Montana Gray Wolf
Conservation and Management
2015 Annual Report

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Montana Fish, Wildlife & Parks

This is a cooperative effort by Montana Fish, Wildlife & Parks, USDA Wildlife Services, Glacier National Park, Yellowstone National Park, Blackfeet Nation, and The Confederated Salish and Kootenai Tribes

This report presents information on the status, distribution, and management of wolves in the State of Montana, from January 1, 2015 to December 31, 2015.

This report is also available at: http://fwp.mt.gov/fishAndWildlife/management/wolf/

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MONTANA EXECUTIVE SUMMARY

Wolf recovery in Montana began in the early 1980's. Gray wolves increased in number and expanded their distribution in Montana because of natural emigration from Canada and a successful federal effort that reintroduced wolves into Yellowstone National Park and the wilderness areas of central Idaho. The federal wolf recovery goal of 30 breeding pairs for 3 consecutive years in Montana, Idaho and Wyoming was met during 2002, and wolves were declared to have reached biological recovery by the U.S. Fish and Wildlife Service (USFWS) that year. During 2002 there were a minimum of 43 breeding pairs and 663 wolves in the Northern Rocky Mountains (NRM). The Montana Gray Wolf Conservation and Management Plan was approved by the USFWS in 2004.

Nine years after having been declared recovered and with a minimum wolf population of more than 1,600 wolves and 100 breeding pairs in the NRM, in April 2011, a congressional budget bill directed the Secretary of the Interior to reissue the final delisting rule for NRM wolves. On May 5, 2011 the USFWS published the final delisting rule designating wolves throughout the Designated Population Segment (DPS), except Wyoming, as a delisted species. Wolves in Montana became a species in need of management statewide under Montana law. State rules and the state management plan took full effect. Using a combination of federal funds and sportsman license dollars, Montana Fish, Wildlife and Parks (FWP) implements the state management plan by monitoring the wolf population, directing problem wolf control under certain circumstances, coordinating and authorizing research, regulating sport harvest, and leading wolf information and education programs.

The minimum count of Montana wolves decreased by 18 from 554 in 2014 to 536 in 2015. A total of 126 packs of 2 or more wolves were verified in Montana for 2015. Thirty-two packs, two less than in 2014 and five more than in 2013, qualified as a breeding pair according to the federal recovery definition of an adult male and female with two surviving pups on December 31. In northwest Montana we verified 349 wolves in 85 packs, 20 of which were breeding pairs, while in western Montana we verified 78 wolves in 22 packs, 4 of which were breeding pairs, and in southwest Montana we verified 109 wolves in 19 packs, 8 of which were breeding pairs.

The Montana State Office of the U.S. Department of Agriculture's Wildlife Services (WS) confirmed 64 livestock losses to wolves including 41 cattle, 21sheep and 2 horses in calendar year 2015 compared to 47 total confirmed losses in 2014. Additional losses (both injured and dead livestock) occurred, but in some cases could not be confirmed. Most depredations occurred on private property. During 2015 the Montana Livestock Loss Board paid $79,311.72 for livestock that were confirmed by WS as killed by wolves, livestock confirmed as probable wolf kills, and 1 injured dog. Fifty-one wolves were killed to reduce the potential for further depredation. This was the lowest number of wolves killed due to depredation in a decade. Of the 51 wolves,35 were killed by WS and 16 were killed by private citizens under state regulations that allow citizens to kill wolves seen chasing, killing, or threatening to kill livestock.

Wolf hunting was recommended as a management tool in the final wolf conservation and management plan (FWP 2004) with the caveat that hunting could only be implemented when wolves were delisted and if there were more than 15 breeding pairs in Montana the previous year. Both of these conditions have been met. Wolves have been delisted since 2011 and there have been more than 15 breeding pairs every year since 2002. The calendar year 2015 included parts of two hunting/trapping seasons for wolves. During the spring 2014-15 season portion of the 2015 calendar year, 88 wolves were harvested, and 117 were taken during the fall 2015-16 season portion for a total harvest of 205.

The total number of known wolf mortalities during 2015 was 276, with 270 of these mortalities being human-related, including 205 legal harvests, 39 control actions (35 agency control and 4 under defense of property statute), 6 vehicle strikes, 8 illegal killings, and 12 killed under Montana State Senate Bill 200. In addition, 3 wolves were known to die of natural causes and 3 of unknown causes.

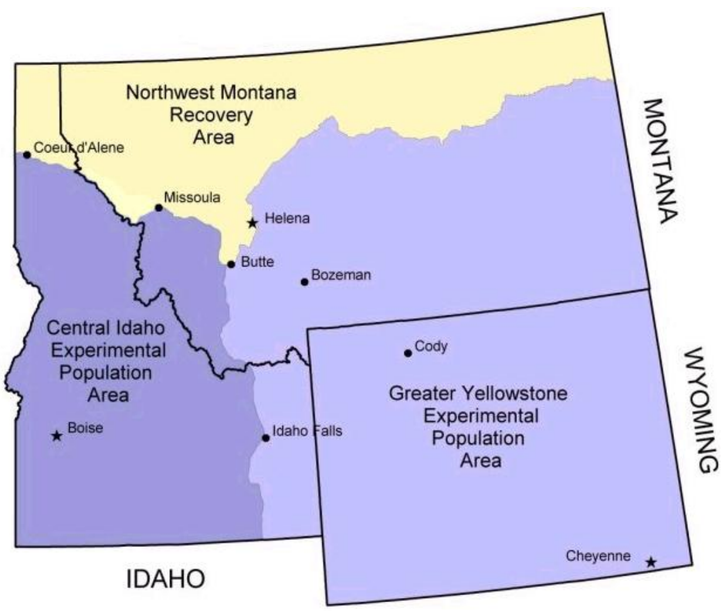
This annual report presents information on the status, distribution, and management of wolves in the State of Montana from January 1 to December 31, 2015. The report and other information about wolves and their management in Montana are available at http://fwp.mt.gov/fishAndWildlife/management/wolf/

INTRODUCTION AND BACKGROUND

Wolf recovery in Montana began in the early 1980's. Gray wolves increased in number and expanded their distribution in Montana because of natural emigration from Canada and a successful federal effort that reintroduced wolves into Yellowstone National Park (YNP) and the wilderness areas of central Idaho. Montana contains portions of all three federal recovery areas: the Northwest Montana Recovery Area (NWMT), the Central Idaho Experimental Area (CID), and the Greater Yellowstone Experimental Area (GYA) (Figure 1).

The biological and temporal requirements for wolf recovery in the northern Rocky Mountains of Montana, Idaho, and Wyoming were met in December 2002, and in 2003 all three states submitted wolf management plans to the USFWS for review. The USFWS accepted Montana's state plan and it is the document guiding wolf management in the state today.

Figure 1. Northern Rockies gray wolf federal recovery area comprised of the states of Montana, Idaho, and Wyoming.



STATEWIDE PROGRAM OVERVIEW

The Montana Wolf Conservation and Management Plan is based on the work of a citizen's advisory council. Completed in 2003, the foundations of the plan are to recognize gray wolves as a native species and a part of Montana's wildlife heritage, to approach wolf management similar to other wildlife species such as mountain lions, to manage adaptively, and to address and resolve conflicts.

Prior to delisting in May 2011, the legal classification and federal regulations put wolves into two separate categories in Montana – endangered in northern Montana and experimental non-essential across southern Montana. Wolf-livestock conflicts were addressed and resolved using a combination of the statewide adaptive management triggers identified in the Montana plan and the federal regulations. In northwest Montana, the 1999 Interim Control Plan provided less flexibility to agencies and livestock owners. In contrast, more flexibility was provided through the revised 10(j) regulations (revised in February 2008).

Beginning with delisting in May 2011, the wolf was reclassified as a species in need of management statewide. Montana's laws, administrative rules, and state plan replaced the federal framework.

In the early stages of implementation, a core team of experienced individuals led wolf monitoring efforts and worked directly with private landowners. FWP's wolf team also worked closely with and increasingly involved other FWP personnel in program activities. Montana wolf conservation and management has transitioned to a more fully integrated program since delisting, led and implemented at the FWP Regional level. USDA Wildlife Services (WS) continues to investigate injured and dead livestock, and FWP works closely with them to resolve conflicts.

Overview of Wolf Ecology in Montana

Wolves are distributed primarily in western Montana east to the Beartooth face near Red Lodge inhabiting various habitats on both private and public lands (Figure 2). Montana wolf pack territory size estimates are naturally variable and heavily influenced by FWP's ability to collect location data on pack members throughout the year. Our confidence in estimating home territories for all packs has decreased as wolf numbers, pack numbers, and wolf conflicts increased the workloads of the wolf team. The size of the average wolf pack with good documentation in Montana is between 6 and 7 wolves. The largest wolf pack documented in Montana in recent years has been 22 animals but packs this large are very rare. There is no significant difference in the average size of wolf packs across the state. FWP is currently engaged in a research project with the University of Montana to obtain better estimates of pack territory size and number of wolves per pack.

