
bald eagle	*Haliaeetus leucocephalus*
Larch Mountain salamander	*Plethodon larselli*
pygmy whitefish	*Prosopium coulteri*
margined sculpin	*Cottus marginatus*
Olympic mudminnow	*Novumbra hubbsi*

(3) Other protected wildlife include:

Common Name	**Scientific Name**
cony or pika	*Ochotona princeps*
least chipmunk	*Tamius minimus*
yellow-pine chipmunk	*Tamius amoenus*
Townsend's chipmunk	*Tamius townsendii*
red-tailed chipmunk	*Tamius ruficaudus*
hoary marmot	*Marmota caligata*
Olympic marmot	*Marmota olympus*
Cascade golden-mantled ground squirrel	*Spermophilus saturatus*
golden-mantled ground squirrel	*Spermophilus lateralis*
Washington ground squirrel	*Spermophilus washingtoni*
red squirrel	*Tamiasciurus hudsonicus*
Douglas squirrel	*Tamiasciurus douglasii*
northern flying squirrel	*Glaucomys sabrinus*
Wolverine	*Gulo gulo*
painted turtle	*Chrysemys picta*
California mountain kingsnake	*Lampropeltis zonata*

All birds not classified as game birds, predatory birds or endangered species, or designated as threatened species or sensitive species; all bats, except when found in or immediately adjacent to a dwelling or other occupied building; mammals of the order Cetacea, including whales, porpoises, and mammals of the order Pinnipedia not otherwise classified as endangered species, or designated as threatened species or sensitive species. This section shall not apply to hair seals and sea lions which are threatening to damage or are damaging commercial fishing gear being utilized in a lawful manner or when said mammals are damaging or threatening to damage commercial fish being lawfully taken with commercial gear.

[Statutory Authority: RCW 77.12.047, 77.12.020. 08-03-068 (Order 08-09), § 232-12-011, filed 1/14/08, effective 2/14/08; 06-04-066 (Order 06-09), § 232-12-011, filed 1/30/06, effective 3/2/06. Statutory Authority: RCW 77.12.047, 77.12.655, 77.12.020. 02-11-069 (Order 02-98), § 232-12-011, filed 5/10/02, effective 6/10/02. Statutory Authority: RCW 77.12.047. 02-08-048 (Order 02-53), § 232-12-011, filed 3/29/02, effective 5/1/02; 00-17-106 (Order 00-149), § 232-12-011, filed 8/16/00, effective 9/16/00. Statutory Authority: RCW 77.12.040, 77.12.010, 77.12.020, 77.12.770. 00-10-001 (Order 00-47), § 232-12-011, filed 4/19/00, effective 5/20/00. Statutory Authority: RCW 77.12.040, 77.12.010, 77.12.020, 77.12.770, 77.12.780. 00-04-017 (Order 00-05), § 232-12-011, filed 1/24/00, effective 2/24/00. Statutory Authority: RCW 77.12.020. 98-23-013 (Order 98-232), § 232-12-011, filed 11/6/98, effective 12/7/98. Statutory Authority: RCW 77.12.040. 98-10-021 (Order 98-71), § 232-12-011, filed 4/22/98, effective 5/23/98. Statutory Authority: RCW 77.12.040 and 75.08.080. 98-06-031, § 232-12-011, filed 2/26/98, effective 5/1/98. Statutory Authority: RCW 77.12.020. 97-18-019 (Order 97-167), § 232-12-011, filed 8/25/97, effective 9/25/97. Statutory Authority: RCW 77.12.040, 77.12.020, 77.12.030 and 77.32.220. 97-12-048, § 232-12-011, filed 6/2/97, effective 7/3/97. Statutory Authority: RCW 77.12.020. 93-21-027 (Order 615), § 232-12-011, filed 10/14/93, effective 11/14/93; 90-11-065 (Order 441), § 232-12-011, filed 5/15/90, effective 6/15/90. Statutory Authority: RCW 77.12.040. 89-11-061 (Order 392), § 232-12-011, filed 5/18/89; 82-19-026 (Order 192), § 232-12-011, filed 9/9/82; 81-22-002 (Order 174), § 232-12-011, filed 10/22/81; 81-12-029 (Order 165), § 232-12-011, filed 6/1/81.]

WAC 232-12-014 Wildlife classified as endangered species. Endangered species include:

Common Name	**Scientific Name**
pygmy rabbit	*Brachylagus idahoensis*
Fisher	*Martes pennanti*
gray wolf	*Canis lupus*
grizzly bear	*Ursus arctos*
sea otter	*Enhydra lutris*
sei whale	*Balaenoptera borealis*
fin whale	*Balaenoptera physalus*
blue whale	*Balaenoptera musculus*
humpback whale	*Megaptera novaeangliae*
black right whale	*Balaena glacialis*
sperm whale	*Physeter macrocephalus*
killer whale	*Orcinus orca*
Columbian white-tailed deer	*Odocoileus virginianus leucurus*
woodland caribou	*Rangifer tarandus caribou*
American white pelican	*Pelecanus erythrorhynchos*
brown pelican	*Pelecanus occidentalis*
sandhill crane	*Grus canadensis*
snowy plover	*Charadrius alexandrinus*
upland sandpiper	*Bartramia longicauda*
spotted owl	*Strix occidentalis*
Streaked horned lark	*Eremophila alpestris strigata*
western pond turtle	*Clemmys marmorata*
leatherback sea turtle	*Dermochelys coriacea*
mardon skipper	*Polites mardon*
Oregon silverspot butterfly	*Speyeria zerene hippolyta*
Taylor's checkerspot	*Euphydryas editha taylori*
Oregon spotted frog	*Rana pretiosa*
northern leopard frog	*Rana pipiens*

[Statutory Authority: RCW 77.12.047, 77.12.655, 77.12.020. 06-04-066 (Order 06-09), § 232-12-014, filed 1/30/06, effective 3/2/06. Statutory Authority: RCW 77.12.047, 77.12.655, 77.12.020. 02-11-069 (Order 02-98), § 232-12-014, filed 5/10/02, effective 6/10/02. Statutory Authority: RCW 77.12.040, 77.12.010, 77.12.020, 77.12.770, 77.12.780. 00-04-017 (Order 00-05), § 232-12-014, filed 1/24/00, effective 2/24/00. Statutory Authority: RCW 77.12.020. 98-23-013 (Order 98-232), § 232-12-014, filed 11/6/98, effective 12/7/98; 97-18-019 (Order 97-167), § 232-12-014, filed 8/25/97, effective 9/25/97; 93-21-026 (Order 616), § 232-12-014, filed 10/14/93, effective 11/14/93. Statutory Authority: RCW 77.12.020(6). 88-05-032 (Order 305), § 232-12-014, filed 2/12/88. Statutory Authority: RCW 77.12.040. 82-19-026 (Order 192), § 232-12-014, filed 9/9/82; 81-22-002 (Order 174), § 232-12-014, filed 10/22/81; 81-12-029 (Order 165), § 232-12-014, filed 6/1/81.]

WAC 232-12-297 Endangered, threatened, and sensitive wildlife species classification.

PURPOSE

1.1 The purpose of this rule is to identify and classify native wildlife species that have need of protection and/or management to ensure their survival as free-ranging populations in Washington and to define the process by which listing, management, recovery, and delisting of a species can be achieved. These rules are established to ensure that consistent procedures and criteria are followed when classifying wildlife as endangered, or the protected wildlife subcategories threatened or sensitive.

DEFINITIONS

For purposes of this rule, the following definitions apply:

2.1 "Classify" and all derivatives means to list or delist wildlife species to or from endangered, or to or from the protected wildlife subcategories threatened or sensitive.

2.2 "List" and all derivatives means to change the classification status of a wildlife species to endangered, threatened, or sensitive.

2.3 "Delist" and its derivatives means to change the classification of endangered, threatened, or sensitive species to a classification other than endangered, threatened, or sensitive.

2.4 "Endangered" means any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

2.5 "Threatened" means any wildlife species native to the state of Washington that is likely to become an endangered species within the forseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

2.6 "Sensitive" means any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

2.7 "Species" means any group of animals classified as a species or subspecies as commonly accepted by the scientific community.

2.8 "Native" means any wildlife species naturally occurring in Washington for purposes of breeding, resting, or foraging, excluding introduced species not found historically in this state.

2.9 "Significant portion of its range" means that portion of a species' range likely to be essential to the long term survival of the population in Washington.

LISTING CRITERIA

3.1 The commission shall list a wildlife species as endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available, except as noted in section 3.4.

3.2 If a species is listed as endangered or threatened under the federal Endangered Species Act, the agency will recommend to the commission that it be listed as endangered or threatened as specified in section 9.1. If listed, the agency will proceed with development of a recovery plan pursuant to section 11.1.

3.3 Species may be listed as endangered, threatened, or sensitive only when populations are in danger of failing, declining, or are vulnerable, due to factors including but not restricted to limited numbers, disease, predation, exploitation, or habitat loss or change, pursuant to section 7.1.

3.4 Where a species of the class Insecta, based on substantial evidence, is determined to present an unreasonable risk to public health, the commission may make the determination that the species need not be listed as endangered, threatened, or sensitive.

DELISTING CRITERIA

4.1 The commission shall delist a wildlife species from endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available.

4.2 A species may be delisted from endangered, threatened, or sensitive only when populations are no longer in danger of failing, declining, are no longer vulnerable, pursuant to section 3.3, or meet recovery plan goals, and when it no longer meets the definitions in sections 2.4, 2.5, or 2.6.

INITIATION OF LISTING PROCESS

5.1 Any one of the following events may initiate the listing process.

5.1.1 The agency determines that a species population may be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

5.1.2 A petition is received at the agency from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the classification process.

5.1.3 An emergency, as defined by the Administrative Procedure Act, chapter 34.05 RCW. The listing of any species previously classified under emergency rule shall be governed by the provisions of this section.

5.1.4 The commission requests the agency review a species of concern.

5.2 Upon initiation of the listing process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the classification process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

INITIATION OF DELISTING PROCESS

6.1 Any one of the following events may initiate the delisting process:

6.1.1 The agency determines that a species population may no longer be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

6.1.2 The agency receives a petition from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may no longer be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the delisting process.

6.1.3 The commission requests the agency review a species of concern.

6.2 Upon initiation of the delisting process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the delisting process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

SPECIES STATUS REVIEW AND AGENCY RECOMMENDATIONS

7.1 Except in an emergency under 5.1.3 above, prior to making a classification recommendation to the commission, the agency shall prepare a preliminary species status report. The report will include a review of information relevant to the species' status in Washington and address factors affecting its status, including those given under section 3.3. The status report shall be reviewed by the public and scientific community. The status report will include, but not be limited to an analysis of:

7.1.1 Historic, current, and future species population trends.

7.1.2 Natural history, including ecological relationships (e.g., food habits, home range, habitat selection patterns).

7.1.3 Historic and current habitat trends.

7.1.4 Population demographics (e.g., survival and mortality rates, reproductive success) and their relationship to long term sustainability.

7.1.5 Historic and current species management activities.

7.2 Except in an emergency under 5.1.3 above, the agency shall prepare recommendations for species classification, based upon scientific data contained in the status report. Documents shall be prepared to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act (SEPA).

7.3 For the purpose of delisting, the status report will include a review of recovery plan goals.

PUBLIC REVIEW

8.1 Except in an emergency under 5.1.3 above, prior to making a recommendation to the commission, the agency shall provide an opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any SEPA findings.

8.1.1 The agency shall allow at least 90 days for public comment.

8.1.2 The agency will hold at least one public meeting in each of its administrative regions during the public review period.

FINAL RECOMMENDATIONS AND COMMISSION ACTION

9.1 After the close of the public comment period, the agency shall complete a final status report and classification recommendation. SEPA documents will be prepared, as necessary, for the final agency recommendation for classification. The classification recommendation will be presented to the commission for action. The final species status report, agency classification recommendation, and SEPA documents will be made available to the public at least 30 days prior to the commission meeting.

9.2 Notice of the proposed commission action will be published at least 30 days prior to the commission meeting.

PERIODIC SPECIES STATUS REVIEW

10.1 The agency shall conduct a review of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing. This review shall include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification.

10.1.1 The agency shall notify any parties who have expressed their interest to the department of the periodic status review. This notice shall occur at least one year prior to end of the five year period required by section 10.1.

10.2 The status of all delisted species shall be reviewed at least once, five years following the date of delisting.

10.3 The department shall evaluate the necessity of changing the classification of the species being reviewed. The agency shall report its findings to the commission at a commission meeting. The agency shall notify the public of its findings at least 30 days prior to presenting the findings to the commission.

10.3.1 If the agency determines that new information suggests that classification of a species should be changed from its present state, the agency shall initiate classification procedures provided for in these rules starting with section 5.1.

10.3.2 If the agency determines that conditions have not changed significantly and that the classification of the species should remain unchanged, the agency shall recommend to the commission that the species being reviewed shall retain its present classification status.

10.4 Nothing in these rules shall be construed to automatically delist a species without formal commission action.

RECOVERY AND MANAGEMENT OF LISTED SPECIES

11.1 The agency shall write a recovery plan for species listed as endangered or threatened. The agency will write a management plan for species listed as sensitive. Recovery and management plans shall address the listing criteria described in sections 3.1 and 3.3, and shall include, but are not limited to:

11.1.1 Target population objectives.

11.1.2 Criteria for reclassification.

11.1.3 An implementation plan for reaching population objectives which will promote cooperative management and be sensitive to landowner needs and property rights. The plan will specify resources needed from and impacts to the department, other agencies (including federal, state, and local), tribes, landowners, and other interest groups. The plan shall consider various approaches to meeting recovery objectives including, but not limited to regulation, mitigation, acquisition, incentive, and compensation mechanisms.

11.1.4 Public education needs.

11.1.5 A species monitoring plan, which requires periodic review to allow the incorporation of new information into the status report.

11.2 Preparation of recovery and management plans will be initiated by the agency within one year after the date of listing.

11.2.1 Recovery and management plans for species listed prior to 1990 or during the five years following the adoption of these rules shall be completed within five years after the date of listing or adoption of these rules, whichever comes later. Development of recovery plans for endangered species will receive higher priority than threatened or sensitive species.

11.2.2 Recovery and management plans for species listed after five years following the adoption of these rules shall be completed within three years after the date of listing.

11.2.3 The agency will publish a notice in the Washington Register and notify any parties who have expressed interest to the department interested parties of the initiation of recovery plan development.

11.2.4 If the deadlines defined in sections 11.2.1 and 11.2.2 are not met the department shall notify the public and report the reasons for missing the deadline and the strategy for completing the plan at a commission meeting. The intent of this section is to recognize current department personnel resources are limiting and that development of recovery plans for some of the species may require significant involvement by interests outside of the department, and therefore take longer to complete.

11.3 The agency shall provide an opportunity for interested public to comment on the recovery plan and any SEPA documents.

CLASSIFICATION PROCEDURES REVIEW

12.1 The agency and an ad hoc public group with members representing a broad spectrum of interests, shall meet as needed to accomplish the following:

12.1.1 Monitor the progress of the development of recovery and management plans and status reviews, highlight problems, and make recommendations to the department and other interested parties to improve the effectiveness of these processes.

12.1.2 Review these classification procedures six years after the adoption of these rules and report its findings to the commission.

AUTHORITY

13.1 The commission has the authority to classify wildlife as endangered under RCW 77.12.020. Species classified as endangered are listed under WAC 232-12-014, as amended.

13.2 Threatened and sensitive species shall be classified as subcategories of protected wildlife. The commission has the authority to classify wildlife as protected under RCW 77.12.020. Species classified as protected are listed under WAC 232-12-011, as amended. [Statutory Authority: RCW 77.12.020. 90-11-066 (Order 442), § 232-12-297, filed 5/15/90, effective 6/15/90.]

RCW 77.15.120 Endangered fish or wildlife – Unlawful taking – Penalty.

(1) A person is guilty of unlawful taking of endangered fish or wildlife in the second degree if the person hunts, fishes, possesses, maliciously harasses or kills fish or wildlife, or maliciously destroys the nests or eggs of fish or wildlife and the fish or wildlife is designated by the commission as endangered, and the taking has not been authorized by rule of the commission.

(2) A person is guilty of unlawful taking of endangered fish or wildlife in the first degree if the person has been:

(a) Convicted under subsection (1) of this section or convicted of any crime under this title involving the killing, possessing, harassing, or harming of endangered fish or wildlife; and

(b) Within five years of the date of the prior conviction the person commits the act described by subsection (1) of this section.

(3)(a) Unlawful taking of endangered fish or wildlife in the second degree is a gross misdemeanor.

(b) Unlawful taking of endangered fish or wildlife in the first degree is a class C felony. The department shall revoke any licenses or tags used in connection with the crime and order the person's privileges to hunt, fish, trap, or obtain licenses under this title to be suspended for two years.

[2000 c 107 § 236; 1998 c 190 § 13.]

RCW 77.15.130 Protected fish or wildlife — Unlawful taking — Penalty.

(1) A person is guilty of unlawful taking of protected fish or wildlife if:

(a) The person hunts, fishes, possesses, or maliciously kills protected fish or wildlife, or the person possesses or maliciously destroys the eggs or nests of protected fish or wildlife, and the taking has not been authorized by rule of the commission; or

(b) The person violates any rule of the commission regarding the taking, harming, harassment, possession, or transport of protected fish or wildlife.

(2) Unlawful taking of protected fish or wildlife is a misdemeanor.

[1998 c 190 § 14.]