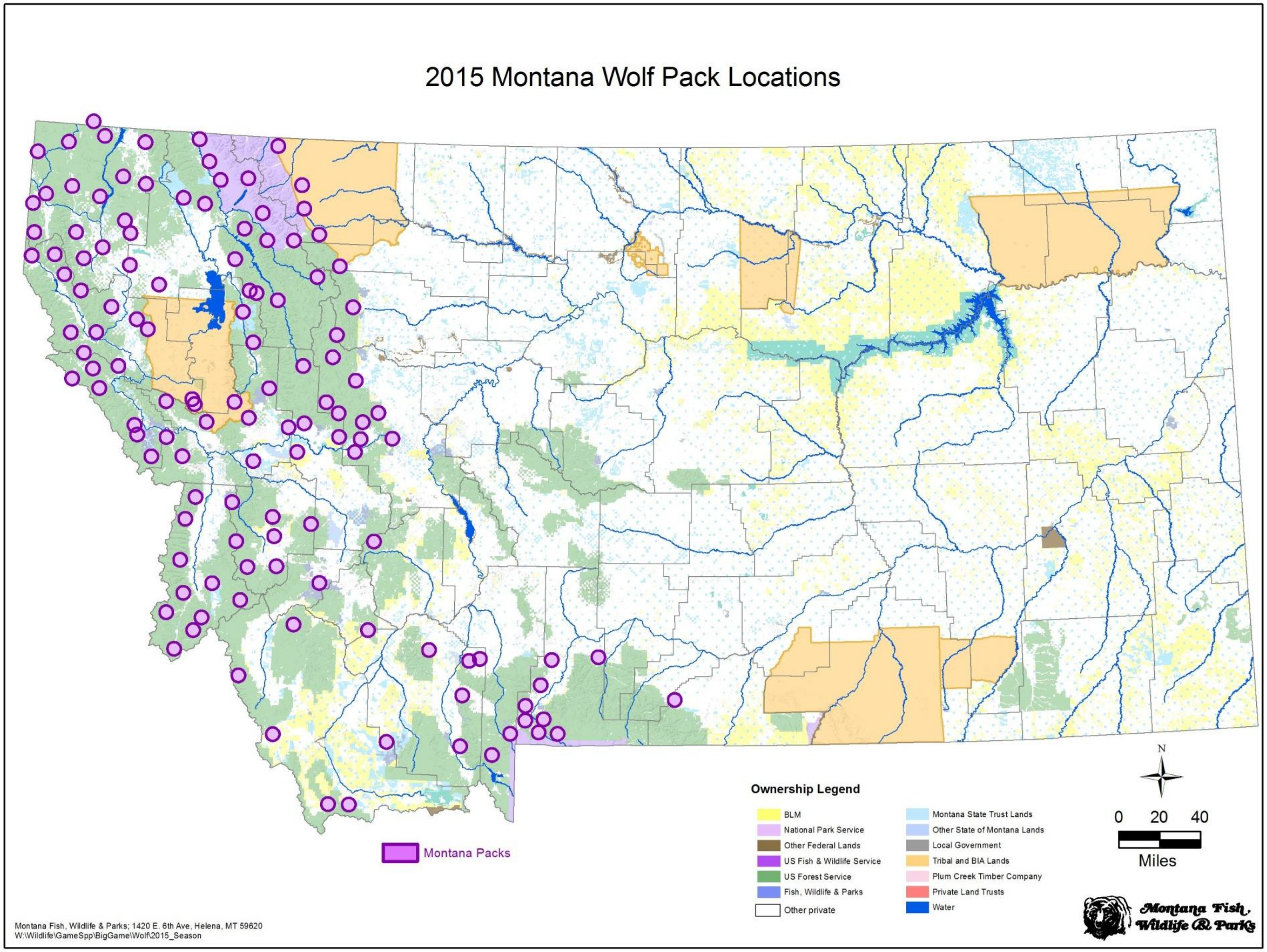


Figure 2. Verified wolf pack distribution in the State of Montana, as of December 31, 2015.

WOLF POPULATION MONITORING

Since wolves returned to the northwestern part of the state by the 1980's, Montana wolf packs have been intensively monitored year round. Objectives for monitoring during the period of recovery were driven by the USFWS's recovery criteria – 30 breeding pairs for 3 consecutive years in Montana, Idaho, and Wyoming. Similar metrics of population status have been used over the last 14 years from the time recovery criteria were met in 2002, through delisting in 2011, and for the last 5 years when the USFWS retained oversight after delisting. These population monitoring criteria and methods were appropriate and achievable when the wolf population was small and recovering. In the early years, most wolf packs had radio-collared individuals, and intensive monitoring was possible to identify new packs and most individuals within packs. In 1995, when the US Fish and Wildlife Service reintroduced wolves into Yellowstone National Park and central Idaho, the end-of-year count for wolves residing in Montana was only 66. However, as wolf populations have increased over time, the ability to count every pack, every wolf, and every breeding pair has become unrealistic. By 2012 the minimum count had reached 625. As Montana transitions during 2016 to complete management authority without USFWS oversight or funding, these same methods will continue to be used to document a minimum of 150 wolves and 15 breeding pairs in Montana as indicated in the state wolf plan. At the same time, FWP will continue to work with the U.S. Geological Survey's Cooperative Research Unit at the University of Montana to develop wolf population monitoring techniques that are scientifically rigorous and more logistically and financially efficient. Basic goals of this work include 1) use of Patch Occupancy Modeling (POM) to estimate distribution and numbers of wolves across the state, and 2) development of a more efficient and effective measure of wolf population recruitment (reproduction and survival of young to breeding age). Current information on estimates made via POM is included below, and more information about the ongoing work with USGS and UM is included in Appendix 3.

Monitoring Method 1: Minimum Counts of Wolves and Breeding Pairs

Field Methods.-- Common wolf monitoring techniques used by FWP include deployment of radio-telemetry collars, direct observational counts, howling and track surveys, use of trail cameras, and following up on public wolf reports. FWP uses these techniques to obtain minimum counts of wolves, document pack size and breeding pair status of known packs, determine pack territories and identify potentially affected private landowners, document dispersal to the extent possible, assess connectivity, and verify wolf activity in new areas that can result in new packs forming. FWP also conducts ground tracking and flies 1-2 times per month to locate collared animals and determine localized use throughout the year and the number of wolves traveling together. Den sites and rendezvous sites are visited to determine if reproduction has taken place. Additional information is collected, such as identification of private lands used by wolves, identification of public land grazing allotments where conflicts could occur, and common travel patterns.

Packs, Individuals, and Breeding Pairs.-- The total number of wolf packs is determined by counting the number of animal groups with 2 or more individuals holding a territory that existed on the Montana landscape on December 31. If a pack was removed because of livestock conflicts or otherwise did not exist at the end of the calendar year (e.g. disease, natural/legal/illegal mortality or dispersal), it is not included in the year-end total or displayed on the Montana wolf pack distribution map for that calendar year. Packs that share a state or provincial border are assigned to one state or another. Northern Rocky Mountain wolf program cooperators have agreed that packs will be tallied in the population of the administrative area where the pack denned or spent most of their time. This assures that all packs are accounted for, but none are double-counted in population estimates. Transboundary packs are included in the administrative region in which the animals were counted. Where packs are suspected, but not verified, and FWP conservatively notes those packs in the narrative. Those suspected packs are not included in the minimum estimate.

FWP estimates the number of individual wolves in each pack when possible. Lone dispersing animals are accounted for when reliable information is available. Montana is required to maintain at least 100 wolves as an absolute minimum to avoid a USFWS status review on wolves, and the state plan calls for a minimum of 150 individual wolves.

FWP also tallies and reports the number of "breeding pairs" according to the federal recovery definition of "an adult male and a female wolf that have produced at least 2 pups that survived until December 31." Montana is required to maintain at least 10 breeding pairs as an absolute minimum to avoid a USFWS status review on wolves, and the Montana state plan calls for at least 15 breeding pairs. Packs of 2 or more adult wolves that meet the recovery definition are considered "breeding pairs" and noted as such in the summary tables. Breeding pair status for each and every known pack in Montana cannot be verified with existing personnel and funding, especially as the wolf population has increased over time. If the breeding pair status is not known with confidence, it is recorded as "not" a breeding pair or "breeding status unknown." Thus, the count of breeding pairs is also a minimum.

Final Counts for the Year.-- The statewide minimum wolf population is derived by adding up the number of observed wolves in verified packs + known lone animals and then removing all known wolf mortalities as of December 31 each year. To do this, each known wolf mortality is assigned to a pack or lone/misc. wolf (Appendix 5, Tables 1a, 1b, 1c), and these mortalities are subtracted from known pack sizes to derive the minimum estimated pack sizes and minimum count of wolves for the year. This is a minimum count, not a population estimate, and has been reported as such since wolves first began re-colonizing northwestern Montana in the mid 1980's. Suspected wolf packs are those that could not be verified with confidence. They are not included in the final minimum estimated count.

FWP wolf monitoring data, while not a precise accounting of the number of wolves in Montana, are used to make decisions to address wolf-livestock conflicts and to set wolf hunting and trapping regulations. These minimum count data are also adequate to demonstrate maintenance of a recovered population according to criteria set by the USFWS during recovery.

2015 Border Packs.-- During 2015, 23 packs occupied areas along the Montana-Idaho Border. Of those, 16 were counted as Montana packs. Five packs occupied the Montana-Canada border and 3 of those were counted as Montana packs. One pack variously occupied Montana, Yellowstone National Park, and Idaho. That pack (Madison) was counted as an Idaho pack. Four other pack territories were adjacent to or crossed the border with YNP (Cinnabar, Parker Peak, Cougar 2 and Hayden) and were counted toward the MT population in 2015. Three border packs (Eightmile, Prospect peak, and Cougar) were documented to have spent some time in MT, but were counted toward the WY (YNP) population.

2015 Minimum Count of Wolves and Breeding Pairs.-- The Montana wolf population is secure and far above the 150 wolf and 15 breeding pair minimums of the state plan, as it has been for over a decade. The Montana minimum wolf count decreased by 18 wolves, from a minimum count of 554 in 2014 to a minimum count of 536 in 2015 (Figure 3). This minimum count for 2015 was obtained with less personnel time than in recent years. FWP Regions 1 (Kalispell) and 2 (Missoula), the two regions with the highest number of wolves in the state, were each short a full-time wolf specialist for all or the majority of the year.

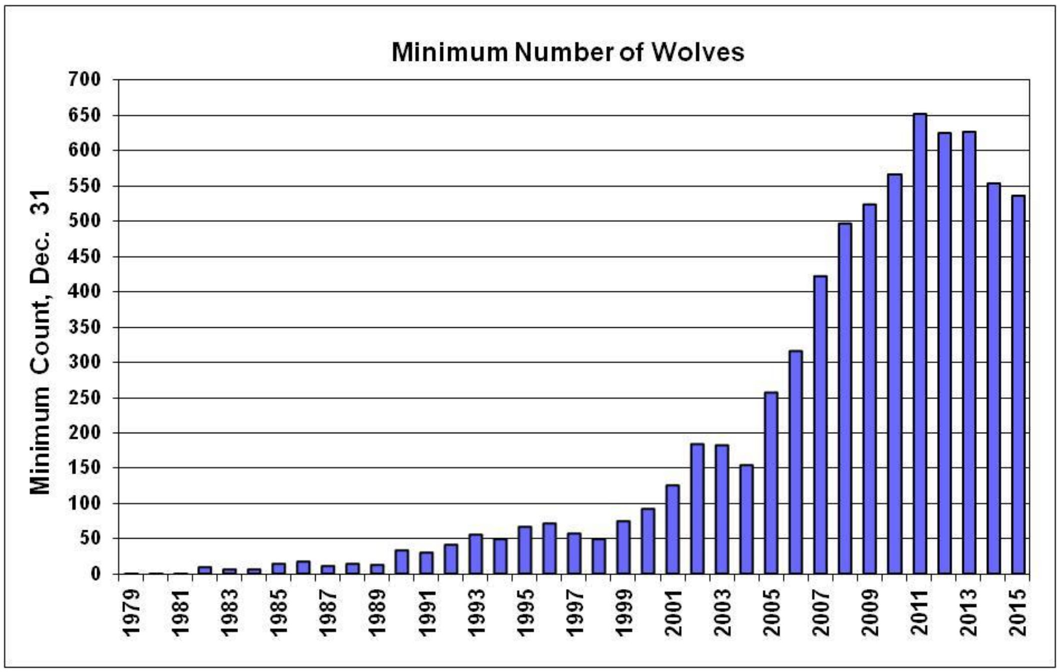


Figure 3. Estimated minimum number of wolves in Montana, 1979-2015

The minimum number of packs statewide decreased from 134 at the end of 2014 to 126 at the end of 2015 (Appendix 4). The minimum number of breeding pairs in Montana decreased from 34 at the end of 2014 to 32 at the end of 2015 (Appendix 4).

In northwest Montana, the minimum wolf count increased from 338 in 2014 to 349 in 2015. Twenty of 85 known packs were documented to have met the breeding pair criteria. Four wolf packs occurred on the Blackfeet Indian Reservation and 5 on the Flathead Indian reservation, for a total of 9 packs on Tribal lands.

In western Montana, the minimum wolf count decreased from 94 in 2014 to 78 in 2015. Four of 22 packs were documented to have met the breeding pair criteria.

In southwest Montana, the minimum wolf count decreased from 122 in 2014 to 109 in 2015. Eight of 19 packs were documented to have met the breeding pair criteria.

Monitoring Method 2: Patch Occupancy Modeling of Wolf Distribution and Numbers

The capacity for MFWP personnel to monitor a larger and rapidly growing wolf population has been declining given robust wolf population growth since about 2006. The traditional field-based methods yield minimum counts that are conservative and inevitably (and probably increasingly) below the true population sizes, and the degree of undercount is unknown. Consequently, MFWP has explored other, cost-effective methods that could more accurately be described as population estimates that account for uncertainty, as opposed to minimum counts.

In anticipation of an increased work load and declining federal funding, MFWP first began considering alternative approaches to monitoring the wolf population in 2006. Preliminary work focused on developing a more reliable and cost-effective method to estimate number of breeding pairs based on the size of a wolf pack (Mitchell et al. 2008). Subsequent work focused on finding ways to utilize wolf observations by hunters in a more systematic way. A collaborative research effort with the UM Cooperative Wildlife Research Unit was initiated in 2007. The primary objective was to find an alternative approach to wolf monitoring that would yield statistically reliable estimates of the number of wolves, wolf packs, and breeding pairs (Glenn et al. 2011). Ultimately, a method applicable to a sparsely distributed and elusive carnivore was developed. The method used hunter observations as a cost effective means of gathering biological data to estimate the area occupied by wolves in Montana, along with information gathered from field monitoring by biologists to estimate the number of packs (Rich et al. 2013).

The general method we used to estimate the number of wolves in Montana was to 1) estimate the area occupied by wolves in packs, 2) estimate the numbers of wolf packs by dividing area occupied by average territory size and correcting for overlapping territories, and 3) estimate the numbers of wolves by multiplying the number of estimated packs by average annual pack size (Figure 4). This technique bypasses the need to count every individual in every pack, and instead relies on public reported wolf observations, field-documented territory size, and a small number of monitored packs and pack sizes. *The following section presents an analysis of data from 2007-2012. Estimates for 2013-2015 are in progress and will be available by summer 2016.*

***Methods for Estimating Area Occupied by Wolves in Packs*.**-- To estimate the area occupied by wolf packs from 2007-2012, we used a multi-season false-positives occupancy model (Miller et al. 2013) using program PRESENCE (Hines 2006). First, we created an observation grid for Montana (Fig. 4A) with a cell size large enough to ensure observations of packs across sample periods, yet small enough to minimize occurrences of multiple packs in the same cell on average (cell size = 600 km^2). We used locations of wolves in packs (2-25 wolves) reported by a random sample of unique deer and elk hunters during MFWP annual Hunter Harvest Surveys (Fig. 4B), and assigned the locations to cells (Fig. 4C). We modeled detection probability, initial occupancy, local colonization and local extinction from 5, 1-week encounter periods, and verified locations (Fig. 4D) using covariates that were summarized at the grid level (Fig. 4E). We made patch-specific estimates of occupancy (Fig. 4F) and estimated total area occupied by wolf packs by multiplying patch-specific estimates of occupancy by their respective patch size and then summing these values across patches (Fig. 4G). Our final estimates of the total area occupied by wolf packs were adjusted for partial cells on the border of Montana and included model projections for reservations and national parks where no hunter survey data existed.

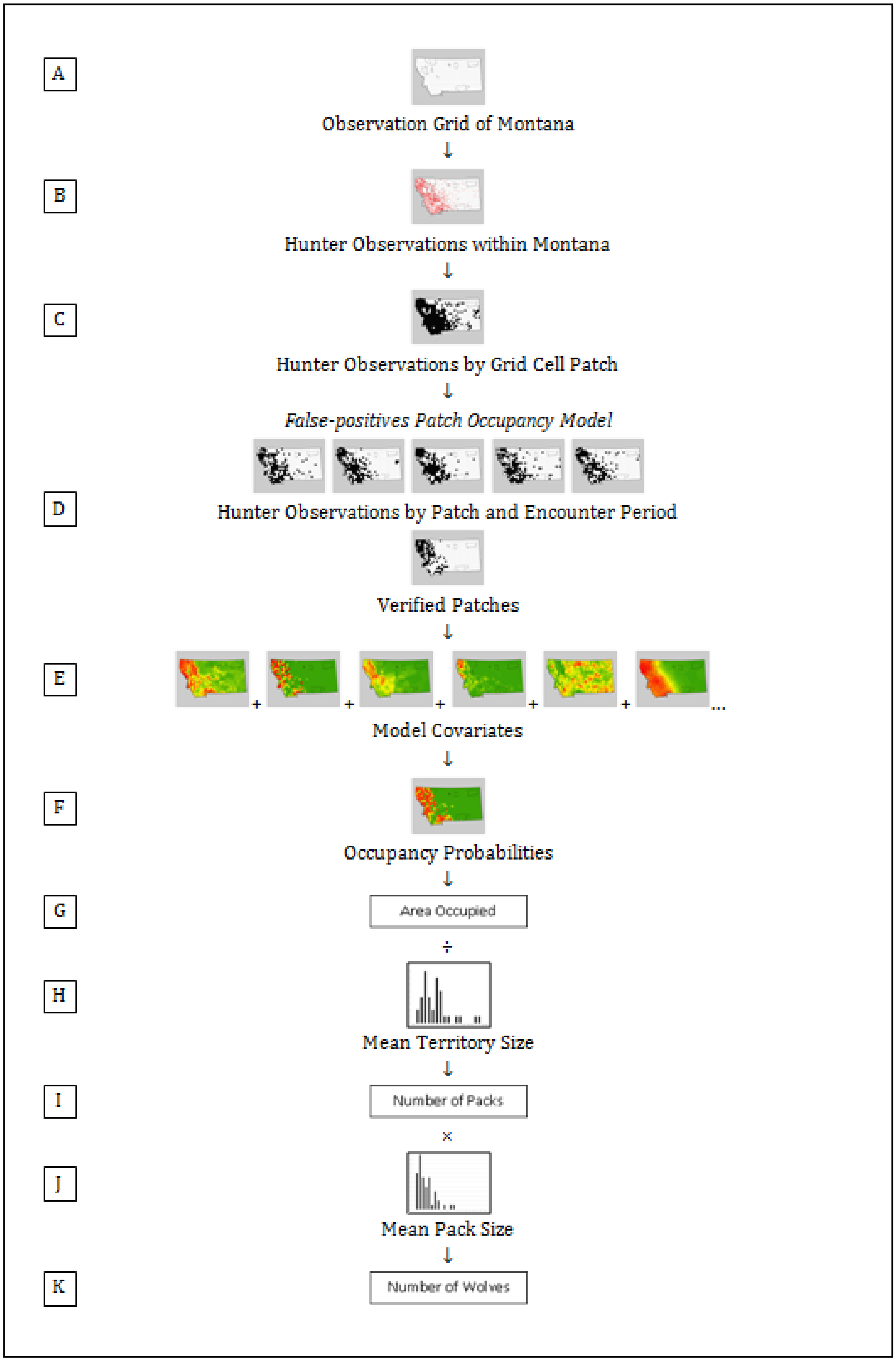


Figure 4. Schematic for method of estimating the area occupied by wolves, number of wolf packs and number of wolves in Montana, 2007-2012.

Model covariates for detection included hunter days per hunting district per year (an index to spatial effort), low use forested and non-forested road densities (indices of spatial accessibility), a spatial autocovariate (the proportion of neighboring cells with wolves seen out to a mean dispersal distance of 100 km), and patch area sampled (because smaller cells on the border of Montana, parks, and Indian Reservations have less hunting activity and therefore less opportunity for hunters to see wolves). Model covariates for occupancy, colonization, and local extinction included a principal component constructed from several autocorrelated environmental covariates (percent forest cover, slope, elevation, latitude, percent low use forest roads, and human population density), and recency (the number of years with verified locations in the previous 5 years).

To estimate area occupied in each year, we calculated unconditional estimates of occupancy probabilities which provided probabilities for sites that were not sampled by Montana hunters (such as National Parks and Reservations). We accounted for uncertainty in occupancy estimates using a parametric bootstrap procedure on logit distributions of occupancy probabilities. For each set of bootstrapped estimates we calculated area occupied. The 95% confidence intervals (C.I.s) for these values were obtained from the distribution of estimates calculated from the bootstrapping procedure.