Daryl Asmussen
Cattle Rancher
PO Box 417
Tonasket, WA 98855

John Blankenship (replaced by Linda Saunders at the June 2011 meeting)
Executive Director
Wolf Haven International
3111 Offut Lake Rd
Tenino, WA 98589

Duane Cocking
Board of Directors
Inland Empire Chapter
Safari Club International
8322 N Glenarvon Ln
Newman Lake, WA 99025

Jeff Dawson
Director
Stevens County Cattleman
Cattle Producers of Washington
449 Douglas Falls Rd
Colville, WA 99114

Jack Field
Executive Vice President
Washington Cattlemen's Association
PO Box 96
Ellensburg, WA 98926

George Halekas
Wildlife Biologist
Raven Wildlife Services
24918 N Monroe Rd
Deer Park, WA 99006

Kim Holt
Secretary/Treasurer
Wolf Recovery Foundation
18632 Broadway Ave
Snohomish, WA 98296

Derrick Knowles
Outreach Coordinator
Conservation Northwest
35 W Main, Suite 220
Spokane, WA 99201

Colleen McShane
Wildlife Ecologist
Seattle City Light
1132 North 76th St
Seattle, WA 98103

Ken Oliver
Former County Commissioner
Pend Oreille County
32371 Le Clerc Rd N
Ione, WA 99139

Tommy Petrie, Jr.
President
Pend Oreille County Sportsmens Club
10152 LeClerc Rd
Newport, WA 99156

Gerry Ring Erickson
Consulting Scientist
PO Box 1896
Shelton, Wa 98584

John Stuhlmiller
Director of State Affairs
Washington Farm Bureau
PO Box 8690
Lacey, WA 98509

Arthur Swannack
President
Washington State Sheep Producers
1201 Cree Rd
Lamont, WA 99017

Bob Tuck
Principal, Eco-Northwest
(Former Member of the Washington Fish and Wildlife Commission)
270 Westridge Rd
Selah, WA 98942

Greta M. Wiegand
Outdoor Recreationist
2142 N 192nd St
Shoreline, WA 98133

Georg Ziegltrum
Supervisor
Washington Forest Protection Association
724 Columbia St NW, Suite 250
Olympia, WA 98501

Wolf Working Group Letter

June 30, 2008

To the citizens of Washington,

The Washington Wolf Working Group (WWG) consists of 17 citizens appointed by Washington Department of Fish and Wildlife (WDFW) Director Jeff Koenings to advise WDFW in developing a Washington Wolf Conservation and Management Plan. WWG members represent a broad range of perspectives, from those concerned that wolf recovery would negatively affect their livelihood or interests to those who believe that wolves are a valued part of Washington's natural heritage and play a role in healthy functioning ecosystems.

The WWG made every effort to understand the complex and diverse issues surrounding wolf recovery in depth, and to carefully craft management approaches that achieve plan objectives in a way that is balanced, fair, cost effective, and that has a high probability of success. Extensive discussion by WWG members focused on how to achieve two key strongly linked objectives (described in the plan as follows):

1. Implementing conservation strategies that will result in the reestablishment of a naturally reproducing and viable wolf population distributed in a significant portion of the species' former range in Washington, and
2. Managing wolf-livestock conflicts in a way that gives livestock owners who are experiencing losses tools to minimize future losses, while at the same time not negatively impacting the recovery or long-term perpetuation of sustainable wolf populations.

Efforts by the WWG to forge a consensus were shaped by shared points of understanding, including the need to assess the entire state in terms of the strengths and weaknesses to support wolf recovery. From the wolf recovery experience in the Northern Rockies, we recognize that large contiguous blocks of public land with abundant ungulate prey not only play an important role in sustaining a viable wolf population, but are also areas with comparatively lower levels of wolf/human conflicts. WWG members share the sentiment that one region or interest group should not unfairly bear the impacts of wolf recovery. WWG members support developing a compensation program to offset livestock losses with the understanding that a high degree of accountability and verification are needed to avoid problems occurring in other state compensation programs. WWG members support taking proactive measures that would lead to faster recovery of wolves, thus allowing greater management flexibility and reducing costs over the long-term. WWG members understand that secure long-term funds will be required to implement this plan, achieve the objectives, and provide the responsiveness needed to maintain public support.

Following many hours of dedicated work and compromise, the WWG has achieved a consensus on all aspects of this draft plan, with the exception of the number of established breeding pairs needed to downlist and delist wolves in Washington (see Appendix D, Minority Report). This draft plan was developed as a "package" and it is critical to recognize that many of the components are linked and have been carefully balanced to meet multiple objectives. As a result, WWG members were willing to pursue innovative proactive approaches (such as promoting "within state" translocation of wolves and defining restricted circumstances where lethal take of wolves would be allowed) to achieve the conservation and management objectives in a timely assured way. Eliminating an individual component would change the overall balance of the package, adversely affect the ability to meet plan objectives, and reduce the level of collective support by the WWG.

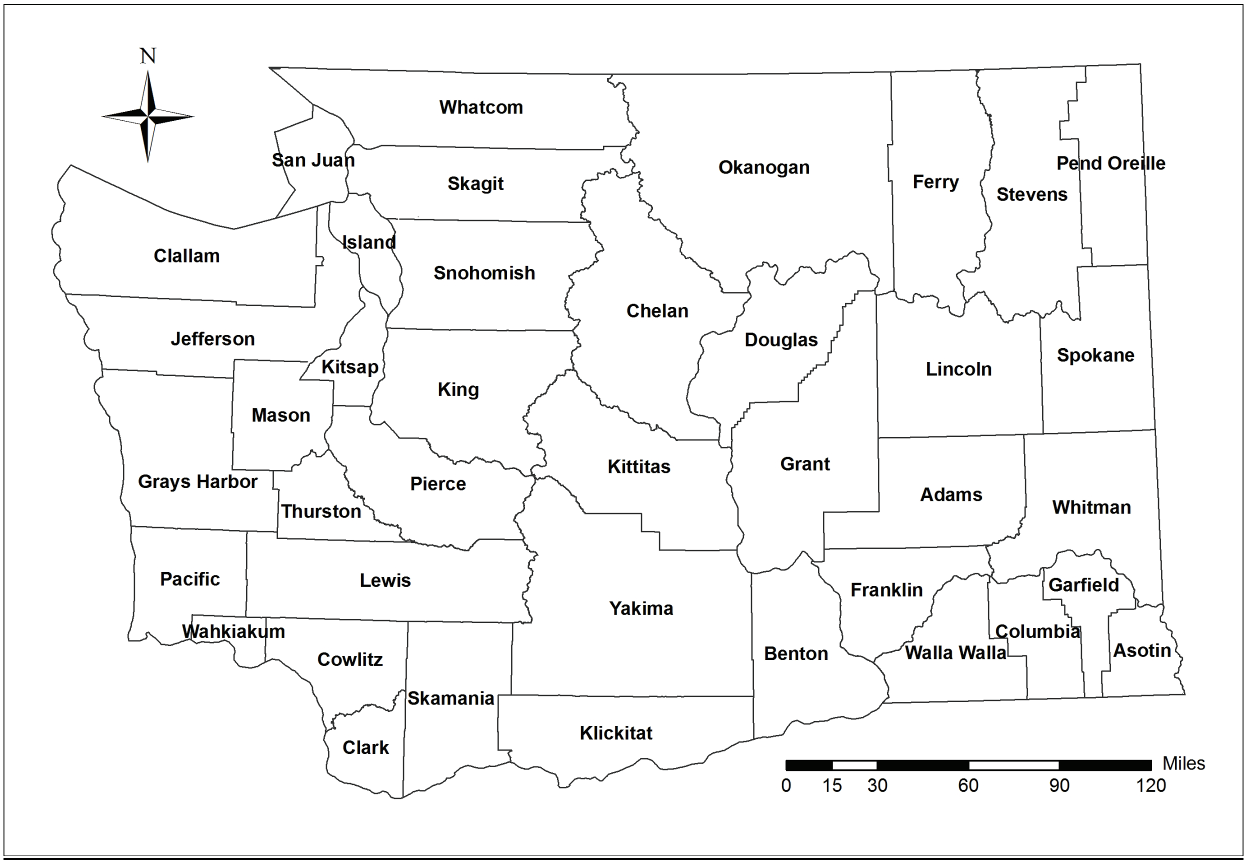
The WWG understands that this plan will be reviewed over time and that adaptive management will guide future changes in direction. Our work over the past year represents a "good faith" effort to anticipate where problems may occur in meeting plan objectives and to suggest reasonable approaches to mitigate potential problems. We recognize that public understanding of the issues surrounding wolf recovery can be hampered because of underlying misconceptions, partial truths, and fears. We have worked especially hard to accurately identify potential impacts, to frame issues within a clear and understandable context, and to be as specific as possible to conditions in Washington state.

Daryl Asmussen
John Blankenship
Duane Cocking
Jeff Dawson
Jack Field
George Halekas
Kim Holt
Derrick Knowles
Colleen McShane
Ken Oliver
Tommy Petrie, Jr.
Gerry Ring Erickson
John Stuhlmiller
Arthur Swannack
Bob Tuck
Greta Wiegand
Georg Ziegltrum

Appendix D. A list 43 reviewers submitting comments on the draft Wolf Conservation and Management Plan during the scientific peer review period conducted from August to October 2008 and the blind peer review period from October 2009 to February 2011.

Name	Affiliation	Title
Peer Review (2008)		
Dr. David Mech	University of Minnesota	Wolf Research Scientist
Dr. James Peek	University of Idaho	Emeritus Professor, Wildlife Management
Dr. Carlos Carroll	Klamath Center for Conservation Research	Research Scientist
Dr. Rich Fredrickson	University of Montana	Faculty Affiliate, Genetics
Dr. John Duffield	University of Montana	Professor, Economics
Dr. Shannon Neibergs	Washington State University	Associate Professor, Economics
Dr. Doug Smith	Yellowstone National Park	Wolf Project Lead Scientist
Ed Bangs	U.S. Fish and Wildlife Service	Federal Wolf Coordinator
John Oakleaf	U.S. Fish and Wildlife Service	Mexican Wolf Field Coordinator
Mike Jimenez	U.S. Fish and Wildlife Service	Federal Wolf Project Leader for Wyoming
Dan Trochta	U.S. Fish and Wildlife Service	Wildlife Biologist – Spokane Field Office
Carolyn Sime	Montana Fish, Wildlife and Parks	State Wolf Coordinator
Russ Morgan	Oregon Department of Fish and Wildlife	State Wolf Coordinator
Carter Niemeyer	U.S. Fish and Wildlife Service (former) and USDA Wildlife Services (former); Idaho Department of Fish and Game	Idaho Wolf Project Leader (former)
Curt Mack	Nez Perce Nation	Wolf Research Biologist
Jim Holyan	Nez Perce Nation	Wolf Research Biologist
Garth Mowat	British Columbia Ministry of Environment	Senior Wildlife Biologist
Roger Woodruff	USDA Wildlife Services (Washington)	State Director
Dr. Bill Gaines	Okanogan-Wenatchee National Forests	Forest Wildlife Ecologist and Forest Service Region 6 Wolf Lead
Mark Henjum	Umatilla National Forest	Biologist (former Oregon DFW Wolf Plan lead)
Dr. Patti Happe	Olympic National Park	Chief, Wildlife Branch
Jeanne Jerred	Colville Confederated Tribes	Chair
Francis Charles	Lower Elwha Klallam Tribe	Chair
David Vales	Muckleshoot Tribe	Wildlife Biologist
Tim Cullinan	Pt. Gamble S'Klallam Tribe	Wildlife Biologist
Jennifer Sevigny	Stillaquamish Tribe	Wildlife Biologist
Mark Nuetzmann	Yakama Nation	Wildlife Biologist
John Pierce	WDFW (Olympia)	Chief Scientist, Wildlife Research Division
Dave Ware	WDFW (Olympia)	Game Division Manager
Dr. Cliff Rice	WDFW (Olympia)	Ungulate Research Scientist
Anthony Novack	WDFW (Ellensburg)	Deer-Elk Conflict Specialist
David Anderson	WDFW (Trout Lake)	District Biologist
Dana Base	WDFW (Colville)	District Biologist
Jeff Bernatowicz	WDFW (Yakima)	District Biologist
Scott Fitkin	WDFW (Winthrop)	District Biologist
Mike Livingston	WDFW (Tri-Cities)	District Biologist
Will Moore	WDFW (Yakima)	Assistant District Biologist
Jon Gallie	WDFW (Wenatchee)	Assistant District Biologist
Chris Hammond	WDFW (Colville) (former)	Assistant District Biologist (former)
Jeff Heinlen	WDFW (Tonasket)	Assistant District Biologist
Eric Holman	WDFW (Vancouver)	Assistant District Biologist
Paul Wik	WDFW (Clarkston)	Assistant District Biologist
Ella Rowan	WDFW (Spokane)	Wildlife Biologist
Blind Peer Review (2009-2010)		
Dr. Todd Fuller	University of Massachusetts, Amherst	Professor, Wildlife Biology
3 anonymous reviewers	Unknown	Unknown

Appendix E. A map of Washington's 39 counties.



RCW 77.36 Wildlife damage.

RCW Sections

77.36.010. Definitions
77.36.030. Trapping or killing wildlife threatening human safety or causing property damage — Limitations and conditions — Rules.
77.36.070. Limit on total claims from wildlife account per fiscal year.
77.36.080. Limit on total claims from general fund per fiscal year — Emergency exceptions.
77.36.100. Payment of claims for damage to commercial crops or commercial livestock — Noncash compensation — Offer of materials or services to offset or prevent wildlife interactions — Appeal of decisions.
77.36.110. Eligibility for compensation under this chapter — Adoption of rules.
77.36.120. Department's duties.
77.36.130. Limit on cash compensation — Burden of proof.
77.36.140. Chapter represents exclusive remedy.
77.36.150. Review of rules and policies. (Expires July 30, 2014)

77.36.010. Definitions.

The definitions in this section apply throughout this chapter unless the context clearly requires otherwise.

(1) "Claim" means an application to the department for compensation under this chapter.

(2) "Commercial crop" means a horticultural or agricultural product, including the growing or harvested product. For the purposes of this chapter all parts of horticultural trees shall be considered a commercial crop and shall be eligible for claims.

(3) "Commercial livestock" means cattle, sheep, and horses held or raised by a person for sale.

(4) "Compensation" means a cash payment, materials, or service.

(5) "Damage" means economic losses caused by wildlife interactions.

(6) "Immediate family member" means spouse, state registered domestic partner, brother, sister, grandparent, parent, child, or grandchild.

(7) "Owner" means a person who has a legal right to commercial crops, commercial livestock, or other property that was damaged during a wildlife interaction.

(8) "Wildlife interaction" means the negative interaction and the resultant damage between wildlife and commercial crops, commercial livestock, or other property.

[2009 c 521 § 184; 2009 c 333 § 54; 1996 c 54 § 2; (2001 c 274 § 2 expired June 30, 2004).]

Notes: Reviser's note: This section was amended by 2009 c 333 § 54 and by 2009 c 521 § 184, each without reference to the other. Both amendments are incorporated in the publication of this section under RCW 1.12.025(2). For rule of construction, see RCW 1.12.025(1).

Effective date -- 2009 c 333 §§ 53-66: "Sections *53 through 66 of this act take effect July 1, 2010." [2009 c 333 § 69.]

*Reviser's note: Section 53, chapter 333, Laws of 2009 was vetoed by the governor.

Application -- 2009 c 333 §§ 53-66: "Sections *53 through 66 of this act apply prospectively only and not retroactively. Sections *53 through 66 of this act apply only to claims that arise on or after July 1, 2010. Claims under chapter 77.36 RCW that arise prior to July 1, 2010, must be adjudicated under chapter 77.36 RCW as it existed prior to July 1, 2010." [2009 c 333 § 67.]

*Reviser's note: Section 53, chapter 333, Laws of 2009 was vetoed by the governor.

Expiration date -- 2001 c 274 §§ 1-3: "The following expire June 30, 2004:

(1) Section 1, chapter 274, Laws of 2001;

(2) Section 2, chapter 274, Laws of 2001; and

(3) Section 3, chapter 274, Laws of 2001." [2001 c 274 § 5.]

Effective date -- 2001 c 274: "This act is necessary for the immediate preservation of the public peace, health, or safety, or support of the state government and its existing public institutions, and takes effect July 1, 2001." [2001 c 274 § 6.]

77.36.030. Trapping or killing wildlife threatening human safety or causing property damage — Limitations and conditions — Rules.

(1) Subject to limitations and conditions established by the commission, the owner, the owner's immediate family member, the owner's documented employee, or a tenant of real property may trap, consistent with RCW 77.15.194, or kill wildlife that is threatening human safety or causing property damage on that property, without the licenses required under RCW 77.32.010 or authorization from the director under RCW 77.12.240.

(2) The commission shall establish the limitations and conditions of this section by rule. The rules must include:

(a) Appropriate protection for threatened or endangered species;

(b) Instances when verbal or written permission is required to kill wildlife;

(c) Species that may be killed under this section; and

(d) Requirements for the disposal of wildlife trapped or killed under this section.

(3) In establishing the limitations and conditions of this section, the commission shall take into consideration the recommendations of the Washington state wolf conservation and management plan.

[2009 c 333 § 61; 1996 c 54 § 4.]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

77.36.070. Limit on total claims from wildlife account per fiscal year.

The department may pay no more than one hundred twenty thousand dollars per fiscal year from the state wildlife account created in RCW 77.12.170 for claims and assessment costs for damage to commercial crops caused by wild deer or elk submitted under RCW 77.36.100.

[2009 c 333 § 59; 1996 c 54 § 8.]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

77.36.080. Limit on total claims from general fund per fiscal year — Emergency exceptions.

(1) Unless the legislature declares an emergency under this section, the department may pay no more than thirty thousand dollars per fiscal year from the general fund for claims and assessment costs for damage to commercial crops caused by wild deer or elk submitted under RCW 77.36.100.

(2)(a) The legislature may declare an emergency if weather, fire, or other natural events result in deer or elk causing excessive damage to commercial crops.

(b) After an emergency declaration, the department may pay as much as may be subsequently appropriated, in addition to the funds authorized under subsection (1) of this section, for claims and assessment costs under RCW 77.36.100. Such money shall be used to pay wildlife interaction claims only if the claim meets the conditions of RCW 77.36.100 and the department has expended all funds authorized under RCW 77.36.070 or subsection (1) of this section.

[2009 c 333 § 60; 1996 c 54 § 9; (2001 c 274 § 3 expired June 30, 2004).]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.
Expiration date -- 2001 c 274 §§ 1-3: See note following RCW 77.36.010.
Effective date -- 2001 c 274: See note following RCW 77.36.010.

77.36.100. Payment of claims for damage to commercial crops or commercial livestock — Noncash compensation — Offer of materials or services to offset or prevent wildlife interactions — Appeal of decisions.

(1)(a) Except as limited by RCW 77.36.070 and 77.36.080, the department shall offer to distribute money appropriated to pay claims to the owner of commercial crops for damage caused by wild deer or elk or to the owners of commercial livestock that has been killed by bears, wolves, or cougars, or injured by bears, wolves, or cougars to such a degree that the market value of the commercial livestock has been diminished. Payments for claims for damage to commercial livestock are not subject to the limitations of RCW 77.36.070 and 77.36.080, but may not exceed the total amount specifically appropriated therefor.

(b) Owners of commercial crops or commercial livestock are only eligible for a claim under this subsection if:

(i) The owner satisfies the definition of "eligible farmer" in RCW 82.08.855;
(ii) The conditions of RCW 77.36.110 have been satisfied; and
(iii) The damage caused to the commercial crop or commercial livestock satisfies the criteria for damage established by the commission under this subsection.
(c) The commission shall adopt and maintain by rule criteria that clarifies the damage to commercial crops and commercial livestock qualifying for compensation under this subsection. An owner of a commercial crop or commercial livestock must satisfy the criteria prior to receiving compensation under this subsection. The criteria for damage adopted under this subsection must include, but not be limited to, a required minimum economic loss to the owner of the commercial crop or commercial livestock, which may not be set at a value of less than five hundred dollars.
(2)(a) The department may offer to provide noncash compensation only to offset wildlife interactions to a person who applies to the department for compensation for damage to property other than commercial crops or commercial livestock that is the result of a mammalian or avian species of wildlife on a case-specific basis if the conditions of RCW 77.36.110 have been satisfied and if the damage satisfies the criteria for damage established by the commission under this subsection.
(b) The commission shall adopt and maintain by rule criteria for damage to property other than a commercial crop or commercial livestock that is damaged by wildlife and may be eligible for compensation under this subsection, including criteria for filing a claim for compensation under this subsection.
(3)(a) To prevent or offset wildlife interactions, the department may offer materials or services to a person who applies to the department for assistance in providing mitigating actions designed to reduce wildlife interactions if the actions are designed to address damage that satisfies the criteria for damage established by the commission under this subsection.
(b) The commission shall adopt and maintain by rule criteria for mitigating actions designed to address wildlife interactions that may be eligible for materials and services under this section, including criteria for submitting an application under this section.
(4) An owner who files a claim under this section may appeal the decision of the department pursuant to rules adopted by the commission if the claim:
(a) Is denied; or
(b) Is disputed by the owner and the owner disagrees with the amount of compensation determined by the department.

[2009 c 333 § 55.]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

77.36.110. Eligibility for compensation under this chapter — Adoption of rules.

(1) No owner may receive compensation for wildlife interactions under this chapter unless the owner has, as determined by the department, first:
(a) Utilized applicable legal and practicable self-help preventive measures available to prevent the damage, including the use of nonlethal methods and department-provided materials and services when available under RCW 77.36.100; and
(b) Exhausted all available compensation options available from nonprofit organizations that provide compensation to private property owners due to financial losses caused by wildlife interactions.
(2) In determining if the requirements of this section have been satisfied, the department may recognize and consider the following:
(a) Property losses may occur without future or anticipated knowledge of potential problems resulting in an owner being unable to take preemptive measures.
(b) Normal agricultural practices, animal husbandry practices, recognized standard management techniques, and other industry-recognized management practices may represent adequate preventative efforts.
(c) Under certain circumstances, as determined by the department, wildlife may not logistically or practicably be managed by nonlethal efforts.
(d) Not all available legal preventative efforts are cost-effective for the owner to practicably employ.
(e) There are certain effective preventative control options not available due to federal or state restrictions.
(f) Under certain circumstances, as determined by the department, permitting public hunting may not be a practicable self-help method due to the size and nature of the property, the property's setting, or the ability of the landowner to accommodate public access.
(3) An owner is not eligible to receive compensation if the damages are covered by insurance.
(4) The commission shall adopt rules implementing this section, including requirements that owners document nonlethal preventive efforts undertaken and all permits issued by the department under RCW 77.12.240 and 77.12.150.

[2009 c 333 § 56.]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

77.36.120. Department's duties.

The department shall establish:

(1) The form of affidavits or proof required to accompany all claims under this chapter;

(2) The process, time, and methods used to identify and assess damage, including the anticipated timeline for the initiation and conclusion of department action;

(3) How claims will be prioritized when available funds for reimbursement are limited;

(4) Timelines after the discovery of damage by which an owner must file a claim or notify the department;

(5) Protocols for an owner to follow if the owner wishes to undertake activities that would complicate the determination of damages, such as harvesting damaged crops;

(6) The process for determining damage assessments, including the role and selection of professional damage assessors and the responsibility for reimbursing third-party assessors for their services;

(7) Timelines for a claimant to accept, reject, or appeal a determination made by the department;

(8) The identification of instances when an owner would be ineligible for compensation;

(9) An appeals process for an owner eligible for compensation under RCW 77.36.100 who is denied a claim or feels the compensation is insufficient; and

(10) Other policies necessary for administering this chapter.

[2009 c 333 § 57.]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

77.36.130. Limit on cash compensation — Burden of proof.

(1) Except as otherwise provided in this section and as limited by RCW 77.36.100, 77.36.070, and 77.36.080, the cash compensation portion of each claim by the department under this chapter is limited to the lesser of:

(a) The value of the damage to the property by wildlife reduced by the amount of compensation provided to the claimant by any nonprofit organizations that provide compensation to private property owners due to financial losses caused by wildlife interactions, except that, subject to appropriation to pay compensation for damage to commercial livestock, the value of killed or injured commercial livestock may be no more than two hundred dollars per sheep, one thousand five hundred dollars per head of cattle, and one thousand five hundred dollars per horse; or

(b) Ten thousand dollars.

(2) The department may offer to pay a claim for an amount in excess of ten thousand dollars to the owners of commercial crops or commercial livestock filing a claim under RCW 77.36.100 only if the outcome of an appeal filed by the claimant under RCW 77.36.100 determines a payment higher than ten thousand dollars.

(3) All payments of claims by the department under this chapter must be paid to the owner of the damaged property and may not be assigned to a third party.

(4) The burden of proving all property damage, including damage to commercial crops and commercial livestock, belongs to the claimant.

[2009 c 333 § 58.]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

77.36.140. Chapter represents exclusive remedy.

This chapter represents the exclusive remedy against the state for damage caused by wildlife interactions.

[2009 c 333 § 62.]
Notes: Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

77.36.150. Review of rules and policies. (Expires July 30, 2014.)

The fish and wildlife commission shall formally review the rules and policies adopted under sections *53 through 66, chapter 333, Laws of 2009. If, in the process of reviewing the rules, the fish and wildlife commission identifies recommended statutory changes related to the subject of sections *53 through 66, chapter 333, Laws of 2009 and to the ability of the fish and wildlife commission to fulfill the intent of sections *53 through 66, chapter 333, Laws of 2009, those recommendations must be forwarded to the appropriate policy committees of the legislature during the regularly scheduled 2014 legislative session.

[2009 c 333 § 64.]
Notes: *Reviser's note: Section 53, chapter 333, Laws of 2009 was vetoed by the governor.
Expiration date -- 2009 c 333 § 64: "Section 64 of this act expires July 30, 2014." [2009 c 333 § 70.]
Effective date -- Application -- 2009 c 333 §§ 53-66: See notes following RCW 77.36.010.

WAC 232-36 Wildlife interaction regulations.

WAC Sections

232-36-010. Introduction.
232-36-020. Purpose.
232-36-030. Definitions.
232-36-040. Wildlife/human interaction and conflict resolution for private property damage.
232-36-050. Killing wildlife for personal safety.
232-36-051. Killing wildlife causing private property damage.
232-36-055. Disposal of wildlife killed for personal safety or for causing private property damage.
232-36-060. Director or his/her designee is empowered to grant wildlife control operator certifications.
232-36-065. Director or his/her designee is empowered to issue wildlife control operator permits to address wildlife interactions.
232-36-100. Payment for commercial crop damage — Limitations.
232-36-110. Application for cash compensation for commercial crop damage — Procedure.
232-36-120. Valuation methods for crop damage assessment.
232-36-200. Payment for commercial livestock damage — Limitations.
232-36-210. Application for cash compensation for commercial livestock damage — Procedure
232-36-300. Public hunting requirements.
232-36-400. Commercial crop or livestock damage claim — Dispute resolution.
232-36-500. Unlawful taking or possession of wildlife for personal safety or causing property damage — Penalties.
232-36-510. Failure to abide by the conditions of permits, provide completed forms, or submit required documents or reports.

232-36-010. Introduction.

The Washington department of fish and wildlife's (department) primary responsibility is to preserve, protect, perpetuate, and manage the fish and wildlife species of the state (RCW 77.04.012). The department promotes conservation of fish and wildlife, while providing fishing, hunting, fish and wildlife viewing, and other outdoor recreational opportunities compatible with healthy, diverse, and sustainable fish and wildlife populations. (RCW 77.04.012, 77.04.020, and 77.04.055.)

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-010, filed 6/23/10, effective 7/24/10.]

232-36-020. Purpose.

Public support for the recovery and management of healthy wildlife populations is an important aspect of wildlife conservation. Support for wildlife can diminish when people experience negative interactions with wildlife and damage to private property. The intent of the department is to provide technical advice and assistance to property owners to prevent and mitigate damages caused by wildlife. Compensation may be necessary in situations where preventative measures are not successful or when circumstances, outside the control of the private property owner, get in the way of resolving negative wildlife interactions.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-020, filed 6/23/10, effective 7/24/10.]

232-36-030. Definitions.

Definitions used in rules of the fish and wildlife commission are defined in RCW 77.08.010, and the definitions for wildlife interactions are defined in RCW 77.36.010. In addition, unless otherwise provided, the following definitions are applicable to this chapter:

"Act of damaging" means that private property is in the process of being damaged by wildlife, and the wildlife are on the private property, which contains commercial crops, pasture, or livestock.

"Big game" means those animals listed in RCW 77.08.030.

"Claim" means an application to the department for compensation under this chapter.

"Claimant" means owner of commercial crop or livestock who has filed a wildlife damage claim for cash compensation.

"Commercial crop" means a commercially raised horticultural and/or agricultural product and includes the growing or harvested product, but does not include livestock, forest land, or rangeland. For the purposes of this chapter, Christmas trees and managed pasture grown using agricultural methods including one or more of the following: Seeding, planting, fertilizing, irrigating, and all parts of horticultural trees, are considered a commercial crop and are eligible for cash compensation.

"Commercial livestock" means cattle, sheep, and horses held or raised by a person for sale.

"Compensation" means a cash payment, materials, or service.

"Completed written claim" means that all of the information required on a department crop or livestock damage claim form is supplied and complete, including all supplemental information and certifications required to process the claim.

"Damage" means economic losses caused by wildlife interactions.

"Damage claim assessment" means department approved methods to evaluate crop loss and value caused by deer or elk damage to commercial crops, or livestock losses and value caused by bear, cougar, or wolves.

"Eligible farmer" means an owner who satisfies the definition of eligible farmer pursuant to RCW 82.08.855 (4)(b)(i) through (iv).

"Emergent" means an unforeseen circumstance beyond the control of the landowner or tenant, that presents a real and immediate threat to crops, domestic animals, or fowl.

"Game animal" means wild animals that shall not be hunted except as authorized by the commission.

"Immediate family member" means spouse, state registered domestic partner, brother, sister, grandparent, parent, child, or grandchild.

"Immediate threat of physical harm" means that animal-to-human bodily contact is imminent; and the animal is in attack posture/mode.

"Owner" means a person who has a legal right to commercial crops, commercial livestock, or other private property that was damaged during a wildlife interaction.

"Physical act of attacking" means actual or imminent animal-to-human physical contact.

"Public hunting" means an owner satisfies the "public hunting" requirement for his or her land, as defined in WAC 232-36-300.

"Wild animal" means those species of the class Mammalia whose members exist in Washington in a wild state.

"Wildlife control operator" means a person who has successfully completed the training and obtained one or more levels of certification from the department to assist landowners to prevent or control problems caused by wildlife.

"Wildlife interaction" means the negative interaction and the resultant damage between wildlife and commercial crops, commercial livestock, or other property.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-030, filed 6/23/10, effective 7/24/10.]

232-36-040. Wildlife/human interaction and conflict resolution for private property damage.

The department is the primary source for property owners seeking to determine legal and effective remedies for addressing wildlife interactions. Protection of property using nonlethal techniques is the primary response encouraged by the department. Harassment and/or lethal removal may also be important techniques to protect human safety or to protect property. The following criteria describe the compensation available to protect property that does not qualify under commercial crop or livestock damage:

(1) Unless specifically appropriated by the legislature, cash compensation will not be provided to property owners by the department.

(2) Compensation will be prioritized in the following order:

(a) Property prioritization:

(i) Private property that is primarily designed for public use, where there is a human safety risk not addressed by other entities.

(ii) Private property that directly contributes to commercial crop or livestock production.

(iii) Private property used for other business purposes.

(iv) Public property.

(v) Residential property.

(vi) Recreational property.

(b) Species prioritization:

(i) Damages caused by wildlife listed as endangered, threatened, sensitive, or categories of concern by the state or federal government.

(ii) Damages caused by big game animals.

(iii) Other federal and state protected species.

(iv) Other wildlife species except unclassified species and predatory birds.

(3) The department may make agreements with private landowners to prevent property damage. These agreements may include the use of:

(a) Best management practices to reduce risk of private property damage;

(b) Scaring or hazing materials;

(c) Fencing materials;

(d) Volunteers referred by the department for hazing, fence repair, etc; and

(e) Lethal removal options.

(4) Private property owners must utilize nonlethal abatement techniques prior to requesting other compensation from the department or before utilizing lethal techniques as outlined in WAC 232-36-050.

(a) Use of nonlethal techniques must be documented and consistent with procedures and requirements established by the department.

(b) Evidence of damage (e.g., photographs) must be provided by the property owner.

(c) Property owner must comply with reporting requirements of the department.

(5) Wildlife may not be captured and transported or relocated off the owner's property (parcel where damage occurred) unless:

(a) Authorized by rule of the commission; or

(b) By written permit from the department; and

(c) Owner is in compliance with department rules, permits, and reporting requirements.

(6) The department will establish written procedures for assisting private property owners, using the criteria and priorities provided in this rule. The procedures will include enlistment of partners and volunteers through agreements, permits, and incentives to help mitigate wildlife interactions.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-040, filed 6/23/10, effective 7/24/10.]

232-36-050. Killing wildlife for personal safety.

(1) The fish and wildlife commission is authorized to classify wildlife as game, as endangered or protected species, or as a predatory bird consistent with RCW 77.08.010 and 77.12.020. The commission is also authorized, pursuant to RCW 77.36.030, to establish the limitations and conditions on killing or trapping wildlife that is threatening human safety.

(2) The conditions for killing wildlife vary, based primarily on the classification of the wildlife species and the imminent nature of the threat to personal safety. Additional conditions defined by the department may also be important, depending on individual situations. Killing wildlife for personal safety is subject to all other state and federal laws including, but not limited to, Titles 77 RCW and 232 WAC.

(3) Killing wildlife for personal safety.

(a) It is permissible to kill wild animals engaged in the physical act of attacking a person.

(b) It is permissible to kill game animals posing an immediate threat of physical harm to a person.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-050, filed 6/23/10, effective 7/24/10.]

232-36-051. Killing wildlife causing private property damage.

The fish and wildlife commission is authorized to classify wildlife as game, as endangered or protected species, or as a predatory bird consistent with RCW 77.08.010 and 77.12.020. The commission is also authorized, pursuant to RCW 77.36.030, to establish the limitations and conditions on killing or trapping wildlife that is causing property damage.

The conditions for killing wildlife vary, based primarily on the classification of the wildlife species, the imminent nature of the threat to damage private property, the type of private property damage, and the preventive and nonlethal methods employed by the person prior to the damage event. Additional conditions defined by the department may also be important, depending on individual situations. Killing wildlife to address private property damage is subject to all other state and federal laws including, but not limited to, Titles 77 RCW and 232 WAC.

(1) Killing wildlife causing damage to a commercial crop or commercial livestock.

(a) It is permissible to kill unclassified wildlife, predatory birds, and big game animals that are in the act of damaging commercial crops or livestock, under the following conditions:

(i) Predatory birds (defined in RCW 77.08.010(39)) and unclassified wildlife that are in the act of damaging commercial crops or livestock may be killed with the express permission of the owner at any time on private property, to protect commercial crops or livestock.

(ii) An owner with a valid, written damage prevention agreement with the department may kill an individual (one) big game animal while it is in the act of damaging commercial crops.

(iii) An individual (one) big game animal may be killed during the physical act of attacking livestock or pets.

(iv) Multiple big game animals may be killed while they are in the act of damaging commercial crops or livestock if the owner is issued a kill permit by the department.

(v) A damage prevention agreement or kill permit must include: An approved checklist of the reasonable preventative and nonlethal means that must be employed prior to lethal removal; a description of the properties where lethal removal is allowed; the species and sex of the animal that may be killed; the terms of the agreement/permit; the dates when lethal removal is authorized; who may kill the animal(s); and other conditions developed within department procedural documents.

(b) It is unlawful to kill protected species (as defined in WAC 232-12-011) or endangered species (as defined in WAC 232-12-014) unless authorized by commission rule or with a permit from the department, with the following additional requirements:

(i) Federally listed threatened or endangered species will require federal permits or federal authority, in addition to a state permit.

(ii) All migratory birds are federally protected and may require a federal permit or federal authority, in addition to a state permit.

(2) Killing wildlife causing damage or killing wildlife to prevent private property damage.

(a) Predatory birds (as defined in RCW 77.08.010(39)), unclassified wildlife, and eastern gray squirrels may be killed with the express permission of the property owner at any time, to prevent private property damage on private real property.

(b) Subject to subsection (6) of this section, the following list of wildlife species may be killed with the express permission of the owner, when causing damage to private property: Raccoon, fox, bobcat, beaver, muskrat, mink, river otter, weasel, hare, and cottontail rabbits.

(c) The department may make agreements with landowners to prevent private property damage by wildlife. The agreements may include special hunting season permits such as: Landowner damage prevention permits, spring black bear hunting permits, permits issued through the landowner hunting permit program, kill permits, and Master Hunter permits.

(d) Landowners are encouraged to allow general season hunters during established hunting seasons on their property to help minimize damage potential and concerns.

(3) Wildlife control operators may assist property owners under the conditions of their permit, as established in WAC 232-36-060 and 232-36-065.

(4) Tribal members may assist property owners under the conditions of valid comanagement agreements between tribes and the department. Tribes must be in compliance with the agreements including, but not limited to, adhering to reporting requirements and harvest restrictions.

(5) Hunting licenses and tags are not required to kill wildlife under this section, unless the killing is pursuant to

subsections (2)(c) and (d) of this section. Tribal members operating under subsection (4) of this section are required to meet tribal hunting license, tag, and permit requirements.

(6) Except as specifically provided in a permit from the department or a rule of the commission, people taking wildlife under this rule are subject to the laws and rules of the state including, but not limited to, those found in Titles 77 RCW and 220 and 232 WAC.