Methods for Estimating Numbers of Wolf Packs.-- To predict the total number of wolf packs in Montana from 2007 to 2012, we first established an average territory size for wolf packs in Montana (Figure 4H). Rich et al. (2012) calculated 90% kernel home ranges from radio telemetry locations of wolves collared and tracked by wolf MFWP biologists for research and/or management from 2008 to 2009. We assumed the mean estimate of territory size from these data was constant during 2007-2012. For each year, we estimated the number of wolf packs by dividing our estimates of total area occupied by the mean territory size (Figure 4I). We then accounted for annual changes in the proportion of territories that were overlapping (non-exclusive) using the number of observed cells occupied by verified pack centers.

We accounted for uncertainty in territory areas using a parametric bootstrap procedure and a log-normal distribution of territory sizes, and for each set of bootstrapped estimates we calculated mean territory size. The 95% C.I.s for these values were obtained from the distribution of estimates calculated from the bootstrapping procedure.

Methods for Estimating Numbers of Wolves.-- To predict the total number of wolves in Montana for each year from 2007 to 2012, we first calculated average pack size from the distribution of packs of known size (Figure 4J). Pack sizes were established by MFWP biologists for packs monitored for research and/or management. We used end-of-year pack counts for wolves documented in Montana from 2007 to 2012. We only used pack counts MFWP biologists considered complete. Typically, intensively monitored packs with radio-collars provided good counts more often than packs that were not radio-marked. For each year, we estimated total numbers of wolves in packs by multiplying the estimate of mean pack size by the annual predictions of number of packs (Figure 4K).

We accounted for uncertainty in pack sizes using a parametric bootstrap procedure and a Poisson distribution of pack sizes, and for each set of bootstrapped estimates we calculated mean pack size. The 95% C.I.s for these values were obtained from the distribution of estimates calculated from the bootstrapping procedure. We allowed pack sizes to vary by year but not spatially.

Results for Area Occupied by Wolves in Packs.-- From 2007 to 2012, 50,039, 81,475, 80,486, 82,386, 81,532 and 76,996 hunters responded to the wolf sighting surveys. From their reported sightings, 1,202, 2,859, 3,056, 3,469, 3,320, and 2,391, locations of 2 to 25 wolves could be determined during the 5, 1-week sampling periods.

The top model of wolf occupancy showed positive associations between the initial probability that wolves occupied an area and an environmental principal component and recency. The probability that an unoccupied patch became occupied in subsequent years was positively related to an environmental principal component and recency. The probability that an occupied patch became unoccupied in the following year was constant. The probability that wolves were detected by a hunter during a 1-week sampling occasion was positively related to hunter days per hunting district per year, low use forest road density, low use non-forest road density, a spatial autocovariate, and area sampled. The probability that wolves were falsely detected by a hunter during a 1-week sampling occasion was positively related to hunter days per hunting district per year, low use forest road density, low use non-forest road density, and a spatial autocovariate

From 2007 to 2012, estimated area occupied by wolf packs in Montana increased from 39,521 km^2 (95% CI = 39,144 to 40,562) to 79,275 km^2 (95% CI = 78,696 to 79,944; Table 1). The predicted distribution of wolves from the occupancy model closely matched the distribution of field-confirmed wolf locations (verified pack locations and harvested wolves; Figure 5).

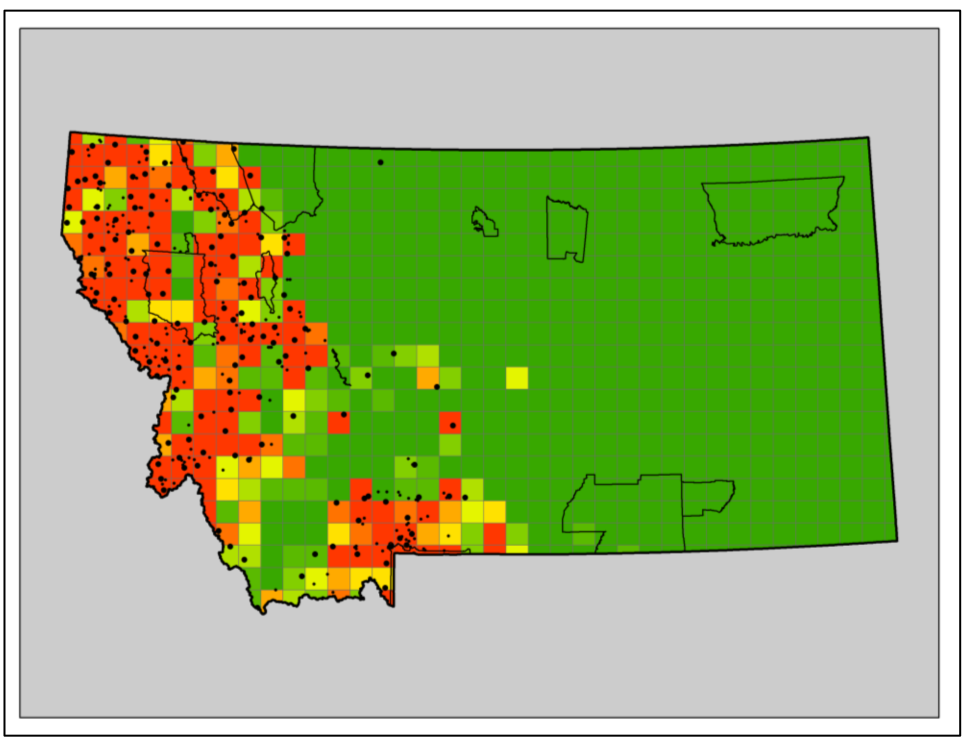


Figure 5. Model predicted probabilities of occupancy (ranging from low to high [green to red]), verified pack centers (large dots), and harvest locations (small dots) in Montana, 2012.

Table 1. Estimated area occupied by wolves, number of wolf packs, and number of wolves in Montana, 2007-2012.

	2007	2008	2009	2010	2011	2012
Estimated Area Occupied (km^2)	39,521	49,831	59,067	64,810	72,134	79,275
(95% C.I.)	(39,144 - 40,562)	(49,298 - 50,593)	(58,542 - 59,814)	(64,277 - 65,476)	(71,606 - 72,871)	(78,696 - 79,944)
Territory Size (km^2)	599.83	599.83	599.83	599.83	599.83	599.83
(95% C.I.)	(493.35 - 740.34)	(493.35 - 740.34)	(493.35 - 740.34)	(493.35 - 740.34)	(493.35 - 740.34)	(493.35 - 740.34)
Estimated Packs (600 km^2 territories)	66	83	98	108	120	132
(95% C.I.)	(54 - 81)	(67 - 101)	(80 - 120)	(87 - 131)	(97 - 146)	(107 - 160)
Territory Overlap Index	1.17	1.11	1.13	1.16	1.24	1.25
Estimated Packs (600 km^2 territories w/overlap)	77	93	112	126	149	165
(95% C.I.)	(63 - 95)	(75 - 113)	(90 - 136)	(102 - 153)	(121 - 181)	(134 - 201)
Average Pack Size (complete counts)	7.03	6.82	6.39	6.16	5.67	4.86
(95% C.I.)	(6.06 - 7.97)	(6.18 -7.65)	(5.75 - 7.10)	(5.46 - 6.86)	(5.05 - 6.28)	(4.27 - 5.51)
Estimated Wolves	542	631	713	774	843	804
(95% C.I.)	(422 - 688)	(503 - 796)	(570 - 888)	(612 - 965)	(664 - 1,056)	(636 - 1,019)

Results for Number of Wolf Packs.-- In 2008 and 2009, territory sizes from 38 monitored packs ranged from 104.70 km^2 to 1771.24 km^2. Mean territory size was 599.83 km^2 (95% C.I. = 478.81 to 720.86; Rich et al. 2012). Dividing the estimated area occupied by mean territory size resulted in an estimated number of packs that increased from 66 (95% C.I. = 54 to 81) to 132 (95% C.I. = 107 to 160) from 2007 to 2012 (Table 1). We adjusted these estimates to account for annual changes in the number of verified pack centers per grid from 2007 to 2012 (1.17, 1.11, 1.13, 1.16, 1.24, and 1.25 for each respective year during 2007-2012) as an index of territory overlap. Accounting for territory overlap, estimated numbers of packs increased from 77 (95% C.I. = 63 to 95) to 165 (95% C.I. = 134 to 201) from 2007 to 2012 (Table 1). The estimated number of wolf packs ranged from 6% larger than the minimum verified number of packs residing in Montana in 2007 to 16% larger in 2010 (Figure 6).

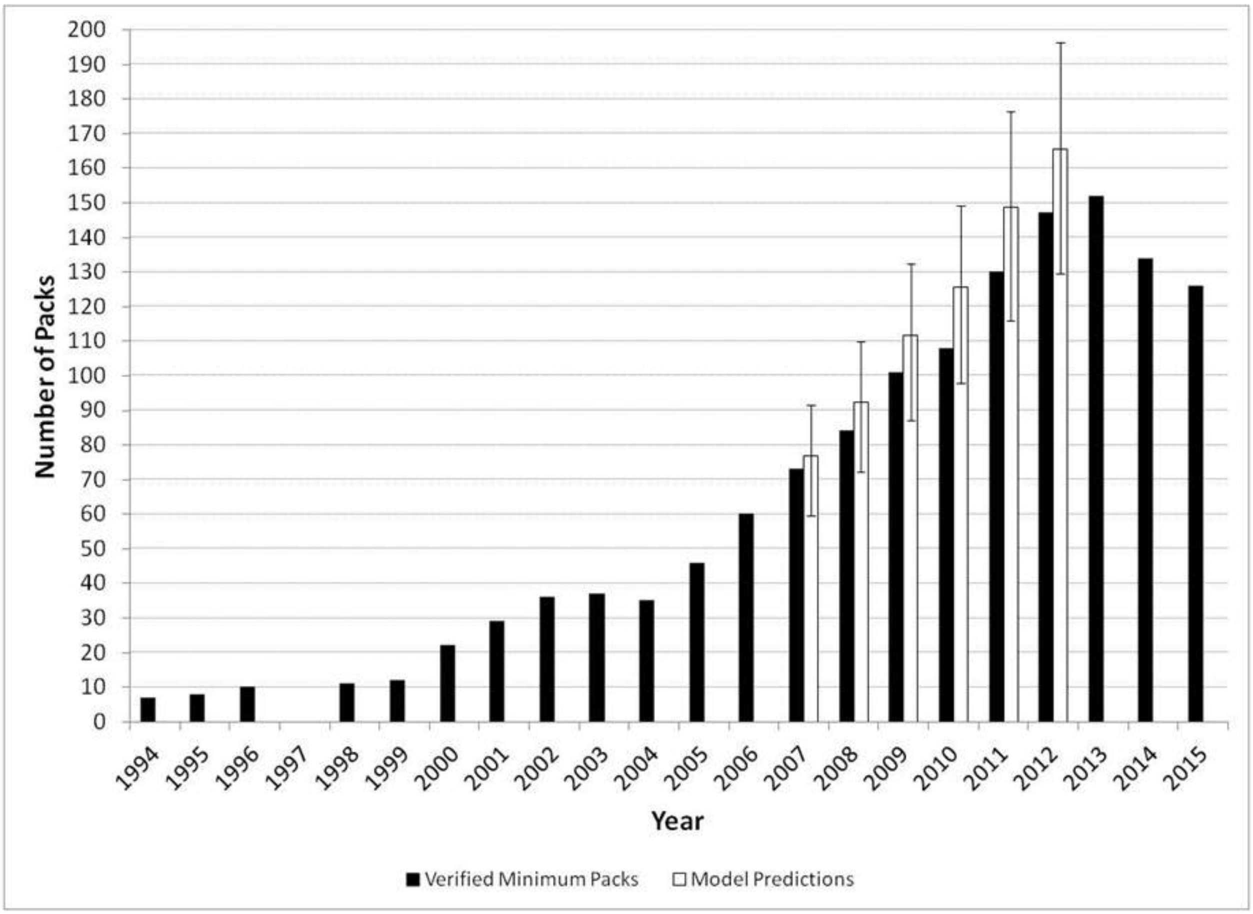


Figure 6. Estimated number of wolf packs in Montana compared to the verified minimum number of packs residing in Montana, 2007-2015. Note: Patch Occupancy Modeling Estimates for 2013-2015 are in progress and should be available by summer 2016.

Results for Number of Wolves.-- From 2007 to 2012, complete counts were obtained from 314 packs within or bordering Montana. Pack sizes ranged from 2 to 22 and from 2007 to 2012 mean pack sizes decreased from 7.03 (95% C.I. = 6.06 to 7.97) to 4.86 (95% C.I. = 4.27 to 5.51). Multiplying estimated packs by mean pack size resulted in an increase of estimated wolves from 542 (95% C.I. = 422 to 688) to 804 from (95% C.I. = 636 to 1,019) 2007 to 2012 (Table 1). The estimated number of wolves ranged from 27% larger than the minimum verified number of wolves in Montana packs in 2008 to 37% larger in 2010 (Figure 7).

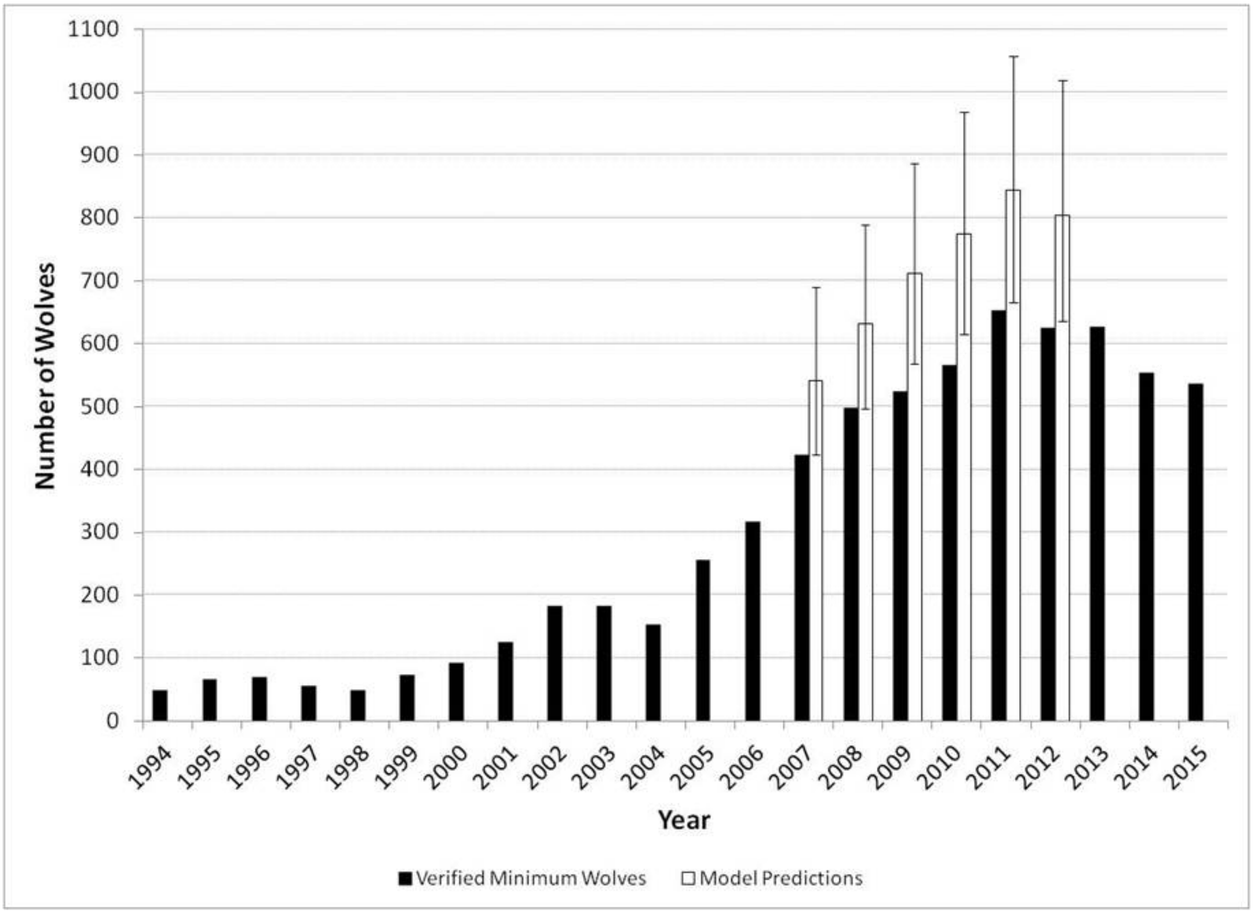


Figure 7. Estimated number of wolves in Montana compared to the verified minimum number of wolves residing in Montana, 2007-2012. Note: Patch Occupancy Modeling Estimates for 2013-2015 are in progress and should be available by summer 2016.

Discussion.-- Although the estimated area occupied has doubled between 2007 and 2012, the rate of growth for the area occupied has been declining. The extent to which this declining rate of increase represents a population responding to density dependent factors as available habitats become filled, versus a response to hunting and trapping harvest, is unknown.

Our estimate for total numbers of wolf packs exceeded the minimum count by 6 to 16% between 2007 and 2012. Such a level of undercount is not unreasonable for elusive carnivores and is within the range of imperfect detection recorded for many other wildlife species and population estimation methods. For example, detection rates of elk during aerial surveys can be less than 20% (e.g., Vander Wal et al 2011), and detection rates of elk during winter surveys on the open winter ranges in southwestern Montana have been estimated at 44-89% (Hamlin and Ross 2002). Becker et al. (1998) produced a population estimate 48% higher than the number of individual wolves they observed, even though they assumed that they detected all wolf tracks in the area they surveyed.

Our estimate of the number of wolf packs assumes that territory size is constant and equal across space. If territory sizes were actually larger in some years or some areas, then the estimated number of packs in those years or areas would have been biased high, and if territory sizes were actually smaller in some years or some areas, then the pack estimates would have been biased low in those years or areas. Similarly, our estimates of territory overlap were indirect indices rather than field-based observations based on high-quality telemetry data. In future applications of this technique, the assumption of constant territory sizes could be relaxed by modeling territory size as a flexible parameter, incorporating estimates of inter-pack buffer space or territory overlap into estimates of exclusive territory size, and incorporating spatially and temporally variable territory size predictions into estimates of pack numbers.

Our estimate for total numbers of wolves exceeded the minimum count by to 37% between 2007 and 2012. The degree of difference exceeds that of packs because in addition to undocumented packs, it incorporates undocumented individuals within known packs. This degree of difference between minimum counts and our population estimate remains within that observed in other studies of wolves (Becker et al. 1998) or more common ungulate species (Hamlin and Ross 2002, Vander Wal et al. 2011).

Our estimate of the number of wolves is dependent on several assumptions that need to be examined further. First, our population estimate assumes that missed packs are the same size as verified packs. If missed packs are smaller (e.g., recently established packs or packs interspersed among known packs), then our estimated number of wolves would be biased high. Also, our estimate assumes that pack size is constant and equal across space. Pack sizes that were actually larger in some years or some areas would induce a negative bias in our estimates of wolves in those years or areas, and pack sizes that were actually smaller in some years or some areas would induce a positive bias in our estimates of wolves in those years or areas. Finally, our population estimate is for wolves in groups of 2 or more and does not factor lone or dispersing wolves into the population estimate. Various studies have documented that on average 10-15% of wolf populations are composed of lone or dispersing wolves (Fuller et al. 2003). The state of Idaho inflates their estimates by 12.5% to account for lone wolves (Idaho Department of Fish and Game and Nez Perce Tribe 2012) and Minnesota inflates their estimate by 15% (Erb 2008). In the future, lone or dispersing wolves could be incorporated into the Montana population estimate in various manners.

The estimated numbers of packs and wolves exceeded the minimum number of verified packs and wolves to some degree because verified packs and wolves did not include those associated with border packs attributed to other states or Canada that spent time in Montana and could have been observed by hunters. We only included verified border packs included in the Montana summaries in comparing our estimates to minimum counts. Also, the minimum number of packs and wolves verified was for the end of the year, and wolf population estimates derived from hunter observations represented the deer and elk hunting season in October- November, a period of time before some natural and human-caused wolf mortalities occurred.