[Statutory Authority: RCW 77.04.012, 77.04.055, 77.12.047, and 77.36.030. 10-23-026 (Order 10-291), § 232-36-051, filed 11/8/10, effective 12/9/10. Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-051, filed 6/23/10, effective 7/24/10.]

232-36-055. Disposal of wildlife killed for personal safety or for causing private property damage.

The fish and wildlife commission is authorized pursuant to RCW 77.36.030, to establish the limitations and conditions on disposal of wildlife killed or trapped because they were threatening human safety or causing property damage.

Except as specifically provided in a permit from the department or a rule of the commission, people taking wildlife under this title are subject to the laws and rules of the state including, but not limited to, those found in Titles 77 RCW and 220 and 232 WAC. Wildlife taken under this chapter remains the property of the state and may be disposed of in the manner and under the conditions that follow:

(1) Wildlife taken under WAC 232-36-050 (1)(b) and 232-36-051 (1)(b), and 232-36-051 (1)(a)(iii) must be reported to the department within twenty-four hours, and the animal and all parts must be provided to the department or its designees.

(2) Wildlife taken under WAC 232-36-051 (1)(a)(i) and (ii) becomes the property of the private landowner and may be lawfully disposed consistent with state laws and rules including, but not limited to, Titles 77 RCW and 232 WAC.

(3) Wildlife taken under WAC 232-36-051 (1)(a)(iv) must be disposed of consistent with the conditions identified under the permit.

(4) Wildlife taken under WAC 232-36-051(2) may be lawfully possessed by the owner, licensee, and/or permit holder. Possession of legally taken wildlife by tribal members is subject to the laws of their tribe and must be consistent with their agreement with the state.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-055, filed 6/23/10, effective 7/24/10.]

232-36-060. Director or his/her designee is empowered to grant wildlife control operator certifications.

For purposes of training individuals to assist landowners with employing nonlethal management techniques, or to harass, kill, trap, release, and dispatch animals that are causing damage to private property, the director or his/her designee may issue wildlife control operator (WCO) certifications.

(1) To qualify for WCO certification, applicants must:

(a) Be at least eighteen years of age;

(b) Take and complete the department's WCO certifications course;

(c) Be certified by the department and have the equipment, knowledge, and ability to control the wildlife species causing conflict or property damage;

(d) Be legally eligible to possess a firearm and without a felony or domestic violence conviction including, but not limited to, convictions under chapter 9.41 RCW, unless firearm possession rights have been restored;

(e) Not have a gross misdemeanor fish and wildlife conviction within the last five years; and

(f) Pay the enrollment fee for certification training/education. After July 1, 2010, this fee shall be fifty dollars (RCW 77.12.184).

(2) Once a person is granted WCO certification, he or she must apply for a permit pursuant to WAC 232-36-065 in order to harass, kill, trap, release, or dispatch animals causing damage to private property.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-060, filed 6/23/10, effective 7/24/10.]

232-36-065. Director or his/her designee is empowered to issue wildlife control operator permits to address wildlife interactions.

For purposes of assisting property owners in managing animals causing damage to private property, the director or his/her designee may issue permits to wildlife control operators (WCOs). Only WCOs who are certified by the department qualify for such a permit.

(1) If the certification for a WCO included training for the use of live traps, the WCO may use live traps to capture any animal causing an animal problem, as that term is defined in RCW 77.15.192.

(2) Depending on a WCO's certification training, he or she may use body gripping traps, but only if he or she complies with RCW 77.15.194.

(3) WCOs who trap wildlife under the authority of a department permit may not release or dispose of such wildlife without the consent of the property owner where the wildlife is to be released or disposed.

(4) WCOs must submit a complete annual report of all control activity on the form supplied by the department. The report must be received or postmarked on or before the twentieth day of April each year. Failure to submit a report may result in the department revoking the WCO's certification and permit and suspending the person's right to future certification and permits.

(5) WCO certification and permits will be revoked and future certification and permits denied by the director or issuing authority when, in the judgment of the department:

(a) Information contained in a WCO's application was inaccurate or false;

(b) The WCO fails to comply with department statutes or rules; or

(c) The WCO violates a trapping or other wildlife law.

(6) A WCO who provides false or misleading information in his or her WCO certification application may be punished under RCW 9A.76.175 or 40.16.030. A WCO who fails to comply with department statutes or rules as required by his or her WCO certification and permit may be punished under RCW 77.15.750. A WCO who violates trapping or other wildlife laws may be punished under the appropriate statute in Title 77 RCW for that crime.

(7) If the initial application for WCO certification is denied or revoked, or the application to renew a WCO's certification is denied or revoked, the department shall provide the applicant, in writing, a statement of the specific reason(s) for the denial or revocation. The applicant may request an appeal in accordance with chapter 34.05 RCW. Appeal requests shall be filed in writing and returned within twenty days from the mailing date of the denial and be addressed to WDFW Legal Services Office, 600 Capitol Way North, Olympia, Washington 98501-1091.

(8) WCO certification and permits are valid for three years.

(9) It is unlawful to trap, harass, or otherwise control wildlife on the property of another for a fee or other consideration without a WCO certification and permit.

(10) The department may develop additional conditions and procedures, to include training requirements, for WCOs consistent with this rule.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-065, filed 6/23/10, effective 7/24/10.]

232-36-100. Payment for commercial crop damage — Limitations.

Owners, who have worked with the department to prevent deer and elk damage, but continue to experience losses, may be eligible to file a damage claim and receive cash compensation from money appropriated by the legislature. Damages payable under this section are limited to the lost or diminished value of a commercial crop, whether growing or harvested, and shall be paid only to the owner of the crop at the time of damage, without assignment. Cash compensation for claims from deer and elk damage shall not include damage to other real or personal property, including other vegetation or animals, lost profits, consequential damages, or any other damages. The department is authorized to pay up to ten thousand dollars to the owner per claim.

Claims for cash compensation will be denied when:

(1) The claim is for a noncommercial crop;

(2) The owner of the commercial crop does not meet the definition of "eligible farmer" in RCW 82.08.855 (4)(b)(i) through (iv);

(3) The loss estimate is less than one thousand dollars;

(4) No claim will be processed unless the owner provides the department with an approved checklist of the preventative and nonlethal means that have been employed, and the owner has complied with the terms and conditions of his or her agreement(s) with the department;

(5) An owner or lessee has accepted noncash compensation to offset crop damage in lieu of cash. Acceptance of noncash compensation will constitute full and final payment for crop damages within the growing season of the damaged crop;

(6) Damages to the commercial crops claimed are covered by insurance or are eligible for payment from other entities. Any portion of the actual damage not covered by others is eligible for compensation from the department;

(7) The property where the damage occurred was not open to public hunting consistent with WAC 232-36-300 for the species causing the damage, unless, as determined by the department, the property is inconsistent with hunting or hunting would not address the damage problem. This includes all properties owned or leased by the owner adjacent to, contiguous to, or in the vicinity of the property where crop damage occurred;

(8) The crop is grown or stored on public property;

(9) The owner or lessee fails to provide on-site access to the department or designee for inspection and investigation of alleged damage or to verify eligibility for a claim;

(10) The owner has not provided a completed written claim form and all other required information, or met required timelines prescribed within WAC 232-36-110;

(11) The owner fails to sign a statement affirming that the facts and supporting documents are truthful to the best of the owner's knowledge;

(12) The owner or designee has harvested commercial crops without an investigation completed under the direction of the department; or

(13) The department has expended all funds appropriated for payment of such claims for the current fiscal year.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-100, filed 6/23/10, effective 7/24/10.]

232-36-110. Application for cash compensation for commercial crop damage — Procedure.

Pursuant to this section, the department may distribute money appropriated by the legislature to pay commercial crop damage caused by wild deer or elk in the amount of up to ten thousand dollars per claim, unless following an appeal the department is ordered to pay more (see RCW 77.36.130(2)). The department shall develop claim procedures and application forms consistent with this section for cash compensation of commercial crop damage. Partnerships with other public and private organizations to assist with completion of applications, assessment of damage, and to provide funding for compensation are encouraged.

Filing a claim:

(1) Owners who have worked with the department to prevent deer or elk damage, yet who still experience loss and meet eligibility requirements, may file a claim for cash compensation.

(2) The claimant must notify the department within seventy-two hours of discovery of crop damage and at least seventy-two hours prior to harvest of the claimed crop.

(3) A complete, written claim must be submitted to the department within sixty days of when the damage stops.

(4) Owners may only file one claim per year. Multiple partners in a farming operation are considered one owner. Operations involving multiple partners must designate a "primary grower" to receive payment from the department.

(5) The claim form declaration must be signed, affirming that the information provided is factual and truthful per the certification set out in RCW 9A.72.085, before the department will process the claim.

(6) In addition to a completed claim form, an applicant must provide:

(a) A copy of applicant's Schedule F of Form 1040, Form 1120, or other applicable forms filed with the Internal Revenue Service indicating the applicant's gross sales or harvested value of commercial crops for the previous tax year.

(b) The assessment method used consistent with WAC 232-36-120, valuation of property damage.

(c) Applicant must provide proof of ownership of claimed commercial crops or contractual lease of claimed commercial crops consistent with department procedural requirements for submission of documents.

(d) Written documentation of approved methodology used to assess and determine final crop loss and value.

(e) Applicant must provide records documenting average yield on claimed crop and parcel, certified yield reports, production reports and weight certificates completed at the time weighed for claimed year, and other applicable documents that support yield loss and current market price. Current market price will be determined less transportation and cleaning costs when applicable.

(f) Declaration signed under penalty of perjury as provided in RCW 9A.72.085, indicating that the applicant is eligible for the claim, meets eligibility requirements listed under this section, and that all claim evaluation and assessment information in the claim application is to the best knowledge of the claimant true and accurate.

(g) Copy of the insurance policy and payment on the commercial crop where loss is claimed.

(h) Copy of application for other sources of loss compensation and any payment or denial documentation.

Damage claim assessment:

(7) Damage claim assessment of amount and value of commercial crop loss is the primary responsibility of the claimant. A crop damage evaluation and assessment must be conducted by a licensed crop insurance adjustor:

(a) The owner must submit a damage claim assessment prepared by a crop insurance adjustor licensed by the state of Washington and certified by the federal crop insurance service.

(b) The department will provide the claimant with a list of approved adjustors. The owner must select an adjustor from the approved list and arrange for the completion of a crop damage assessment. Adjustor fees will be the shared responsibility of the owner and the department.

(c) The department or the owner may accept the damage claim assessment provided by the licensed adjuster or may hire a state licensed adjustor of their choosing and conduct a separate assessment or evaluation of the crop loss amount and value. The party hiring an adjustor to conduct a separate assessment or evaluation is responsible for payment of all fees.

(8) Disagreement between the claimant and the department over the crop loss value may be settled through an adjudicative proceeding.

Settlement of claims:

(9) Subject to money appropriated to pay commercial crop damage, undisputed claims will be paid, less one-half of the crop adjustor's fee or a maximum of six hundred dollars for the owner's share of the crop adjustor's fee. The crop adjustor's fee is not subject to the ten thousand dollar payment limit per owner.

(10) Compensation paid by the department, in addition to any other compensation received by the claimant, may not exceed the total value of the assessed crop loss.

(11) The owner will be notified by the department upon completion of the evaluation and has sixty days to accept or appeal the department's offer for settlement of the claim, or the claim is considered satisfied and not subject to appeal.

(12) The department shall prioritize payment for commercial crop damage in the order the claims were received or upon final adjudication of an appeal. If the department is unable to make a payment for commercial crop damage during the first fiscal year of a biennium, the claim shall be held over until the following fiscal year when funds become available. Claims that are carried over will take first priority and receive payment before any new claims are paid. Claims will not be carried from one biennium to the next.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-110, filed 6/23/10, effective 7/24/10.]

232-36-120. Valuation methods for crop damage assessment.

Several methods may be used to determine the extent of a crop damaged by deer and elk and the lost value of the crop resulting from the damage. Assessment methods used by qualified crop adjustors licensed by the state and certified by the federal crop insurance service will be accepted by the department. Evaluation of crop losses must consider other impacts to crop production, including fertilization, irrigation, precipitation, weather, timing of planting or harvest, and weed control. The following methods are listed in preferred order based on reliability:

(1) Amount consumed - relies on wildlife-proof exclosures in the field; clipping similar sized plots inside and outside of exclosures; then comparing yields.

(2) Amount of stored crops consumed or damaged - determine the bales or pounds of stored crops consumed or destroyed; then determine replacement value.

(3) Replacement value of horticultural trees lost as a result of damage; partial loss due to damage can be estimated per tree based on the percentage destroyed.

(4) Damage vs. undamaged areas - using random sampling methods to compare the yields of damaged to undamaged portions of a field or two similar fields can provide an estimate of loss. Comparing similar fields assumes the fields are truly "similar" (soil type, aspect, slope, irrigation, fertilization, stand age, etc.).

(5) Animal use - count the number of animals causing damage and the number of days they were present; then estimate the percentage of daily intake provided by the crop (generally less than fifty percent), and the amount of waste, trampling, or trailing; the result should also consider the timing of the damage and potential recovery of the vegetation prior to crop harvest.

(6) Decrease from average yield - historic yields can be used for comparison; the difference between average yield and current yield may shed light on the extent of damage; changing weather or crop growing conditions from one year to the next make this technique less reliable.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-120, filed 6/23/10, effective 7/24/10.]

232-36-200. Payment for commercial livestock damage — Limitations.

Owners who have worked with the department to prevent depredation but continue to experience losses, or who experience unforeseen losses, may be eligible to file a damage claim and receive cash compensation. Cash compensation will only be provided to livestock owners by the department when specifically appropriated by the legislature. Damages payable under this section are limited to the lost or diminished value of commercial livestock caused by wild bears, cougars, or wolves and shall be paid only to the owner of the livestock at the time of damage, without assignment. Cash compensation for livestock losses from bears, cougars, and wolves shall not include damage to other real or personal property, including other vegetation or animals, lost profits, consequential damages, or any other damages including veterinarian services. The department is authorized to pay up to two hundred dollars per sheep and one thousand five hundred dollars per head of cattle or per horse, and no more than ten thousand dollars to the commercial livestock owner per claim.

Claims for cash compensation will be denied when:

(1) Funds for livestock compensation have not been specifically appropriated by the legislature;

(2) The claim is for livestock other than sheep, cattle, or horses;

(3) The owner of the commercial livestock does not meet the definition of "eligible farmer" in RCW 82.08.855 (4)(b)(i) through (iv);

(4) The loss estimate is less than five hundred dollars;

(5) The owner fails to provide the department with an approved checklist of the preventative and nonlethal means that have been employed, or the owner failed to comply with the terms and conditions of his or her agreement(s) with the department;

(6) The owner has accepted noncash compensation to offset livestock losses in lieu of cash. Acceptance of noncash compensation will constitute full and final payment for livestock losses within a fiscal year;

(7) Damages to the commercial livestock claimed are covered by insurance or are eligible for payment from other entities. However, any portion of the damage not covered by others is eligible for filing a claim with the department;

(8) The owner fails to provide on-site access to the department or designee for inspection and investigation of alleged attack or to verify eligibility for claim;

(9) The owner has not provided a completed written claim form and all other required information, or met required timelines prescribed within this chapter;

(10) No claim will be processed if the owner fails to sign a statement affirming that the facts and supporting documents are truthful to the best of the owner's knowledge;

(11) The owner or designee has salvaged or rendered the carcass or allowed it to be scavenged without an investigation completed under the direction of the department; or

(12) The department has expended all funds appropriated for payment of such claims for the current fiscal year.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-200, filed 6/23/10, effective 7/24/10.]

232-36-210. Application for cash compensation for commercial livestock damage — Procedure.

Pursuant to this section, the department may distribute money specifically appropriated by the legislature to pay commercial livestock losses caused by wild bear, cougar, or wolves in the amount of up to ten thousand dollars per claim unless, following an appeal, the department is ordered to pay more (see RCW 77.36.130(2)). The department will develop claim procedures and application forms consistent with this section for cash compensation of commercial livestock losses. Partnerships with other public and private organizations to assist with completion of applications, assessment of losses, and to provide funding for compensation are encouraged.

Filing a claim:

(1) Owners who have worked with the department to prevent livestock depredation, yet who still experience loss or losses that occur under emergent situations, may file a claim for cash compensation if they meet eligibility requirements.

(2) Claimant must notify the department within twenty-four hours of discovery of livestock attack.

(3) Damage claim assessment of amount and value of commercial livestock loss is the primary responsibility of the claimant.

(4) Assessment of loss will be conducted by the department:

(a) The owner must provide access to department staff or designees to investigate the cause of death or injury to livestock and use reasonable measures to protect evidence at the depredation site.

(b) Federal officials may be responsible for the investigation when it is suspected that the attack was by a federally listed species.

(5) Claimant must request a damage claim application within ten days of a loss.

(6) A complete, written claim must be submitted to the department within sixty days of an attack on commercial livestock.

(7) The claim form declaration must be signed, affirming that the information provided is factual and truthful, before the department will process a claim.

(8) In addition to a completed claim form, an applicant must provide:

(a) A copy of applicant's Schedule F of Form 1040, Form 1120, or other applicable forms filed with the Internal

Revenue Service indicating the applicant's gross sales or value of commercial livestock for the previous tax year.

(b) Claimant must provide proof of legal ownership or contractual lease of claimed livestock.

(c) Claimant must provide records documenting livestock value based on current market price.

(d) Declaration signed under penalty of perjury indicating that the applicant is eligible for the claim, meets eligibility requirements listed under this section, and all claim evaluation and assessment information in the claim application is to the best knowledge of the claimant true and accurate.

(e) Copy of any insurance policy covering livestock loss claimed.

(f) Copy of application for other sources of loss compensation and any payment or denial documentation.

Settlement of claims:

(9) Subject to money appropriated to pay for commercial livestock losses, undisputed claims will be paid up to ten thousand dollars.

(10) Compensation paid by the department, in addition to any other compensation, may not exceed the total value of the assessed livestock loss.

(11) Upon completion of the evaluation, the department will notify the owner of its decision to either deny the claim or make a settlement offer (order). The owner has sixty days from the date received to accept the department's offer for settlement of the claim or to submit an appeal of the order. The response must be in writing and the signed document may be mailed or submitted by fax or e-mail. If no written acceptance or request for appeal is received, the offer is considered rejected and not subject to appeal.

(12) The department will prioritize payment for commercial livestock losses in the order the claims were received or upon final adjudication of an appeal. If the department is unable to make a payment for commercial livestock losses during the first fiscal year of a biennium, the claim shall be held over until the following fiscal year when funds become available. Claims that are carried over will take first priority and receive payment before any new claims are paid. Claims will not be carried from one biennium to the next.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-210, filed 6/23/10, effective 7/24/10.]

232-36-300. Public hunting requirements.

"Public hunting" generally means that land is open for licensed hunters. The intent of the provision in this chapter is to allow hunting at an appropriate time, manner, and level to help prevent property damage.

As specified in WAC 232-36-100, cash compensation will only be paid when the property where the damage occurred is open to public hunting. Public hunting is defined as:

(1) The landowner opens the property on which the damage or loss is claimed for general access to all licensed hunters during the season prior to the occurrence of damage; or

(2) The landowner has entered into and complied with any agreement with the department covering the land(s) on which the damage is claimed. Access agreements shall require that:

(a) The land is open to general access to licensed hunters; or

(b) The landowner allows the department to select a limited number of hunters who are authorized to access the land; or

(c) The landowner and the department determine how hunters will be selected and authorized to hunt on the landowner's property in order to effectively prevent damage.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-300, filed 6/23/10, effective 7/24/10.]

232-36-400. Commercial crop or livestock damage claim — Dispute resolution.

For claims where the owner has met all claim eligibility criteria and procedures, but ultimately rejects the written settlement offer (order) for crop or livestock loss and/or value assessment, the provisions of this section shall apply:

Informal resolution:

(1) If the owner rejects the property loss or value assessment and would like to discuss a negotiated settlement, he or she can request a meeting by notifying the department in writing within ten days of receiving the settlement offer or claim denial (order).

(2) A department representative and the owner or designee(s) will meet and attempt to come to mutual resolution.

(3) Monetary compensation or noncash compensation, mutually agreed upon by both the department and owner, shall be binding and constitute full and final payment for claim.

(4) If parties cannot agree upon damages, the owner may elect to apply for an adjudicative proceeding pursuant to chapter 34.05 RCW.

Adjudicative proceeding:

(5) If the owner wishes to appeal the claim denial or the department settlement offer (order), the owner may request an adjudicative proceeding consistent with chapter 34.05 RCW within sixty days of receiving the original order.

(6) The request must comply with the following:

(a) The request must be in writing, and the signed document may be mailed or submitted by fax or e-mail;

(b) It must clearly identify the order being contested (or attach a copy of the order);

(c) It must state the grounds on which the order is being contested and include the specific facts of the order that are relevant to the appeal; and

(d) The request must identify the relief being requested from the proceeding (e.g., modifying specific provisions of the order).

(7) The proceeding may only result in the reversal or modification of an order when the preponderance of evidence shows:

(a) The order was not authorized by law or rule;

(b) A fact stated in the order is materially incorrect;

(c) The award amount offered is inconsistent with applicable and accepted procedures, rule, and/or law; or

(d) Material information or evidence was made available by the owner at the time of the damage assessment, but was not considered in the order.

(8) The burden of proof is on the appellant (owner) to show that he or she is eligible for a claim and that the damage assessment is reliable (see RCW 77.36.130(4)).

(9) Findings of the hearings officer are subject to the annual funding limits appropriated by the legislature and payment rules (WAC 232-36-110(12) and 232-36-210(9)) of the commission.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-400, filed 6/23/10, effective 7/24/10.]

232-36-500. Unlawful taking or possession of wildlife for personal safety or causing property damage — Penalties.

(1) The unlawful trapping, killing, or possession of wildlife is punishable under Title 77 RCW including, but not limited to, the following:

(a) RCW 77.15.120 for endangered wildlife;

(b) RCW 77.15.130 for protected wildlife;

(c) RCW 77.15.140 for unclassified wildlife;

(d) RCW 77.15.170 for wildlife wastage;

(e) RCW 77.15.190 and 77.15.194 for unlawful trapping or traps;

(f) RCW 77.15.290 for transportation of wildlife;

(g) RCW 77.15.400 for wild birds;

(h) RCW 77.15.410 for big game;

(i) RCW 77.15.420 for illegally taken or possessed wildlife; and

(j) RCW 77.15.430 for wild animals.

(2) A person trapping or killing wildlife who fails to notify the department pursuant to WAC 232-36-055 may be in violation of RCW 77.15.750(1).

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-500, filed 6/23/10, effective 7/24/10.]

232-36-510. Failure to abide by the conditions of permits, provide completed forms, or submit required documents or reports.

(1) Failure to abide by the conditions of permits is a misdemeanor pursuant to RCW 77.15.750.

(2) Failure to provide reports or abide by the conditions of landowner agreements is an infraction pursuant to RCW 77.15.160.

(3) Failure to abide by the conditions of wildlife conflict operator permits is a misdemeanor pursuant to RCW

77.15.750.

(4) A person who provides false or misleading information required by this chapter may be in violation of RCW 9A.76.175 or 40.16.030.

[Statutory Authority: RCW 77.04.012, 77.04.020, and 77.04.055. 10-13-182 (Order 10-156), § 232-36-510, filed 6/23/10, effective 7/24/10.]

Maletzke, Benjamin T. Washington State University, Pullman, WA 99164
Wielgus, Robert B. Washington State University, Pullman, WA 99164

Abstract

Washington Department of Fish and Wildlife contracted with Washington State University to create a wolf population model derived from vital rates based on empirical data from other states in the Northwestern United States. We applied an existing habitat model for Idaho, Montana, and Wyoming to the Washington landscape to determine extent of probable recolonization. Wolf territory size was determined by data from Northwest Montana, Central Idaho, and an average of the two areas. We created three metapopulation landscapes based on pack territories evenly distributed across the state where average probability of recolonization for individual pack territories exceeded 15% and 50%. Using RAMAS GIS, we created a female only, stage matrix model with dispersal based on population metrics from Idaho and Northwest Montana. This model is intended to be a versatile and adaptive tool for managers to project potential recovery and extirpation probabilities for different management regimes and can be easily modified with empirical data as wolves recolonize Washington.

Introduction

Washington Department of Fish and Wildlife (WDFW) contracted with Washington State University (WSU) to develop a wolf population model based on population vital rates (i.e. survival, fecundity, territory size, etc) reported in peer review and agency literature or empirical data obtained for wolf populations from the Northwestern states (ID, MT, WY). Additionally, the agency requested development of RAMAS computer program metapopulation files that WDFW could use to explore wolf population dynamics under the targeted recovery levels and different management scenarios considered in its draft Wolf Conservation and Management Plan (Wiles and Allen 2009)

Extensive spatial and demographic datasets have been collected on wolves recolonizing Idaho and Western Montana. Spatially explicit population models and recolonization probability models have been derived to predict potential habitat suitability in several areas not yet recolonized by wolves (Larsen 2004, Carroll et al. 2006, Oakleaf et al. 2006) and were reported in WDFW's draft Wolf Conservation and Management Plan for Washington (Wiles and Allen 2009). These habitat models can provide a tool to wildlife managers by predicting potential numbers and distribution of wolves in areas where they will likely recolonize.

Our objective was to use research on landscape and population metrics (habitat selection, survival, fecundity, dispersal, etc) from existing wolf populations to create a model that represent population dynamics from Idaho and Montana that could serve as a baseline to model potential population dynamics in Washington. Specifically we created three landscape dispersal models for Washington based on average pack territory size and the distribution of potential habitat. We used survival and fecundity data as well as knowledge of wolf social pack structure to create landscape population models in RAMAS GIS to project potential recovery and extirpation probabilities for different management regimes in Washington.

Study Area

We developed a landscape population viability model for the three recovery regions (Figure 1) in Washington identified in the draft 2009 Wolf Conservation and Management Plan (Wiles and Allen 2009). The Eastern Washington Region was the area of the state east of highway 97, 17, and 395. The North Cascades Region included the portion of the state north of Interstate 90 and west of highway 97 and 17. The Southern Cascades and Northwest Coast recovery region included the Cascades south of Interstate 90 to the Oregon border and the Coastal region of Washington.

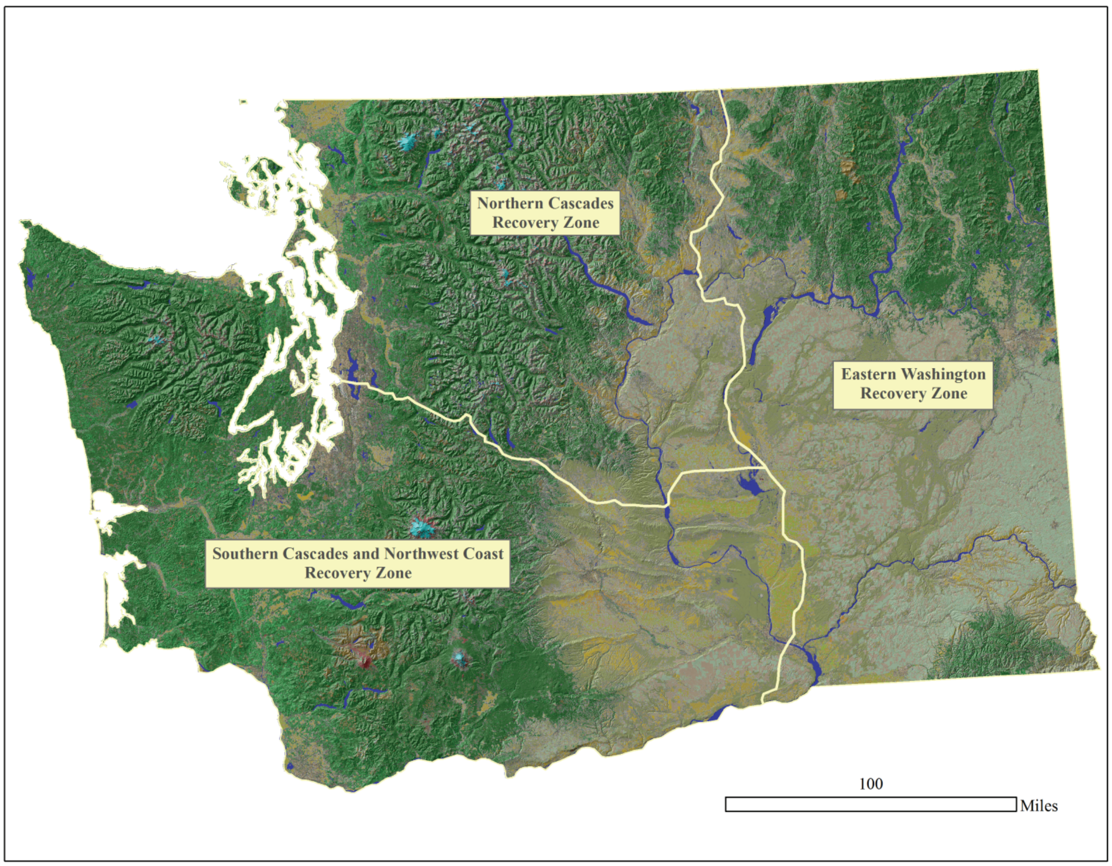


Figure 1. Wolf recovery regions identified in the draft 2009 EIS/Wolf Conservation and Management Plan for Washington (Wiles and Allen 2009).

Methods

We used a habitat model developed by Oakleaf et al. (2006) to quantify relative probabilities of habitat use to determine areas where wolves may potentially inhabit Washington. The model parameters included forest cover, human density, ungulate density, and density of domestic sheep. The equation is $P_{wolves} = -4.457 + (0.057)$ Forest Cover + (-0.87) Human density + (1.351) Elk + (-

1.735) Sheep density (Oakleaf et al. 2006). We used the Spatial Analyst extension in ArcGIS 9.1 to calculate the model probabilities.

Landscape Model

We used the National Land Cover Data (30 m resolution) to develop a map for the percent forest cover. We isolated the forest cover types and created a new raster calculating the percent forest cover within 9 km^2 grid.

Human census data were derived from information collected in 2000 by U.S. Bureau of Census. We converted census data from census block groups to the number of people per square kilometer. We then created a raster layer of human population density for a 9 km grid.

Ungulate density data were based on unpublished harvest statistics provided by Washington Department of Fish and Wildlife. All successful general harvest and permit hunts were tallied for each game management unit (GMU) and divided by the total area of each GMU (Oakleaf et al. 2006). The total harvest per GMU was then averaged over a three-year period from 2003 to 2005 to estimate relative density of deer and elk. Oakleaf et al. (2006) averaged total harvest over a 5-year period, however significant changes in Washington's GMU and permit boundaries only allowed a consistent average of 3 years.

Domestic sheep density was calculated from U.S. Department of Agriculture statistics on total sheep per county from 1997 - 2002. The density estimate for domestic sheep excluded any national parks or wilderness areas where sheep would not be allowed to free range. Domestic sheep may be free ranged in separate counties from the locations of the ranch where they are tallied so the impacts to wolves may be different than the relative densities used in the analysis and further investigation of range allotments may be needed to better understand this impact.

Hypothetical Pack Territories

Using the statewide recolonization probability layer as the extent of the outer boundary for hypothetical pack territories, we generated regular spaced points with alternating rows aligned at the midpoint. Points were spaced regularly based on the diameter of average pack territory size. We created circles with a radius of 13.8 km for Northwest Montana data (Rich 2010), 17.2 km for Central Idaho data (USFWS 1999), and 15.6 km as an average of both areas and saturated the entire landscape of Washington.

We overlaid the hypothetical packs with the habitat probability layer (Oakleaf et al. 2006) and calculated the average probability of recolonization for wolves for each territory. Any territory with an average probability > 15% was included in the initial landscape population model. Packs on the border were identified as dispersal corridors or potential source populations. We converted the centroid locations of the pack territories to grids with a cell size of 1 km^2 and imported the territory locations into RAMAS GIS (Akcakaya 2002) to create three different landscapes (Central Idaho recovery, Northwest Montana recovery, mean of both) for the metapopulation models.

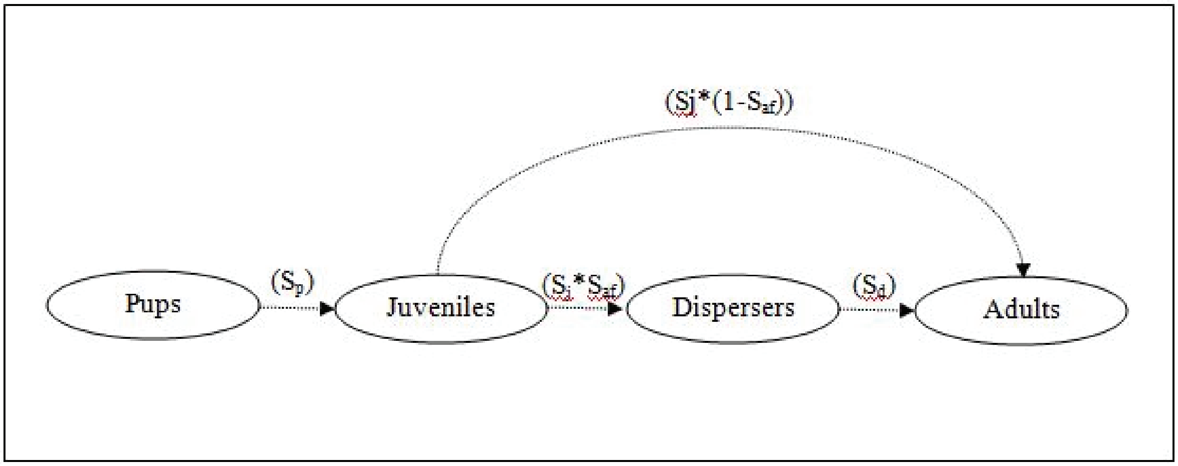


Figure 2. Life cycle graph for a stage matrix model for wolves. Stages include pups (0-1 yr old), juveniles (1-2 yr old), dispersers (3-4 yr old), and adults (4+) with associated transition probabilities where S_p is annual survival rate of pups, S_j is the annual survival rate of juveniles, S_d is the annual survival rate of dispersers, and S_{af} is the annual survival rate of adult females.

RAMAS Landscape Population Model

We created a female only - four stage matrix model in RAMAS GIS – Metapopulation model (Akcakaya 2002) where individual packs were considered populations in a statewide metapopulation analysis.

We then created a stage matrix (Table 1) which incorporated transition equations from stage to stage. Stages (Figure 2) included pups (0-1 year of age), juveniles (1-2 year olds), dispersers (3-4 year olds), and adults (4+). Transitions for fecundity of adult females was the product of average litter size of newborns (4.12) observed in the Central Idaho recovery area (for successfully reproducing females) * percentage of successfully reproductive females (70%) * sex ratio (50%) * survival rate of adult females (Lambert et al. 2006).

In Idaho, litter size was determined by den site and rendezvous site inspections (Mitchell et al. 2008) and we calculated the average litter size from annual averages presented in the 2005 – 2009 annual Idaho wolf progress reports (Mack et al. 2010, Nadeau et al. 2009, Nadeau et al. 2008, Nadeau et al. 2007, Nadeau et al. 2006). The data on litter size from Northwest Montana was estimated primarily from aerial and ground observations of pack denning in spring as well as composition observations during the fall months (Mitchell et al. 2008). With few actual den site inspections in Northwest

Table 1. Stage matrix transition probabilities for a Quantitative Population Viability Analysis using parameter estimates from Northwest Montana (a) and Central Idaho Recovery area (b).

a. Northwest Montana

	Pups	Juveniles	Dispersers	Adults
Pups	0.00	0.35	1.04	1.04
Juveniles	0.81	0.00	0.00	0.00
Dispersers	0.00	0.52	0.00	0.00
Adults	0.00	0.20	0.72	0.72

b. Central Idaho Recovery area

	Pups	Juveniles	Dispersers	Adults
Pups	0.00	0.37	1.14	1.14
Juveniles	0.89	0.00	0.00	0.00
Dispersers	0.00	0.64	0.00	0.00
Adults	0.00	0.15	0.79	0.79

Montana, the litter counts may have been underestimated so we used Central Idaho estimates of litter size for all fecundity calculations.

The percentage of successfully reproductive females was determined by the ratio of packs with pups in December each given year divided by the total number of packs for that year in a given recovery area (Smith et al. 2010, Mack et al. 2010). Fecundity of juveniles was 1/3 that of dispersers and adult females (Boyd and Pletscher 1999).

Transition probabilities from stage to stage were the products of stage specific survival rates * percentage of that group moving to a specific stage. For example the transition from juvenile to adult breeder in a pack was S_j (0.72) * 1-S_{af} (0.28) = 0.20 or the probability of a juvenile female surviving times the probability of a resident adult female dying (Table 1a). The transition from juvenile to disperser was S_j (0.72) * S_{af} (0.72) = 0.52 or the probability of a juvenile female surviving times the probability of a resident adult female surviving in a pack. Transitions from dispersers to adults and adults to adults were simply their survival rates.