Future applications of this modeling and population estimation technique will include incorporation of harvest (locations and number of harvested wolves) effects on wolf occupancy, territory sizes and overlap, and pack sizes. Incorporation of harvest as a model covariate for each of these aspects of wolf population size will enable a formal assessment of the effects of harvest on wolf populations in Montana. This strategy will also allow for predictions of the effects of different seasons or harvest quotas on wolf populations, to provide information to decision makers as they set wolf hunting and trapping seasons in coming years. Therefore, in addition to its use for monitoring and wolf population estimation, the technique described here also will provide utility for directly informing decisions about public harvest of wolves.

WOLF MANAGEMENT

Regulated Public Hunting and Trapping

Regulated public harvest of wolves, recommended by the Governor's Wolf Advisory Council in 2000, was included in Montana's final wolf conservation and management plan. In 2001, the Montana Legislature authorized the FWP Commission to reclassify wolves under state law from an endangered species to a species in need of management upon federal delisting. In anticipation of delisting, FWP first began exploring the idea of how to design regulated public hunting and trapping for wolves early in 2007. The 2007 Legislature created a wolf hunting license for residents and nonresidents (SB 372). The 2013 Legislature modified that statute to allow the sale of multiple wolf licenses, allowing the FWP Commission to set hunting bag limits higher than 1 wolf per hunter (HB 73). Other statutes within MCA enable the FWP Commission to adopt rules and regulations pertaining to wolf hunting and trapping as a species in need of management after delisting. FWP developed and implemented wolf harvest strategies that maintain a recovered and connected wolf population, minimize wolf-livestock conflicts, reduce wolf impacts on low or declining ungulate populations and ungulate hunting opportunities, and effectively communicate to all parties the relevance and credibility of the harvest while acknowledging the diversity of values among those parties. The Montana public has the opportunity for continuous and iterative input into specific decisions about wolf harvest throughout the public season-setting process. Finally, hunting can only be implemented when wolves are delisted and under state authority and if more than 15 breeding pairs of wolves existed in Montana the previous year.

Wolves were delisted in 2009 and were classified as a species in need of management statewide under Montana law. After a public comment process, the FWP Commission adopted a conservative quota of 75 wolves statewide, including subquotas of 41 in Wolf Management Unit 1 (Northwest), 22 in WMU 2 (Montana portion of Central Idaho Experimental Population Area), and 12 in WMU 3 (Montana Portion of Greater Yellowstone Experimental Population Area). Litigation over the 2009 delisting decision was again initiated in federal court in Missoula, and an injunction was requested, based on arguments presented by the plaintiffs that the hunting seasons planned for Idaho and Montana would harm the regional wolf population. The injunction request was denied, and the first fair chase wolf hunting season occurred in fall 2009. Seventy-two wolves were taken, representing 12% of the *minimum known population*. The actual percentage taken was lower by an unknown amount. After subtracting all 240 known wolf mortalities from the known minimum wolf population, the minimum remaining Dec. 31 wolf population at the end of 2009 was 5% higher than at the end of 2008. Wolf license sales in Montana generated $326,000 for wolf monitoring and management in the state.

During 2010, federal district court ruled that delisting within the Northern Rocky Mountains (NRM) Distinct Population Segment (DPS) could not occur without Wyoming (Wyoming's state plan had not been approved by the USFWS) and vacated the delisting of the entire DPS. Wolves throughout the NRM DPS were relisted under ESA. The Montana Congressional Delegation and other parties began pursuing federal legislation (as a standalone bill or as a rider amended to budget bills) that would delist the wolf. No wolf season was held, and no wolf license dollars were generated for wolf management and monitoring within Montana.

During April of 2011, nine years after having been declared recovered and with a minimum population of over 1,600 wolves including more than 100 breeding pairs in the tri-state area (approximately 4 times the stated recovery goals), a congressional budget bill directed the Secretary of the Interior to reissue the final delisting rule of 2009 for Northern Rocky Mountain wolves. On May 5, 2011 the USFWS published the final delisting rule designating wolves throughout the Designated Population Segment, except Wyoming, as a delisted species. Montana state rules and the state management plan took full effect at that time and have remained so despite additional litigatory challenges. A statewide wolf quota of 220, partitioned into fourteen individual wolf management units (WMU's) was proposed at the May FWP Commission meeting. FWP proposed quotas or subquotas in WMU 150 and in deer/elk hunting districts (HD's) 280 and 313/316 where an early back country rifle wolf season would coincide with the existing early elk back country hunting season. An archery-only wolf season in all WMUs with an allocated harvest potential not to exceed 20% of the WMU quota or subquota was also proposed to coincide with the existing deer and elk archery only season. Any harvest over-run at the WMU scale was proposed to be reduced from adjacent WMU quotas, other WMUs in the region or at the statewide scale to eliminate potential for any harvest over-run. Additional mechanisms to regulate take included rigorous tracking of harvest in each WMU through mandatory harvest reporting and a 24-hour closure notice process. Harvest quotas were proposed to tally only legal hunting harvest. In addition to other forms of wolf mortality (including cattle depredation removal), a harvest equal to the proposed quota level was predicted to reduce the year-end minimum total wolf numbers 25% from 566 in 2010 to approximately 425 in 2011. By December 31, 121 wolves had been harvested during the legal take season and quotas had been met in only 2 of the 14 WMUs. At the November FWP Commission meeting a season extension was proposed in order to increase wolf harvest closer to the statewide quota of 220. That specific proposal extended the 2011 wolf hunting season through January 31, 2012 or until specific WMU quotas were met. The commission further adjusted the season extension end date to February 15, 2012 at the December commission meeting and then adopted that extension. From January 1 through February 15, 2012, 45 wolves were harvested by hunters. Total wolf harvest during the 2011-2012 season was 166. After subtracting all 216 known wolf mortalities during 2011, the minimum remaining count of wolves at Dec. 31, 2011 was 653, an increase of 13% rather than the predicted decrease of 25%. Wolf license sales generated $407,000 for wolf management and monitoring in Montana.

On July 12, 2012, the FWP Commission adopted the framework for the 2012-13 wolf season. Because the wolf population appeared to be continuing to increase in number with the conservative approach to harvest taken during the 2009 and 2011 seasons, significant changes included a hunting closing date of February 28; no statewide quota with WMU quotas remaining only in WMU's 110 (2) and 316 (3) bordering Glacier and Yellowstone National Parks; trapping authorized from December 15 through February 28; overall bag limit of 3, with up to 3 taken via trapping and up to 1 taken via hunting; and up to 3 taken via hunting with the passages of necessary legislation. On February 19, 2013, Governor Bullock signed House Bill 73 which, among other elements, authorized electronic calls and the sale of multiple wolf hunting licenses. Given the prior commission authorization on July 12, the hunting bag limit was increased to 3 and electronic calls were allowed immediately. At the close of the season on February 28th, the harvest included 128 wolves taken by hunters and 97 wolves taken by trappers, for a total of 225 wolves harvested during the 2012-13 season. The total, calendar year 2012 wolf harvest in Montana was 175, including 45 wolves harvested during the 2011-12 spring season and 130 wolves harvested during the 2012-13 fall season. After subtracting all 324 known wolf mortalities during 2012, the minimum remaining count of wolves at Dec. 31, 2012 was 625, a 4% decrease from 2011. Two-thousand four-hundred and fourteen people participated in the first year of wolf trapper education courses that are required to trap wolves in Montana. Wolf license sales generated $441,000 for wolf management and monitoring in Montana.

On July 10, 2013, the FWP Commission adopted the framework for the 2013-14 wolf season. Significant changes included a longer general season extending from September 15, 2013 through March 15, 2014; bag limit of 5 wolves per person; and creation of WMU 313 with a quota of 4 wolves (bordering Yellowstone National Park). At the close of the 2013-14 season on March 15, 2014, the harvest included 143 wolves taken by hunters and 87 wolves taken by trappers, for a total of 230 wolves harvested during the 2013-14 season. The total, calendar-year 2013 wolf harvest in Montana was 231, including 95 wolves harvested during the 2012-13 season and 136 wolves harvested during the 2013-14 season. After subtracting all 335 known wolf mortalities during 2013, the minimum wolf count at Dec 31, 2013 was 627, essentially unchanged from 2012. Wolf license sales generated $537,000 for wolf management and monitoring in Montana.

During July 2014, the FWP Commission adopted the framework for the 2014-15 wolf season. Significant changes included expanding setbacks for wolf traps from 150 ft. to 500 ft. in 25 high-use recreational areas (5 areas in TD1, 20 areas in TD 3). The wolf quota in WMU 313, north of Yellowstone Park, was reduced from 4 to 3 wolves. At the close of the 2014-15 wolf season on March 15, 2015, the harvest included 130 wolves taken by hunters and 76 wolves taken by trappers, for a total of 206 wolves harvested during the 2014-15 season. The total, calendar-year 2014 wolf harvest in Montana was 212, including 94 wolves harvested during the 2013-14 season and 118 wolves harvested during the 2014-15 season. After subtracting all 308 known wolf mortalities during 2014, the minimum wolf count at Dec 31, 2014 was 554, a decrease of 13%. Wolf license sales generated $455,000 for wolf management and monitoring in Montana.

During July 2015 the FWP Commission adopted the framework for the 2015-16 wolf season. Changes included reductions in the wolf quotas in WMU’s 313 and 316 north of Yellowstone Park. The quota in each area was reduced from 3 to 2 wolves. At the close of the 2015-16 wolf season on March 15, 2016, the harvest included 133 taken by hunters and 76 taken by trappers, for a total of 209 wolves harvested during the 2015-2016 season. The total calendar-year 2015 wolf harvest in Montana was 205, including 88 wolves harvested during the 2014-15 season and 117 wolves harvested during the 2015-16 season. After subtracting all 276 known wolf mortalities during 2015, the minimum wolf count at Dec 31, 2015 was 536, down 3% from 2014. Wolf license sales generated $417,000 for wolf management and monitoring in Montana.

Wolf – Livestock Interactions in Montana

Montana wolves routinely encounter livestock on both private land and public grazing allotments. Wolves are opportunistic predators, most often seeking wild prey. However, some wolves "learn" to prey on livestock and teach this behavior to other wolves. Wolf depredations are very difficult to predict in space and time. The majority of cattle and sheep wolf depredation incidents confirmed by USDA Wildlife Services (WS) occur on private lands. The likelihood of detecting injured or dead livestock is probably higher on private lands where there is greater human presence than on remote public land grazing allotments. The magnitude of under-detection of loss on public allotments is unknown. Most cattle depredations occur during the spring or fall months while sheep depredations occur more sporadically throughout the year.