Survival rates for wolves in Central Idaho was estimated from data collected between 1995 – 2004 and Northwest Montana from 1982 -2004 (Table 2, Smith et al. 2010). Due to higher levels of mortality and potentially demographic stochasticity while at lower numbers, the wolf population in Northwest Montana grew at a much slower rate than the Central Idaho Recovery area population.

Table 2. Demographic parameters including survival of pups (S_p), juveniles (S_j), dispersers (S_d), and adult females (S_{af}), maternity (m_x), fecundity (F_x), and growth rate (R) for wolf populations in Central Idaho, Northwest Montana, and Greater Yellowstone areas.

Demographic parameters	Location of data set	
	CIR[a]	NWMT[b]
S_p	0.89 (0.18)	0.81[c](0.16)
S_j	0.79 (0.18)	0.72[d] (0.16)
S_d	0.79 (0.18)	0.72[d] (0.16)
S_{af}	0.79 (0.18)	0.72[d] (0.16)
m_x	2.884[e]	2.884[e]
F_x	1.14	1.04
R	1.34	1.22

[a] Central Idaho Recovery area, Smith et al. (2010).
[b] Northwest Montana, Smith et al. (2010).
[c] NWMT pup survival is 9% lower than CIR, Smith et al. (2010).
[d] NWMT survival rates were calculated from weighted average of 1987 – 2004, Smith et al. (2010).
[e] Litter size and ratio of reproductive packs/total packs from Mack et al. (2010), Nadeau et al. (2009), Nadeau et al. (2008), Nadeau et al. (2007), Nadeau et al. (2006).

The population trend in Northwest Montana from 1995 (minimum 66 wolves) through 2004 (minimum 59 wolves) was stable to slightly declining with an intrinsic rate of growth rate of 0.988 during that time period (Sime et al. 2011). The pup survival during that time period as reported by Smith et al. (2010) was only 0.398 (0.273, 0.579; 95% CI; n = 27 deaths) and the adult survival was 0.68 (0.643, 0.740; 95% CI; n=107 deaths) which when we input into the model displayed a similar decline in the intrinsic rate of growth for the population. From 2004 to 2010 the population increased from 59 to 374 wolves (Sime et al. 2011), displaying an intrinsic rate of growth of 1.36 which was similar to the population growth observed in Central Idaho following the reintroduction (Mack et al. 2010). We used the weighted (# animals) adult survival data from 1987 – 2004 in Northwest Montana because sample sizes were small and unreliable from 1982 to 1986. The survival for adult wolves (Table 2) from 1987 – 2004 in Northwest Montana was 0.72 (0.16) which was 9% lower than what we observed in Central Idaho. We did not have empirical data on pup survival over the same time period so we decreased the Idaho pup survival by the same percentage (9%) as the adult survival was decreased for consistency of estimates for Northwest Montana.

Environmental and demographic stochasticity was built into our model by inputting the standard deviations observed from the time series into the matrix model for fecundity and survival. The standard deviation of survival was calculated from the average annual survival for all years monitored for a given area.

Density Dependence

Pack size and density dependence affected all vital rates and was based on a ceiling model where the observed survival and fecundity rates were used until the carrying capacity (k) of each pack exceeded (k) at which time growth rates abruptly declined to 1.0. Carrying capacity for each pack was set to 4 combined female juveniles, dispersers and adults and based on half (female only component) the average pack size for the Central Idaho and Northwest Montana (Boyd and Pletscher 1999, USFWS 1999, Mitchell et al. 2008).

Dispersal

All dispersal aged animals dispersed or became breeders. Minimum age of reproduction was 2 years (22 months, Mech 1970) for juveniles in our model and mean dispersal age of wolves was 3 years (35.7 months, Boyd and Pletscher 1999) for dispersers in our model. Average dispersal distance for wolves was similar between sexes with an average distance of 95.5 km (113 km for males, 78 km for females) with a maximum dispersal distance of 840 km (Boyd and Pletscher, 1999). These metrics were used to create a dispersal function in RAMAS GIS – Metapopulation and develop a matrix to determine probabilities of dispersal between hypothetical packs in Washington. Large scale landscape features that pose potential barriers to dispersal movements, such as the Columbia Basin and Puget Sound, were set to zero in the dispersal matrix.

Results

Testing Population Growth Projections

Our model, using demographic and pack size parameters from Northwest Montana, yielded a population growth rate of 1.22 compared to the observed growth rate of wolves in Northwest Montana of 1.22 (Sime et al. 2011). The model for the Central Idaho Recovery area yielded a growth rate of 1.34 compared to an observed growth rate of 1.34 (Mack et al. 2010). The same occurred for wolf pack size with an average of 8 wolves per pack for both the average observed (Boyd and Pletscher 1999, USFWS 1999, Mitchell et al. 2008) and modeled pack size. The similarity between the modeled intrinsic growth rates and pack size and the observed growth rates and pack size for Northwest Montana and the Central Idaho Recovery area gives us confidence that our model structure represents reality.

Discussion

We created the models to be versatile and adaptive because of the uncertainty of average pack or territory size for wolves recolonizing Washington. We have not been able to assess the accuracy of the Oakleaf (2006) habitat model, particularly its applicability for the Washington landscape. However, the probabilities of recolonization are built in as part of individual pack sub-populations in RAMAS, therefore the population model can be easily adapted as more empirical data is collected during the recolonization of wolves in Washington.

Our model gives the Washington Department of Fish and Wildlife the ability in the future, when actual data for Washington wolves are available, to predict potential effects of management decisions on wolves. The model split into separate recovery regions or specified for the entire statewide metapopulation and can also be easily modified as information on dispersal, landscape connectivity, and demographic parameters are collected on wolves in Washington.

Literature Cited

Akcakaya, H.R. 2002. RAMAS GIS: Linking Spatial Data with Population Viability Analysis (version 4.0). Applied Biomathematics, Setauket, New York.

Boyd, D.K. and D.H. Pletscher. 1999. Characteristics of dispersal in a colonizing wolf population in the Central Rocky Mountains. Journal of Wildlife Management. 63(4): 1094-1108.

Carroll, C., M.K. Phillips, C.A. Lopez-Gonzalez, and N.H. Schumaker. 2006. Defining recovery goals and strategies for endangered species: The wolf as a case study. BioScience. 56(1): 25-37.

Chapron, G., R. Wielgus, P. Quenette, J. Camarra. 2009. Diagnosing mechanisms of decline and planning for recovery of an endangered brown bear (*Ursus arctos*) population. Plos One. 4(10) 1-7.

Lambert, C. M., R. B. Wielgus, H. S. Robinson, H. S. Cruickshank, R. Clarke, and J. Almack. 2006. Cougar population dynamics and viability in the Pacific Northwest. Journal of Wildlife Management 70:246-254.

Larsen, T. 2004. Modeling gray wolf habitat in Oregon using a geographic information system. MSc Thesis, Oregon State University, Corvallis, Oregon. Pg. 69.

Mack, C., J. Rachael, J. Holyan, J. Husseman, M. Lucid, B. Thomas. 2010. Wolf conservation and management in Idaho; progress report 2009. Nez Perce Tribe Wolf Recovery Project, P.O. Box 365, Lapwai, Idaho; Idaho Department of Fish and Game, 600 South Walnut, Boise, Idaho. 67 pp.

Mitchell, M.S., D.E. Ausband, C.A. Sime, E.E. Bangs, J.A. Gude, M.D. Jimenez, C.M. Mack, T.J. Meier, M. S. Nadeau, and D.W. Smith. 2008. Estimation of successful breeding pairs for wolves in the northern Rocky Mountains, USA. Journal of Wildlife Management. 72(4): 881-891.

Nadeau, M. S., C. Mack, J. Holyan, J. Husseman, M. Lucid, B. Thomas. 2006. Wolf conservation and management in Idaho; progress report 2005. Idaho Department of Fish and Game, 600 South Walnut, Boise, Idaho; Nez Perce Tribe, P.O. Box 365, Lapwai, Idaho. 61 pp.

Nadeau, M. S., C. Mack, J. Holyan, J. Husseman, M. Lucid, P. Frame, B. Thomas. 2007. Wolf conservation and management in Idaho; progress report 2006. Idaho Department of Fish and Game, 600 South Walnut, Boise, Idaho; Nez Perce Tribe, P.O. Box 365, Lapwai, Idaho. 73 pp.

Nadeau, M. S., C. Mack, J. Holyan, J. Husseman, M. Lucid, B. Thomas, D. Spicer. 2008. Wolf conservation and management in Idaho; progress report 2007. Idaho Department of Fish and Game, 600 South Walnut, Boise, Idaho; Nez Perce Tribe, P.O. Box 365, Lapwai, Idaho. 73pp.

Nadeau, M. S., C. Mack, J. Holyan, J. Husseman, M. Lucid, D. Spicer, B. Thomas. 2009. Wolf conservation and management in Idaho; progress report 2008. Idaho Department of Fish and Game, 600 South Walnut, Boise, Idaho; Nez Perce Tribe, P.O. Box 365, Lapwai, Idaho. 106 pp.

Oakleaf, John K., Dennis L. Murray, James R. Oakleaf, Edward E. Bangs, Curt M. Mack, Douglas W. Smith, Joseph A. Fontaine, Michael D. Jimenez, Thomas J. Meier, Carter C. Niemeyer. 2006. Habitat Selection by recolonizing wolves in the northern Rocky Mountains of the United States. Journal of Wildlife Management. 70(2): 554-663.

Rich, Lindsey N. 2010. An assessment of factors influencing territory size and the use of hunter surveys for monitoring wolves in Montana. M.S. Thesis. University of Montana, Missoula, MT. pg 94.

Sime, Carolyn A., V. Asher, L. Bradley, N. Lance, K. Laudon, M. Ross, A. Nelson, and J. Steuber. 2011. Montana gray wolf conservation and management 2010 annual report. Montana Fish, Wildlife & Parks. Helena, Montana. 168 pp

Smith, D. W., E.E. Bangs, J.K. Oakleaf, C. Mack, J. Fontaine, D. Boyd, M. Jimenez, D.H. Pletscher, C.C. Niemeyer, T.J. Meier, D.R. Stahler, J. Holyan, V.J. Asher, and D.L. Murray. 2010. Survival of colonizing wolves in the northern Rocky Mountains of the United States, 1982-2004. Journal of Wildlife Management. 74(4): 620-634.

United States Fish and Wildlife Service. 1999. Rocky Mountain Wolf Recovery 1999 Annual Report. http://www.fws.gov/mountain-prairie/species/mammals/wolf/annualrpt99/

Wielgus, R.B., F. Sarrazin, R. Ferriere, and J. Clobert. 2001. Estimating effects of adult male mortality on grizzly bear population growth and persistence using matrix models. Biological Conservation. 98: 293-303.

Wielgus, R.B. 2002. Minimum viable population and reserve sizes of naturally regulated grizzly bears in British Columbia. Biological Conservation. 106: 381-388.

Wiles, G. and H. Allen. 2009. Draft wolf conservation and management plan for Washington. Washington Department of Fish and Wildlife, Olympia, WA.

Appendix 1

GIS Layers	Description of layer.
\PVA_GIS\Prob_AVE\	Navigation to folder
WP_15_6_PT15_pts.shp	Points layer with centroids of hypothetical wolf packs
cir15_6km_PT15.shp	Polygon layer of hypothetical wolf packs with average recolonization probabilities >15% ~ Average territory size (766 km^2) between NWMT and Idaho.
WP_15_6_PT50_pts.shp	Polygon layer of hypothetical wolf packs with average recolonization probabilities >50% ~ Average territory size (766 km^2) between NWMT and Idaho.
\PVA_GIS\Prob_PT_ID\	Navigation to folder
WP_17_2_P15_pt.shp	Points layer with centroids of hypothetical wolf packs
WP_17_2_P15.shp	Polygon layer of hypothetical wolf packs with average recolonization probabilities >15% ~ Average territory size (766 km^2) between NWMT and Idaho.
WP_17_2_P50.shp	Polygon layer of hypothetical wolf packs with average recolonization probabilities >50% ~ Average territory size (933 km^2) for Idaho wolves (USFWS 1999).
\PVA_GIS\Prob_PT_MT\	Navigation to folder
WP_13_8km_P15_pt1.shp	Points layer with centroids of hypothetical wolf packs
WP_13_8km_P15.shp	Polygon layer of hypothetical wolf packs with average recolonization probabilities >15% ~ Average territory size (599.8 km^2) for Idaho wolves (Rich 2010).
WP_13_8km_P50.shp	Polygon layer of hypothetical wolf packs with average recolonization probabilities >50% ~ Average territory size (599.8 km^2) for Idaho wolves (Rich 2010).
\PVA_GIS\raster\	Navigation to folder
wolf_prob_elk	Raster layer depicting the habitat model of recolonization probabilities for wolves in Washington created by Maletzke (2006) from parameter metrics specified by Oakleaf et al. (2006).
\PVA_GIS\	Navigation to folder
wolf_zone	Raster layer depicting the Washington Wolf Recovery Zones defined by the draft Wolf Conservation and Management Plan for Washington (Wiles and Allen, 2009).
Wolf_Rec_Zones.shp	Polygon layer depicting the Washington Wolf Recovery Zones defined by the draft wolf conservation and management plan for Washington (Wiles and Allen, 2009).

Attribute table descriptions for Hypothetical Pack Territory polygon shapefiles.

Attribute	Description
MEAN	Average probability of recolonization
Wolf_Zone	Washington Wolf Recovery Region
Pack_ID	Unique ID for each pack which links to RAMAS GIS files
Border	Pack territory intersects Washington state boundary (Y/N)

Appendix 2

GIS Layers	Description of layer.
\PVA_GIS\RAMAS\	Navigation to folder
Wolf_13_8km_NWMT_Prob_2Aprr2011	RAMAS GIS metapopulation model with all packs on average >15% probability of recolonization with NWMT territory size and demographic parameter estimates. (Contains border packs)
Wolf_17_2km_ID_Prob_30Mar2011	RAMAS GIS metapopulation model with all packs on average >15% probability of recolonization with ID territory sizes and demographic parameter estimates. (Contains border packs)
Wolf_15_6km_AVE_Prob_30Mar2011	RAMAS GIS metapopulation model with all packs on average >15% probability of recolonization with an average territory size between NWMT and Idaho and average demographic parameter estimates. (Contains border packs)
\PVA_GIS\RAMAS\Templates\	Navigation to folder
Wolf_17_2km_ID_Prob_IDparam	RAMAS GIS metapopulation model with Idaho average territory size and population demography metrics from the Central Idaho recovery area. (>50% probability of recolonization and no border packs)
Wolf_17_2km_ID_Prob_MTparam	RAMAS GIS metapopulation model with Idaho average territory size and population demography metrics from the NW MT recovery area. This model was created as a very conservative model of recolonization, has >50% probability of recolonization and no border packs.
Wolf_17_2km_ID_Prob_MTparam_NE_clsd	RAMAS GIS metapopulation model for only the Eastern WA recovery zone based on Idaho average territory size and population demography metrics from the NW MT recovery area. This model has >50% probability of recolonization, no source population, and no border packs.
Wolf_17_2km_ID_Prob_MTparam_NE_open	RAMAS GIS metapopulation model for only the Eastern WA recovery zone based on Idaho average territory size and population demography metrics from the NW MT recovery area. This model has >50% probability of recolonization and has a border pack as a source population.

Appendix H. Results of nine scenarios of wolf population modeling in Washington using RAMAS (Appendix G).

Assumptions/parameters used:

1) Pack territory size of 933 km^2 (360 mi^2) based on data from Idaho (n = 13, USFWS 2000) and Washington (n = 2).
2) Survival data from northwestern Montana (Smith et al. 2010), except pup survival of 0.81 (see discussion in Appendix G).
3) Four hypothetical packs were used to mimic a low level of immigration, two in British Columbia and one each in northern Idaho and Oregon, except when simulations assumed no immigration.
4) Frequency of successful dispersal between packs was a function of distance; maximum dispersal distance used was 200 km (124 miles).
5) Average pack size = 8 individuals.
6) Average litter size = 4 pups.
7) For scenarios where growth was limited and territories were selected, territories with the highest probability of occupancy (based on the suitable habitat model) were used where possible, while maintaining recovery region pack delisting requirements.
8) Inbreeding depression was not included.

NOTE: The results of this exercise are not considered definitive, and vary widely depending on the assumptions used, especially about wolf survival and immigration.

Scenario (100 simulations, 50 years)	Parameter[a]	Result	Conclusion/Notes
Evaluations of persistence of metapopulation of 15 successful breeding pairs for 50 years			
1. Statewide population growth to 73 possible territories, starting with 2 occupied territories, assume immigration	Tx	0	With immigration, wolves would maintain about 58 packs, with no risk (0%) of the population declining to extinction.
	Mo	58.3 (49-65)	
	Qx	0	
2. Statewide population growth to 73 possible territories, starting with 2 occupied territories, assume no immigration	Tx	0.02	With no immigration, the population may grow to 56 packs, but there is a 2% chance it would decline to extinction.
	Mo	56 (0-64)	
	Qx	0.02	
3. Statewide population growth to 73 possible territories, starting with 23 occupied territories (distributed as 7 EW, 7 NC, 9 SC), assume no immigration	Tx	0	Starting with the recovery objective (15 breeding pairs) met, wolves would likely persist if demographically significant immigration was stopped.
	Mo	56.3 (47-63)	
	Qx	0	

NOTE: The results of this exercise are not considered definitive, and vary widely depending on the assumptions used, especially about wolf survival and immigration.			
Scenario (100 simulations, 50 years)	Parameter[a]	Results	Conclusion/Notes
4. Start with 23 packs (distributed as 7 EW, 7 NC, 9 SC) to approximate the 5/4/6 recovery objective, no additional growth (i.e., population is capped), assume immigration	Tx	<0.03	Starting with the recovery objective (15 breeding pairs) met but further population growth is capped, the likelihood of needing to relist/falling below the statewide recovery objective is high (93%), even with continued immigration.
	Mo	19.0 (14-22)	
	Qx	0.93	
5. Start with 23 packs (distributed as 7 EW, 7 NC, 9 SC) to approximate the 5/4/6 recovery objective, no additional growth (i.e., population is capped), assume no immigration	Tx	<0.01	Starting with the recovery objective (15 breeding pairs) met but further population growth is capped and immigration is stopped, there is a 97% risk of having to relist/falling below the statewide recovery objective.
	Mo	18.6 (15-23)	
	Qx	0.97	
Evaluations of management scenarios after recovery objectives met within a recovery region			
6. Start with recovery objective (5 breeding pairs) met in the Eastern WA recovery region, but not in the other two recovery regions; assume immigration, conduct management Quasi-extinction at statewide level (<46 adult + dispersing females)	Tx	<0.01	Conducting wolf management in the Eastern WA recovery region after recovery objectives are met there, but before regional objectives are met in the other two regions, will not inhibit the ability to achieve recovery in all three regions over time.
	Mo	58 (50-66)	
	Qx	<0.01	
7. Start with recovery objective (5 breeding pairs) met in the Eastern WA recovery region, but not in the other two recovery regions; assume immigration, conduct management Quasi-extinction at recovery region level (<12 adult + dispersing females)	Tx	<0.01	Conducting wolf management in the Eastern WA recovery region after recovery objectives are met there, but before regional objectives are met in the other two regions and with continued immigration, results in a 7% risk of falling below the recovery objective for Eastern WA; model assumed 1 of 5 pairs established in Blue Mountains.
	Mo	9 (6-12)	
	Qx	<0.07	

<table>
<tr><td colspan="4">NOTE: The results of this exercise are not considered definitive, and vary widely depending on the assumptions used, especially about wolf survival and immigration.</td></tr>
<tr><th>Scenario
(100 simulations, 50 years)</th><th>Parameter[a]</th><th>Results</th><th>Conclusion/Notes</th></tr>
<tr><td rowspan="3">8. Start with recovery objectives (5 breeding pairs) met in the Eastern WA recovery region, but not in the other two recovery regions; assume no immigration, conduct management

Quasi-extinction at statewide level (<46 adult + dispersing females)</td><td>Tx</td><td><0.01</td><td rowspan="3">Conducting wolf management in the Eastern WA recovery region after recovery objectives are met there, but before regional objectives are met in the other two regions, will not inhibit the ability to achieve recovery in all three regions over time, even without immigration.</td></tr>
<tr><td>Mo</td><td>55
(41-62)</td></tr>
<tr><td>Qx</td><td><0.01</td></tr>
<tr><td rowspan="3">9. Start with recovery objectives (5 breeding pairs) met in the Eastern WA recovery region, but not in the other two recovery regions; assume no immigration, conduct management

Quasi-extinction at recovery region level (<12 adult + dispersing females)</td><td>Tx</td><td><0.01</td><td rowspan="3">Conducting wolf management in the Eastern WA recovery region after recovery objectives are met there, but before regional objectives are met in the other two regions and without any immigration from outside populations, results in a 48% risk of falling below the recovery objective for Eastern WA; model assumed 1 of 5 pairs established in Blue Mountains.</td></tr>
<tr><td>Mo</td><td>8 (3-11)</td></tr>
<tr><td>Qx</td><td>0.48</td></tr>
</table>

[a] Parameters:

Tx = Probability of terminal extinction (the probability that the metapopulation will be extinct at the end of the duration, in this case 50 years)

Mo = Metapopulation occupancy (the average number and range of occupied territories during the 50-year period). It is assumed that 70% of occupied territories represent packs with successfully breeding females.

Qx = Quasi-extinction probability (the probability that the number of female adults and dispersers will fall below the recovery objective level at which relisting would be warranted).

Management scenario = 0.3 of all disperser and adult age class removed every 4 years after the delisting goal is met.

Appendix I. Summary of the Wolf Working Group's discussions related to the recovery objectives, recovery regions, and translocation elements of the plan. Discussions by the Working Group on other aspects of the plan can be found in the meeting summaries posted at http://wdfw.wa.gov/conservation/gray_wolf/working_group_meetings.html.

Wolf Working Group participation and discussions prior to the development of the draft EIS/wolf conservation and management plan. They were especially helpful in the preparation of Chapters 3 (wolf conservation) and 4 (wolf-livestock conflicts) of this plan. This appendix summarizes the group's discussions on three of the key elements of the recovery objectives appearing in Chapter 3, including the numbers of successful breeding pairs needed to achieve downlisting and delisting of wolves, the designation of recovery regions, and the use of translocation as a conservation tool.

Numbers of Successful Breeding Pairs

Throughout the Wolf Working Group deliberations, the issue of numbers of successful breeding pairs, as criteria for moving from one listing designation to another, was a point of significant discussion. Originally, WDFW suggested that specific numbers be excluded from the plan until after some wolf packs had settled in the state. Modeling of the habitat use and demographics of these animals and genetic considerations could then be used to derive scientifically based estimates of the wolf numbers needed for recovery, which would then be placed in a future version of the plan. All Working Group members rejected this approach and preferred the inclusion of specific numbers in the current plan, as done by other states and as needed to meet the criteria for Washington state recovery plans. Furthermore, specific numbers would give Working Group members a starting place for their deliberations. WDFW researched other state wolf plans and applied their understanding of wildlife biology to the question. It then proposed the numbers of 8 successful breeding pairs for transitioning from endangered to threatened and 15 successful breeding pairs for transitioning from threatened to sensitive as a starting point for the Working Group's consideration.

Eventually, the Working Group collectively settled on an approach that called for 6 successful breeding pairs for transitioning from endangered to threatened, 12 successful breeding pairs for transitioning from threatened to sensitive, and 15 successful breeding pairs for delisting from sensitive. These numbers also required that the minimum number of successful breeding pairs be in place for 3 years (although there are some exceptions; see Chapter 3, Section B) and distribution across three regions.

The deliberation around numbers was a negotiation where each participant attempted to balance his or her own interests with everyone else's in the group. The 6/12/15 numbers were not viewed as "ideal" by anyone on the Working Group; however, these numbers represented the balance point among the different interests around the table. It should be emphasized that these numbers represented only the criteria for downlisting and delisting, and not a population cap or ceiling at which wolves would ultimately be managed.

For Working Group members from the conservation community, the numbers were viewed as being close to ecologically defensible, though lower than they would have set if they were the only ones writing the plan. For the livestock and hunting communities, the numbers were higher than they would have recommended if they were the only ones writing the plan. Working Group members ultimately recognized that having certainty around a set of numbers they could live with, along with the other specific components of the package that each party viewed as desirable, made more sense than deferring the decision to others. The group further understood that to obtain the necessary external support (e.g., legislative) for funding and operation of the plan, their final product needed support by a cross section of interests.

Throughout the process, some Working Group members representing the livestock/hunting community indicated they would be hard pressed to agree to the 6/12/15 numbers. At the end of the deliberations, while they were able to live with the rest of the package, six of the 17 members indicated they needed to submit a minority report on breeding pair numbers and proposed an alternative set of 3/6/8 numbers (see Appendix K for more detail). They further proposed that there be no 3-year time requirement, but did not address regional distribution. However, the package agreed to by the group was based on the 6/12/15 numbers and if those numbers were changed as a result of the peer review, public review, and other agency processes, then agreement around other components of the plan would not necessarily remain. In particular, consensus on management options for resolving wolf-livestock conflicts and compensation for wolf-caused losses of livestock could be jeopardized.

Recovery Regions

During the Working Group discussions, there was an evolution in the design and agreement of wolf recovery regions for the state. As one possibility, WDFW initially suggested that Washington's nine "ecoregions" be considered for recovery regions. WDFW and other conservation organizations have adopted an ecoregional approach for landscape-level conservation planning in Washington, as described in the state's Comprehensive Wildlife Conservation Strategy (WDFW 2005a). Ecoregions are relatively large areas of land and water that contain geographically discrete assemblages of natural plant and animal communities and have distinctive environmental conditions.

Each ecoregion has unique strengths and weaknesses affecting wolf recovery, such as differing amounts of large contiguous forested public land blocks, varying abundance of ungulate prey and locations of winter range, human population density and distribution, distance from colonizing sources, and challenges to successful natural dispersal. Some ecoregions (or groupings of ecoregions) contain an abundance of higher quality habitats that could potentially support a growing wolf population with dispersing young (source populations), while others have lower habitat quality where resident packs would have difficulty sustaining themselves without immigration (sink populations).

Some members of the Working Group felt that nine ecoregions were too many and too complex for addressing wolf distribution needs in the state. The group considered a number of variations on the ecoregional approach (including combinations of ecoregions, modifications of ecoregions, and an eastside-westside division of the state) and other factors before arriving at three consolidated regions chosen for use in the recovery objectives.

Like the nine ecoregions, the consolidated wolf recovery regions also have unique strengths and weaknesses affecting wolf recovery. For example, when comparing wolf recovery regions, the Southern Cascades and Northwest Coast recovery region is the most distant from colonizing sources with greater hurdles to successful natural dispersal, yet this region contains nearly 80% of the state's elk population.

Translocation

Translocation was discussed extensively by the Working Group and was largely supported for a variety of reasons. Translocation within Washington was proposed as a tool if wolves were not naturally dispersing into regions needed for recovery, or if it was desired to move wolves from regions that had already achieved recovery objectives to other regions that had not yet met their objectives. Conservation groups supported the concept to achieve recovery objectives and establish source populations within the state. County, hunting, and livestock interests also supported the concept, which would enable moving wolves out of areas after sufficient numbers of breeding pairs were reestablished to achieve recovery objectives, thereby speeding up the delisting process and access to more flexible management tools. Overall, there was broad support and recognition within the Working Group that translocation is a key management tool to ensure that both conservation and management goals are achieved. Translocation is considered an essential part of the "negotiated package" developed by the Working Group.

The primary area suggested and discussed for translocation by the Working Group was the southern Cascade Mountain range based on insights gained from the experiences of wolf recovery in the northern Rocky Mountain states (USFWS 2009). These included the strong correlation between large contiguous blocks of public land and wolf recovery. This is due to large areas of public land generally experiencing lower levels of conflict between wolves and livestock, as well as supporting larger populations of elk.

Discussions on translocation focused on the southern Cascade Mountains for the following reasons:

- The southern Cascades have the potential to support a source population of wolves, a factor of importance for maintaining a sustainable viable population in Washington.
- The southern Cascades contain about half of Washington's elk population and large contiguous blocks of public land. Consequently, there is abundant natural prey for wolves combined with potentially lower levels of conflict with livestock when compared to areas with extensive private landholdings.
- The southern Cascades are distant from colonizing areas in Idaho and British Columbia, and there are more potential barriers to overcome for successful natural dispersal. However, once wolves are reestablished in the southern Cascades, extensive contiguous forested public lands will facilitate natural dispersal within this area.
- Elk populations fluctuate in response to a number of environmental conditions, including forest succession. Portions of the Mount St. Helens elk herd, which is the largest herd in the state, are currently experiencing problems due to advanced forest succession. Wolf recovery in the southern Cascades could help restore and contribute to ecological balance and integrity in these types of situations.

To date there have not been any discussions of translocations to other areas; the primary focus has been the southern Cascade Mountains.

This package contains carefully balanced strategies and management tools to achieve key objectives. There were strong concerns among Working Group members that if translocation was precluded for any reason, then:

- The carefully crafted “negotiated package” would become unbalanced in ways that adversely affect achieving primary goals.
- Barriers to the natural dispersal of wolves into the southern Cascade Mountains may result in increasing conflict with livestock in eastern Washington and delayed recovery.
- Eastern and northern Washington would unfairly bear the costs and challenges of wolf recovery.

The Working Group therefore recommends that if translocation is removed from the management tools available to WDFW, the Fish and Wildlife Commission or WDFW shall immediately reconvene the Working Group (to the extent possible with the original membership) to advise WDFW on how to manage wolves without this critical tool to address these concerns.

Appendix J. The minority report on proposed numbers of successful breeding pairs for achieving the downlisting and delisting of wolves in Washington, which was submitted by six members of the state's Wolf Working Group in May 2008.

May 27, 2008

The following represents a minority position held by the following members of the Wolf Working Group (WWG) Jack Field, Duane Cocking, Tommy Petrie, Daryl Asmussen, Jeff Dawson and Ken Oliver (We) on one critical component of the Wolf Working Group Plan; the number of Breeding Pairs (BP) of wolves that the state can support. We are "unable to live with" the proposed numbers in the WWG Draft Plan. We believe the numbers are too high and will result in direct conflict with the Livestock and Sportsman Communities.

Currently the plan calls for 6 BP's to down list to Threatened, 12 BP's to down list to State Sensitive and at least 15 BP's for 3 years before they can be considered for limited hunting(p. 41 WWG draft). During this time period wolf populations could increase 24% per year (Bangs, conversation). Plus at the end of the 3 year time period, there is a very definite probability of one or more lawsuits as is now occurring after the Federal delisting of wolves in the Northern Rocky Mountain (NRM) area. It is estimated that it will take a minimum of 18 months for these challenges to work their way through the court system.

This same scenario will probably occur in this state. Consequently we could be looking at as many as 28 to 35 BP's before control measures could be taken to control their growth. All of this in a state with Washington's Population of 6,490,000 people and a population density of 97.5 people/ sq mi (WWG Draft Plan). This is 5 to 6 times the human population density of the 3 principle states in the NRM area, MT, ID, and WY. (WA, WY, ID, and MT state web sites). According to the Federal Register, Feb. 8, 2007, Vol.72, number 26, this state has only 297 square miles of suitable wolf habitat in the eastern third of the state (p.6117 Federal Register). It should be noted that this same source shows the following amounts of suitable habitat in each of the states comprising the NRM are, MT. 40924 sq. mi., WY. 29808 sq. mi., ID. 31,586 sq. mi., OR. 2556 sq. mi. and, UT. 1635 sq. mi. This same report indicates that if the 3 major states (ID, MT, and WY) can support 10 BP's for 3 years that the species can be considered to be fully recovered and can be considered for delisting (p.6107 Federal Register). That criteria was met in 2002 (p. 6111 Federal Register).

The amount of suitable wolf habitat in the remaining two thirds of the state as depicted in the "Application of habitat models to wolf recovery planning in WA" by Carroll indicates scattered habitat in small isolated areas of the Okanogan, larger amounts of marginal habitat both North and South of Mt. Rainier, and a large area of habitat in and around the Olympic National Park, an area that strongly opposed wolf reintroduction several years ago.

Therefore we feel that the WWG's desired number of BP's is unrealistic given the lack of suitable habitat and the much higher human population density of this state and that the requirement of 15 BP's for 3 years (50% Higher that the USFW criteria for recovery in WY, MT, and ID,) defies common sense. This is further compounded by a recent recommendation from the Idaho Department of Fish and Game Commissioners to set the limit for a wolf hunt at 2005 levels which could mean 500 wolves could be killed this year. Idaho Fish and Game biologists estimate there are currently about 750 wolves in the state, but after the breeding season this spring they expect more than 1,000. The commissioners on the higher figures because they did not believe that hunting would bring the wolf population numbers down to the levels they wanted to see.

We therefore propose the following numbers of BP's statewide: 3 BP's to down list to Threatened, 6 BP's to down list to State Sensitive, and 8 BP's to change to a Big Game Animal. And we would eliminate the 3 year period since the state was not considered essential for recovery of wolves in the NRM (p.6119 Federal Register). This total number of 8 BP's or approximately 80 wolves would fit in the states economic analysis as outlined in Chapter 14, "Economics" which states "Wolf numbers between 50 and 100 animals should pose little detriment to the states livestock industry as a whole…As wolf populations become larger and more widely distributed, financial impacts are likely to accrue to more producers" (p.126). "Populations of 50 to 100 wolves should not have negative effects on big game hunting in Washington" (p.139).

The advantages of going with a lower number of BP's are: the sooner wolves can be removed from endangered and threatened status, the more tools stockmen and rural residents will have at their disposal to deal with problem wolves.

The sooner we can get wolves de-listed, the sooner our Fish and Wildlife Department can begin to manage them, until then their hands are tied. The sooner we can get them listed as a Big Game Species, the sooner our Fish and Wildlife can turn them from a liability into an asset through the sale of raffle tags, permits, and Governors Tags.

We believe that these numbers are far too high and do not accurately represent the concerns that the livestock production community has with wolves. The livestock community has preferred zero wolves from the beginning however, due to ESA and WDFW requirements zero is not an option. We support the Minority Opinion Numbers of 3 breeding pairs to downlist to threatened, 6 breeding pairs to downlist to sensitive, and 8 breeding pairs to delist from sensitive and managed as a Big Game Species**.** The higher numbers that the WWG Draft Plan includes will result in far more individual wolves than Washington has habitat to support thus causing a severe negative impact on private landowners and livestock producers. Livestock producers must be able to protect their property regardless of the wolf's status. We are also concerned that the WDFW has not effectively demonstrated its ability to secure long-term funds that will be a requirement in Management and Compensation. Without funding there is **NO Support** of any plan!!

The remainder of the WWG plan is acceptable to the supporters of the minority position.

Jack Field
Duane Cocking
Ken Oliver
Daryl Asmussen
Jeff Dawson
Tommy Petrie

Response Guidelines

For

Reported Gray Wolf Activity

In Washington State

Coordinating Agencies:

U.S. Fish and Wildlife Service
Washington Department of Fish and Wildlife
USDA/APHIS – Wildlife Services

November 2010

Table of Contents

Purpose…………………………………………………………………………………..……..……. 1

Legal Status……………………………………………………………………………........ 1

Overview of Potential Situations……………………………………...…………………….. 2

1. Unconfirmed Reports of Wolf Activity (Tracks or Sightings)………….………………. 2

2. Verified Wolf Activity (Without a Depredation or Conflict)…..……..………………….. 2

3. Report of Possible Wolf-caused Depredation on Livestock or Other Domestic Animals……………………………………………………………….……………. 3

4. Report of a Wolf Capture……………………………….....………………………… 3

5. Report of a Dead or Injured Wolf…………………………………………..…..…… 4

Response Strategy and Checklists……………………………………………………….. 5

1. Unconfirmed Reports of Wolf Activity (Tracks or Sightings)………….………………. 5

2. Verified Wolf Activity (Without a Depredation or Conflict)…..……..………………….. 6

3. Report of Possible Wolf-caused Depredation on Livestock or Other Domestic Animals……………………………………………………………………………... 7

4. Report of a Wolf Capture……………………………….....………………………… 9

5. Report of a Dead or Injured Wolf………………………………………………………. 10

Attachment A: Phone Contacts to Report Wolf Observation, Injury, or Suspected Depredation……………………………………………....……………………………… 12

PURPOSE

These response guidelines are a cooperative effort between the U. S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW) and U.S. Department of Agriculture Wildlife Services (WS). The purpose of the guidelines is to prepare for a coordinated and effective response to possible situations that may occur if wolf/human interactions take place in Washington State. **This is not a wolf management plan or recovery plan.** It does not contain any objectives for establishing wolves in Washington State. The guidelines adhere to federal and, where appropriate, state law and policy and emphasize close interagency and inter-governmental coordination and a common understanding of specific roles and responsibilities between all involved agencies.