Wildlife Service's workload increased through 2009 as the wolf population increased and distribution expanded. The number of suspected wolf complaints received by WS increased steadily from federal fiscal year 1997 to 2009 (Figure 8). The number of complaints received since those years has declined from 233 complaints in 2009 to 91 in 2015. About 50% of the complaints received by WS are verified as wolf-caused.

In 2012 wolves were under full management authority of the state and wolf-livestock conflict resolution was guided by a combination of Montana's approved state plan and the administrative rules of Montana. Federal and state regulations since 2009 have allowed private citizens to kill wolves seen in the act of attacking, killing, or threatening to kill livestock. In 2009, 14 wolves were taken by private citizens, 17 were taken in 2010, 7 in 2011, 5 in 2012, 8 in 2013, 7 in 2014, and 16 in 2015. . The remainder of wolves killed in control situations were removed by federal agency personnel.

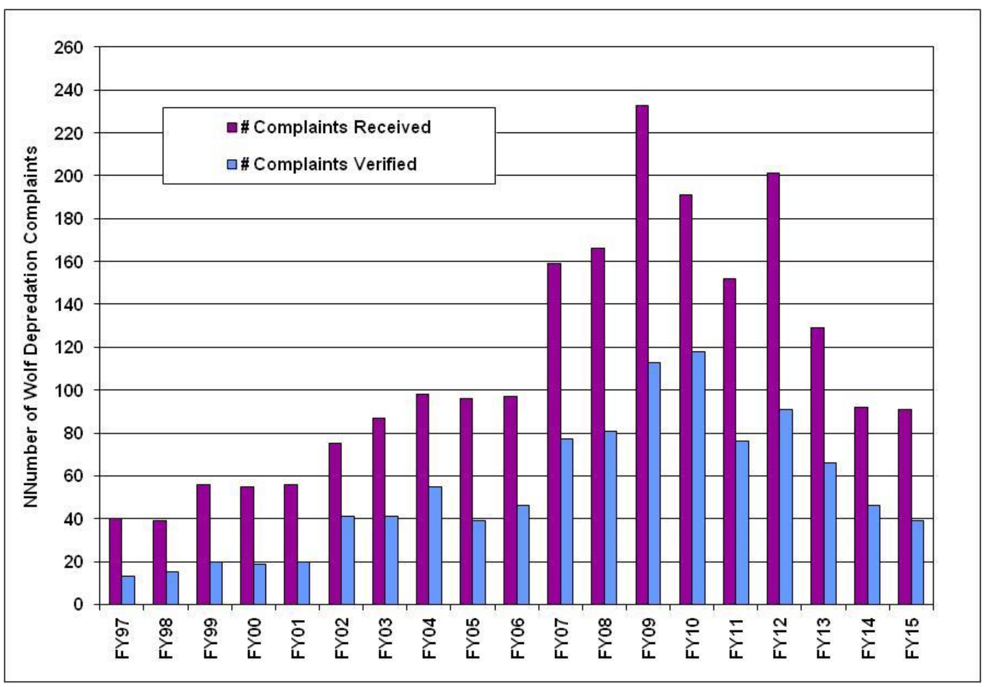


Figure 8. Number of complaints received by USDA Wildlife Services as suspected wolf damage and the number of complaints verified as wolf damage, FFY 1997 – 2015.

***Depredation Incidents during 2015*.--** Wildlife Services confirmed that, statewide, 41 cattle, 21 sheep, and 2 horses were killed by wolves during 2015, compared to 37 cattle, 8 sheep, 1 dog and 1 miniature pony killed by wolves in 2014. Total confirmed cattle and sheep losses were up slightly from 2014 levels, primarily due to a few sheep incidents where multiple sheep were killed. During 2015, WS confirmed 1 dog as injured by wolves, and reported another 7 cattle as probable wolf depredations. Furthermore, many livestock producers reported “missing” livestock and suspected wolf predation. Others reported indirect losses including poor weight gain and reduced productivity of livestock. There is no doubt that there are undocumented losses.

To address livestock conflicts and to reduce the potential for further depredations, 51 wolves were killed during 2015, compared to 57 wolves killed during 2014. The number of wolves removed in control actions by Wildlife Services (35) was lower during 2015 than any year since 2006. Sixteen of the 51 wolves were killed by private citizens when wolves were seen chasing, killing, or threatening to kill livestock.

Eighteen packs that existed at some point during 2015 were confirmed to have killed livestock. Two of these packs were removed entirely due to chronic livestock conflicts during 2015. The general decrease in livestock depredations since 2009 may be a result of several factors including a trend toward more aggressive wolf control in response to depredations and effects of legal wolf harvest (Figure 9).

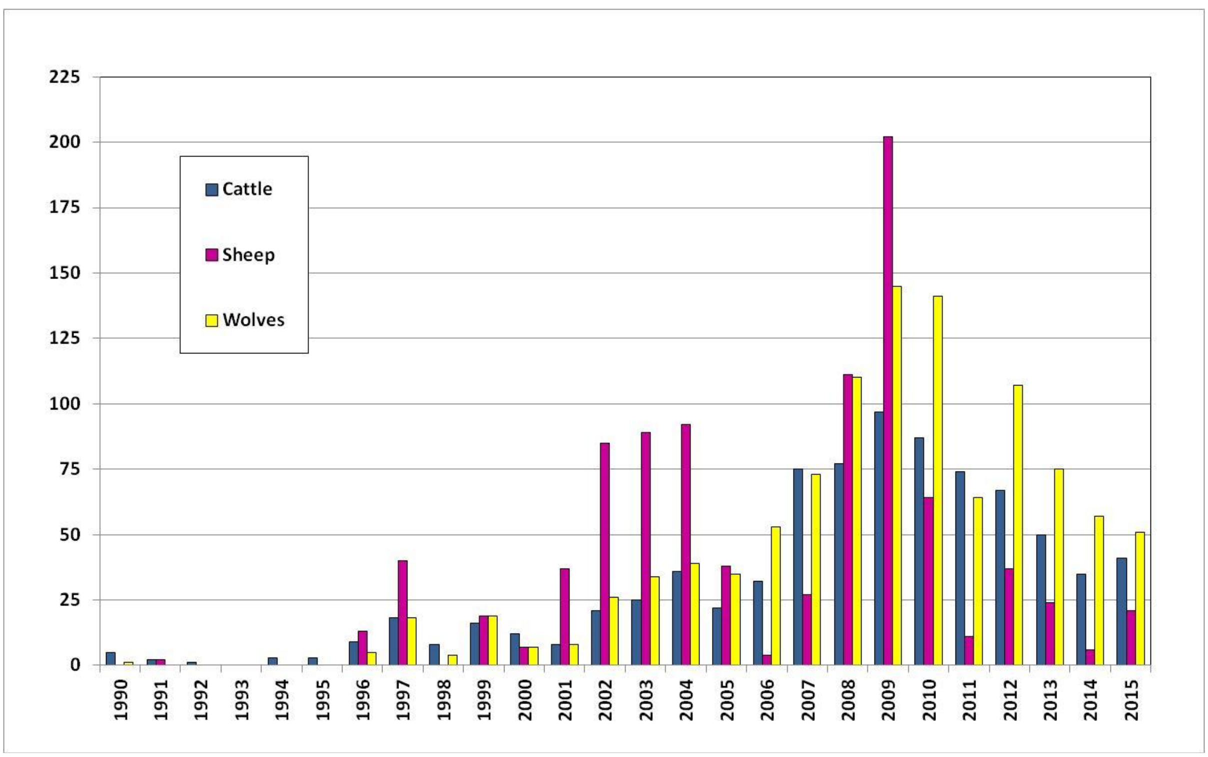


Figure 9. Number of cattle and sheep killed by wolves and number of wolves removed through agency control and take by private citizens, 2000-2015.

Montana Livestock Loss Board: A Montana-Based Reimbursement Program.-- The Montana Wolf Conservation and Management Plan called for creation of this Montana-based program to address the economic impacts of verified wolf caused livestock losses. The plan identified the need for an entity independent from FWP to administer the program.

The purposes of the MLLB are to provide financial reimbursements to producers for losses caused by wolves based on the program criteria and to proactively apply prevention tools and incentives to decrease the risk of wolf-caused losses and to minimize the number of livestock killed by wolves through proactive livestock management strategies.

The Loss Mitigation element implements a reimbursement payment system for confirmed and probable losses that are verified by USDA Wildlife Services. Indirect losses and costs are not directly covered, but eventually could be addressed through application of a multiplier for confirmed losses and a system of bonus or incentive payments. Eligible livestock losses are cattle, calves, hogs, pigs, horses, mules, sheep, lambs, goats, llamas, and guarding animals. Confirmed and probable death losses are reimbursed at 100% of fair market value. Veterinary bills for injured livestock that are confirmed due to wolves may be covered up to 100% of fair market value of the animal when funding becomes available.

Preliminary reimbursement totals for 2015 are $79,311.72 paid to livestock owners on 68 head of livestock and 1 dog. Overall, 2015 livestock losses increased over 2014 totals. Both cattle and sheep losses increased during 2015. Individual animal values continue to be higher than animal values in prior years.

Livestock loss statistics are available for 2008 to the present on the board's website http://liv.mt.gov/LLB/lossdata_2015.mcpx. The board began accepting claims in the spring of 2008. Total numbers for 2009 to 2015 are for a full calendar year.

The Livestock Loss Board has a Facebook page where the number of livestock killed and the county where the loss occurred is listed. This page is updated on the same day the livestock loss claim is received. To view the page, go to https://www.facebook.com/pages/Livestock-Loss-Board/208087235878971.

See the MLLB for detailed information http://liv.mt.gov/LLB/default.mcpx .

Total 2015 Documented Statewide Wolf Mortalities

FWP detected a total of 276 wolf mortalities during 2015 statewide due to all causes (Figure 10). Undoubtedly, additional mortalities occurred but were not detected. Because mortality counts and total population counts are incomplete, actual mortality rates cannot be determined.