LEGAL STATUS

Federal

1. As of August 2010, the gray wolf is listed as endangered throughout Washington under the federal Endangered Species Act (ESA). The eastern third of Washington is included in the federal Northern Rocky Mountain Distinct Population Segment (NRM DPS). This means that, while WDFW and USFWS are co-managers, the USFWS has overall lead responsibility for wild wolves in Washington while they are federally listed. Wild wolves in Washington are fully protected by the ESA, which is administered and enforced by the USFWS. Wolf-dog hybrids have no federal or state legal status.

   For species listed under the federal ESA, activities that may result in "take" of endangered species are generally prohibited. The definition of take under the ESA includes to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.

   Wildlife Services (WS) is the federal agency with nationwide responsibility for managing wildlife damage problems and investigates possible wolf depredation on livestock and/or other domesticated animals and implements control actions under the direction of the USFWS to address conflicts.

State

2. The gray wolf is also listed as endangered by the State of Washington and receives protection under state law (WAC 232-12-014, RCW 77.15.120). The State may designate agents or enter into cooperative agreements with Federal agencies to enforce State law. The Washington Fish and Wildlife Commission may also promulgate rules to authorize Federal and State agencies concerned with the management of fish and wildlife resources to lethally remove wolves under limited circumstances.

   The WDFW currently has a cooperative agreement with the USFWS, under Section 6 of the federal ESA, that provides WDFW authority to manage for the conservation of endangered or threatened species, including gray wolves, within the state, except for lethal take of those species. The WDFW is in the process of developing a Wolf Conservation and Management Plan for the state.

Tribal

3. Tribal governments manage wildlife on their reserved lands and they maintain certain rights to wildlife resources on ceded lands in the state.

OVERVIEW OF POTENTIAL SITUATIONS

Discussed below are five situations that might arise in Washington and an overview of the recommended response strategy for each situation. The five situations are:

1. **Unconfirmed report of wolf activity or sightings.**
2. **Verified wolf activity, without a problem incident.**
3. **Report of possible wolf-caused livestock depredation.**
4. **Report of a wolf capture.**
5. **Report of an injured or dead wolf.**

Specific incidents will have unique circumstances and responses are likely to vary from case to case to account for individual situations. The cooperating agencies will coordinate their responses to the various wolf management situations as they arise. If wolf activity is discovered within or adjacent to tribal lands, government-to-government discussions with the affected Tribe will be initiated.

1. Unconfirmed Reports of Wolf Activity (Tracks or Sightings)

USFWS, WDFW and other agencies occasionally receive reports from people who have observed either large tracks or large animals that they think may be wolves. The response procedure is to interview the caller and fill out the observation form that documents details on the observation and where it was located. This information will be stored for future reference.

2. Verified Wolf Activity (Without a Depredation or Conflict)

- Wolf activity in Washington will be considered verified when a State, Federal or Tribal wildlife biologist has been able to see and, to the extent possible, conclusively identify a wild wolf in the field. If current, highly credible reports are received from another source, or if multiple credible reports are received from the same area, appropriate personnel may be sent out to the area to verify it. If there is uncertainty about the identification, wolf experts may be brought in to assist in the confirmation process.

- If wild wolves are confirmed to be present and the animal(s) has not been implicated in a livestock depredation or other problem incident, USFWS, WS and WDFW will collaborate to monitor the wolf activity to the best of their ability, given available resources. Tribal wildlife agencies may also participate in monitoring activities. In addition, a WDFW local enforcement officer will coordinate with livestock producers in the local area to provide relevant information and what steps they may legally take to prevent depredation.

- The preferred monitoring approach is to capture and radio-collar wolves to facilitate regular tracking of movements. However, this can be difficult to accomplish with a lone wolf that is roaming across wide areas. Available funding and personnel may limit the ability to pursue this approach. Coordinating agencies would likely wait until there are multiple observations of wolf activity in an area – indicating the presence of one or more resident animals – before considering a concerted effort to capture and collar a wolf. A potential alternative approach would be to do periodic surveillance from the ground and air to document tracks and any observed wolf activity.

- The purpose of monitoring wolf activity, once verified, is to determine what areas wolves are using. Also, by knowing where the wolves are located, the agencies may be able to anticipate problem situations and utilize non-lethal techniques to prevent or reduce conflicts. If problem situations do occur, the presence of radio-collared animals will increase the efficiency of subsequent actions.

- Both confirmed and unconfirmed reports of wolf sightings should be mapped, and reports stored by the agency wolf point of contact in their respective offices.

3. <u>Report of Possible Wolf-Caused Depredation on Livestock or Other Domestic Animals</u>

WS is the lead Federal agency for animal damage control and, when authorized by USFWS, will implement wolf control actions in Washington. When a report is received claiming that a wolf has attacked livestock (for example, cattle, sheep, horses, mules, and livestock herding or guarding animals such as dogs, llamas, and donkeys) or other domestic animals, agency response will include the following elements:

- WS investigates. Keys to a successful response include:
  - WS personnel are rapidly notified and respond promptly and determine whether or not it is a wolf depredation.
  - There is prompt coordination with the affected livestock producer to secure the scene.
  - Key individuals in USFWS and WDFW are promptly notified, including USFWS Office of Law Enforcement and WDFW Enforcement.
  - There is coordination between USFWS, WDFW, WS, and landowner to plan possible follow-up actions.

- If the WS investigation determines that the depredation was wolf-caused, a response action will be initiated. Site-specific circumstances will dictate what type of response action will be used.

4. <u>Report of a Wolf Capture</u>

Wolves may be caught in traps or snares set for other animals. If a captured wolf is healthy, the responding agency will consult with partner agencies prior to initiating an action. Site-specific circumstances will influence how such captures are handled; however, a rapid response and decision will be necessary to ensure the health and well being of the animal. USFWS Office of Law Enforcement should immediately be consulted in this situation (to make a legal determination about the capture, properly document the event, and initiate further action if necessary).

Factors that will be considered when responding to a wolf capture include the following:

- If there is no history of wolf problems in the area where the animal is captured, the preferred approach is on-site release. However, decisions regarding how to manage the issue will be made on a case-by-case basis. An evaluation will be made to determine if there have been any reported wolf problems in the area prior to making a release decision. Interagency coordination will be initiated to determine what should be done with the animal.
- If an on-site release is being considered, an evaluation of the animal's health will be conducted prior to release. If the wolf is injured, depending on the severity of the injury, a decision will be made on whether or not to release the animal. Female wolves with pups captured on public lands prior to October 1 should be released in the same area as capture unless there have been repeated depredations in the area.
- If the animal is collared and released, collaborating agencies will monitor its movements as regularly as possible.
- If a decision is made to hold the animal, arrangements will be made with an appropriate kennel facility and veterinary care will be arranged, if needed.

5. Report of a Dead or Injured Wolf

USFWS Office of Law Enforcement and WDFW enforcement personnel will immediately be called in to investigate all reports of dead or injured wolves and make a determination about the cause of death or injury, properly document the event, and initiate further action as necessary. The USFWS is responsible for investigating cases that involve unauthorized take of a Federally listed species. The WDFW is responsible for investigating violations of State wildlife laws.

When an injured or dead wolf is found, response will include the following elements:

- USFWS and WDFW Law Enforcement will be immediately notified and they will determine and control all subsequent aspects of the response.
- Keys to a successful response include:
  - Law Enforcement officers are rapidly notified and respond promptly.
  - Scene where the animal was found is left undisturbed and effectively secured.
  - Key individuals in various agencies are promptly notified.
- If an injured wolf is found, actions will be taken immediately to stabilize its condition. Interagency coordination will be initiated to determine what should be done with the animal. Depending on the severity of the injury, a decision will be made on whether or not to release the animal.

RESPONSE STRATEGY AND CHECKLISTS

Response checklists have been developed for each of the five potential wolf situations listed above to facilitate a smooth and organized response:

1. UNCONFIRMED REPORT OF WOLF ACTIVITY (TRACKS OR SIGHTINGS)

Recipient of report:

Take caller's name and call back information.

Contact the appropriate USFWS or WDFW office.

The USFWS or WDFW will interview the person(s) reporting the sighting and record all relevant information regarding the sighting on the appropriate form and mark the location on a map.

When warranted and resources are available, the WDFW or its designated agents will conduct a follow-up field investigation to try to determine if wolves are in fact in the area, particularly when multiple credible reports come in from the same area.

2. VERIFIED WOLF ACTIVITY, WITHOUT A DEPREDATION OR CONFLICT

If the presence of wild wolves is confirmed, and there has not been a livestock or domestic animal depredation or other problem incident, the first recipient of the information will respond as follows:

Recipient of report:

- Take caller's name and call back information.
- Document the specific location(s) where activity has been observed.
- Contact the appropriate USFWS or WDFW office.

Agency Roles and Responsibilities

WDFW will investigate verified wolf sightings and monitor wolf activity.

USFWS may assist WDFW with investigating verified wolf sightings and monitoring wolf activity.

Wildlife Services personnel may provide assistance in trapping efforts for radio-collaring wolves.

1. The agencies will coordinate and share this information with all other appropriate agencies, e.g. USFWS or WDFW, WS, US Forest Service, BLM, National Park Service (NPS), and Washington Department of Natural Resources (WDNR).

2. If wolf activity is within or adjacent to Tribal lands, the USFWS office involved will share this information with the affected tribe.

3. All media inquiries should be referred to USFWS External Affairs contact Doug Zimmer, and WDFW Public Affairs contacts Madonna Luers (Spokane, east of the Cascade Mountains), or Margaret Ainscough (Olympia, west of the Cascade Mountains).

4. WDFW local Enforcement Officers will provide information updates to livestock producers in the area and describe what they can legally do to discourage wolves from frequenting their property or grazing allotment.

5. Monitoring of wolf activity will be coordinated among USFWS, WDFW and WS, using one or more of the following three approaches:
   - Compile information and map locations of sightings of animals and tracks through interviews with persons(s) reporting activity.
   - Conduct periodic ground surveys (i.e., scat and track surveys, howling surveys) and/or flyovers to monitor wolf activity.
   - Use radio-telemetry to regularly track collared animal(s).

3. REPORT OF POSSIBLE WOLF-CAUSED DEPREDATION ON LIVESTOCK OR OTHER DOMESTIC ANIMALS

Recipient of report:

Take caller's name and call back information and advise the caller to protect the scene. Ask for specific directions on how to reach the scene (street names, landmarks, gates, etc).

Give the caller the following instructions to protect the scene:

- Avoid walking in and around the area;
- Keep dogs and other animals from the area to protect evidence;
- Place tarp over carcass;
- If possible, use cans or other objects to cover tracks and scats that can confirm the depredating species;
- Inform caller that a Wildlife Services investigator will be notified of the incident.

Immediately contact the appropriate USFWS or WDFW office.

Agency Roles and Responsibilities

Wildlife Services is the lead agency for investigating livestock depredations and making the determination on cause of death.

1. USFWS, WDFW, or WS will interview the person(s) reporting the incident and record all relevant information regarding the incident on the appropriate form and mark the location on a map.

2. USFWS or WDFW will contact WS and relay the information provided by the caller and request that an investigator be dispatched to the scene.

3. The responding agency will coordinate with WS, WDFW, USFWS, and the livestock owner, as needed, to ensure someone responds and that the owner is kept informed.

4. The agency will notify law enforcement, and all other appropriate agencies (e.g. US Forest Service, BLM, NPS, WA DNR).

5. If wolf activity is within or adjacent to Tribal lands, the USFWS office involved will work with the affected tribe.

6. All media inquiries should be referred to USFWS External Affairs contact Doug Zimmer, and WDFW Public Affairs contacts Madonna Luers (Spokane, east of the Cascade Mountains), or Margaret Ainscough (Olympia, west of the Cascade Mountains).

If Wildlife Services Determines that the Depredation was Wolf-Caused:

1. USFWS, WDFW, and WS will coordinate and consult with designated agency managers to evaluate possible response actions, assess the efficacy of non-lethal measures and document that process, and determine the appropriate response measure.

2. USFWS, in coordination with WDFW and WS, will authorize a course of action, with notification to USFWS and WDFW Law Enforcement prior to action being taken.

3. WS will implement the response efforts under the direction of the USFWS. WDFW may assist if conditions warrant.

4. WDFW local enforcement officers will provide information updates to livestock producers in the area and describe what they can legally do to discourage wolves from frequenting their property or grazing allotment.

4. REPORT OF A WOLF CAPTURE

Recipient of report:

Take caller's name and call back information and get detailed description of the incident location from the caller. Ask about specific directions on how to reach the scene (street names, landmarks, gates, etc), provide them with instructions on what to do until someone arrives, and inform them that USFWS or WDFW personnel will respond to the scene immediately.

Immediately contact the appropriate USFWS or WDFW office.

Agency Roles and Responsibilities

WDFW will respond to wolf captures.

USFWS may assist in responding to wolf captures and will coordinate with WDFW and WS to decide on what course of action to take.

Wildlife Services may assist if conditions warrant.

1. The responding agency will interview the person(s) reporting the incident and record all relevant information regarding the incident on the appropriate form and map the location.

2. An agent from WS, or a biologist from WDFW or USFWS will be dispatched to confirm that the captured animal is a wolf and to evaluate the animal's condition.

3. If it is confirmed that the animal is a wolf, contact USFWS Office of Law Enforcement and advise them of the circumstances as soon as possible.

4. Initiate interagency coordination to determine what should be done with the animal. Depending on the severity of any injury to the animal, a decision will be made on whether or not to release the animal.

5. Upon the USFWS Office of Law Enforcement's determination that information can be released (if a wolf), the responding agency will notify all other appropriate agencies (e.g. US Forest Service, BLM, NPS, and WA DNR).

6. If wolf activity is within or adjacent to Tribal lands, the USFWS office involved will work with the affected tribe.

7. If the decision is to release the animal on site, WDFW Enforcement officers will provide information updates to livestock producers in the area and describe what they can legally do to discourage wolves from frequenting their property or grazing allotment.

8. In USFWS Office of Law Enforcement matters, refer media inquiries to the Redmond Office of Law Enforcement. In non-law enforcement matters, refer all media inquiries to USFWS External Affairs contact Doug Zimmer and WDFW Public Affairs contacts Madonna Luers (Spokane, east of the Cascade Mountains), or Margaret Ainscough (Olympia, west of the Cascade Mountains).

5. REPORT OF A DEAD OR INJURED WOLF

Recipient of report:

Take caller's name and call back information and advise the caller to secure the scene. Ask about specific directions on how to reach the scene (street names, landmarks, gates, etc).

Give the caller the following instructions to protect the scene:

- Treat area as a potential crime scene.
- Do not touch anything and keep all people and animals from the area.

- A tarp can be placed over the wolf carcass.
- Cans or other items can be placed over footprints and animal tracks.

Immediately contact the appropriate USFWS or WDFW office.

Agency Roles and Responsibilities

WDFW will respond to reports of dead or injured wolves.

USFWS will make decisions on euthanasia of injured wolves.

WS may respond to reports of injured wolves.

1. USFWS or WDFW will contact caller to get a detailed description of the incident location.

2. USFWS or WDFW will notify USFWS and WDFW Law Enforcement, relay information provided by the caller, and request that an officer be sent to the scene.

IF THE WOLF IS DEAD: USFWS Law Enforcement personnel will take over the investigation and determine all subsequent aspects of the response. If there is an ongoing law enforcement investigation, refer all media inquiries to USFWS Office of Law Enforcement, Redmond.

IF THE WOLF IS INJURED:

1. Dispatch a USFWS, WS or WDFW biologist to the scene to evaluate the seriousness of injuries and recommend further action and continue coordination with USFWS law enforcement agent and on-site person.

2. With USFWS Office of Law Enforcement concurrence, the USFWS and WDFW will notify all other appropriate agencies (WS, US Forest Service, BLM, NPS, and WA DNR).

3. Interagency coordination will be initiated to determine what should be done with the animal. Depending on the severity of the injury, a decision will be made on whether or not to release the animal.

4. If wolf activity is within or adjacent to Tribal lands, the USFWS will work with the affected tribe.

5. If there is an ongoing law enforcement investigation, refer all media inquiries to USFWS Office of Law Enforcement, Redmond. Otherwise, refer all media inquiries to USFWS External Affairs contact Doug Zimmer and WDFW Public Affairs contacts Madonna Luers (Spokane, east of the Cascade Mountains), or Margaret Ainscough (Olympia, east of the Cascade Mountains).

Attachment A: Phone Contacts to Report Wolf Observation, Injury, or Suspected Depredation

U.S. Fish and Wildlife Service, Monday through Friday, 8:00 – 4:30 (except federal holidays):

Eastern Washington:
Wenatchee………………………………………………..……………………(509) 665-3508

Western Washington:
Lacey …………………………………………………………………………… (360) 753-9440

USFWS Office of Law Enforcement to report dead or injured wolves:

Spokane ………………………………………………………………………… (509) 928-6050
Lacey …………………………………………………………………………… (360) 753-7764
Redmond ……………………………………………………………………….. (425) 883-8122
Bellingham ……………………………………………………………………... (360) 733-0963
Burbank (Tri-Cities)…………………………………………………………... (509) 546-8344
Portland ………………………………………………………………………… (503) 780-9771

USFWS Office of Law Enforcement after hours:

Call Washington State Patrol Office (425-649-4370). Tell dispatcher which county is involved and ask to be connected to a USFWS Special Agent.

Washington Department of Fish and Wildlife, Monday through Friday, 8:00 – 5:00:

Spokane …………………………………………………………………………. (509) 892-1001
Ephrata …………………………………………………………………………. (509) 754-4624
Yakima ………………………………………………………………………….. (509) 575-2740
Vancouver ………………………………………………………………………. (360) 696-6211
Mill Creek ……………………………………………………………………….. (425) 775-1311
Montesano ……………………………………………………………………… (360) 249-4628
Olympia …………………………………………………………………………. (360) 902-2200

USDA Wildlife Services, Statewide, Monday through Friday, 7:30 – 4:00:

Olympia …………………………………………………………………………. (360) 753-9884

For Emergency and after-hours:
Contact your local State Patrol Office and ask to be connected to a local WDFW wildlife officer.

Washington State 24 hr Wolf Reporting System…………..……………………… (877)933-9847