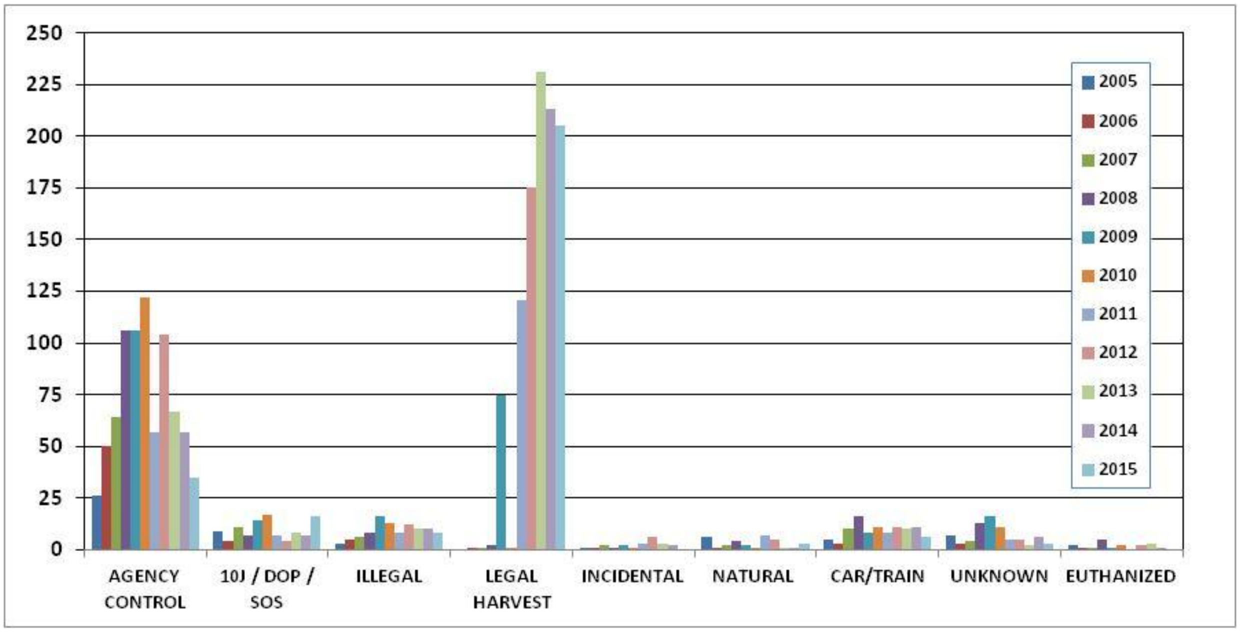


Figure 10. Minimum number of wolf mortalities documented by cause for gray wolves (2005-2015). Total number of documented wolf mortalities during 2015 was 276.

The majority of wolf mortality overall in Montana is related to humans: livestock conflict removals, regulated public harvest, car strikes, train strikes, illegal killings, and incidental to other activities (e.g. trapping/snaring). That pattern is similar across time and throughout all of the northern Rocky Mountains, except inside national parks where the majority of wolf mortality is due to intraspecific strife (wolf on wolf aggression) or other natural causes.

Documented total wolf mortality in 2015 (276) was lower than in 2014 (308). Mortalities in 2015 included 205 public harvests versus 213 harvests in 2014. There were fewer lethal control removals in 2015 (39) than in 2014 (57). Of the 39 wolves removed in 2015 for livestock depredations, 35 were removed by WS and 4 were killed by private citizens under the Montana state law known as the Defense of Property statute. Other human-related mortalities included: 1 train and 5 vehicle collisions, 8 illegally killed, and 12 killed under SB200. In addition, 3 wolves were known to have died of natural causes and 3 of unknown causes.

Similar to other species that Montana manages, illegal mortalities among wolves are often difficult to document because many result from clandestine criminal activities. While other mortalities such as those from hunting and trapping, Wildlife Services' management removals, defense of property, SB 200 and other legal causes are nearly full counts, mortality from other causes, including illegal mortalities, are a minimum count. Moreover, with the legal harvest of 200-plus wolves in Montana, there will inherently be more ‘mistakes’ by hunters and trappers that get classified as illegal harvests. This is also true of any managed species that we hunt be it black bear, mountain lion, deer, elk, ducks or grouse.

MFWP has started to try to track trend in illegal mortality using collared and non-collared samples relative to the estimated population (number of packs times mean pack size). It appears to FWP staff that illegal activity has gone down since the need to resort to this activity is diminished with a legal season and 5 wolf bag limit, the institution of trapping, and a longer season over the past few years. In the final analysis, wolves in Montana are thriving and productive, like many big game species in the state, and illegal take does not appear to be a major source of mortality.

Mange continued to be documented during 2015 in southwest Montana. It does not appear to have a detrimental effect on Montana’s wolf population as a whole (see Jimenez et al. 2010).

AREA SUMMARIES

Northwest Montana
Montana Portion of the Northwest Montana Recovery Area (NWMT)

Overview

In 2015, we verified a minimum count of 349 wolves in 85 packs and 20 breeding pairs in the Montana portion of the Northwest Montana (NWMT) recovery area, compared to 338 wolves in 91 packs and 17 breeding pairs in 2014. There were four newly identified packs in 2015: Lost Dog, Sleeping Woman (CSKT), Stonewall Mountain, and Thunderbolt. One previously identified pack, Mullan, not confirmed in 2014, was determined to still exist in 2015. One pack, Kerr, was removed from the population as a consequence of control actions following livestock depredations and public harvest. Another pack, Ashley, was removed through public harvest. Another seven packs could no longer be counted due to lack of evidence: Bisson, Cataract, Cedar, Chippy, Noisy, Silcox, and Sugarloaf. Two packs, Lost and Lost Peak, were counted as Idaho packs for 2015 since they were suspected to have denned and spent most of their time on the Idaho side of the border. These factors combined produced a net decrease of 6 packs in NWMT in 2015.

Fifty radio-collared wolves in 32 packs, 38% of the 85 total known packs, were monitored in NWMT during at least some portion of 2015. This is seven packs fewer than were monitored in 2014. MFWP captured and radio-collared 10 wolves in nine packs in NWMT in 2015. Wildlife Services captured and collared an additional seven wolves in five packs. Radio-collared wolves were located from the ground or air approximately 1–2 times per month, as weather permitted. Thirty-two radio-collared wolves from 27 packs (32% of the 85 total packs) were still being monitored by the end of the year. Eighteen radio-collared wolves were lost throughout the year due to a variety of factors including legal harvest, control action, unknown mortalities, illegal mortalities, vehicle collisions, collar failure, and dispersal. In addition, one radio-collared wolf was missing by the end of the year. Missing collars are due to long-range dispersal, collar failure, or other unknown fate. Three dispersals were recorded in 2015.

The 85 packs included in the Montana portion of the NWMT recovery area as of December 2015 are listed in Table 1a. There are 10 packs within the Montana/Idaho transboundary area. Seven of these packs, Cache Creek, DeBorgia, Preacher, Silver Lake, Solomon Mountain, Twilight, and Wiggletail, den and spend most of their time in Montana and therefore are counted toward the Montana population. Three of these packs, Copper Falls, Lost, and Lost Peak, den and spend most of their time in Idaho and therefore are counted toward the Idaho wolf population. MFWP monitors these packs in close coordination with IDFG and the Nez Pierce Tribe (NPT). Five packs reside within the US/Canada transboundary. Three of these international packs, Kintla, Kootenai North, and Kootenai South, den and spend most of their time in Montana and therefore are counted toward the Montana population. Two packs, Spruce Creek and Belly River, den and spend most of their time in Canada and therefore are not counted in the NWMT population.

We were able to confirm reproduction in 32 wolf packs in Northwest Montana, with 20 of those packs qualifying as breeding pairs at the end of 2015 (Table 1a). Breeding pair status could not be documented in some packs because we were unable to confirm a minimum of two adults and two pups at the end of the year. Reproduction was confirmed in the Arrastra Creek, Baptiste, Bearfite, Belmont, Bennie, Blowout Mountain, Cache Creek, Cilly, Condon, Corona, Crown Mountain, DeBorgia, Dutch, Firefighter, Humbug, Inez, Kerr, Kootenai North, Landers Fork, Lost Dog, Morrell Mountain, Mullan, Murphy Lake, Ninemile, No, Preacher, Quintonkon, Redshale, Satire, Silver Lake, Sleeping Woman, and Stonewall Mountain packs. Reproductive status of other Northwest Montana wolf packs was unknown.

One hundred and thirty-four wolf mortalities were documented in the Montana portion of the Northwest Montana recovery area population in 2015. One wolf was known to have died of natural cause. Two wolves were found that died of unknown causes. All other documented mortalities were attributed to some form of human cause including 107 wolves legally harvested (57 wolves harvested by hunters, 50 by trappers; down from a total of 140 wolves harvested in 2014), 13 lethally removed in control actions (12 by Wildlife Services and 1 by a citizen protecting livestock; down from 32 in 2014), 2 illegally killed (down from 8 in 2014), 3 vehicle collisions (down from 10 in 2014), and 6 wolves legally killed under Montana State Senate Bill 200 rules (up from 3 in 2014). All control action and legally harvested mortalities are precise numbers, while the number of mortalities from all other causes is a minimum observed. Because mortality counts and total population counts are incomplete, actual mortality rates cannot be determined. The hunting season continued beyond 2015 for another 2.5 months.

Eight wolf packs were involved in confirmed livestock depredations in 2015 in Northwest Montana: Crown Mountain, Flesher Pass, Kerr, Ksanka, Looking Glass, Lydia, Moore, and Olson Peak. We documented 13 confirmed kills of livestock or domestic animals: 11 cattle and two horses. For Northwest Montana, the total confirmed kills decreased from 17 in 2014 to 13 in 2015. An additional two calves and two cows were classified as probable wolf kills, and eight calves were confirmed as injured by wolves in 2015. The number of wolves lethally controlled in Northwest Montana decreased from 32 in 2014 to 13 in 2015. One of those was legally killed by a livestock producer that observed the wolf in the act of killing livestock. No wolves were legally killed by affected livestock producers issued kill permits. These figures only account for verified losses. It is not possible to document unverified losses due to wolves. Unverified losses are losses where the cause of dead or missing livestock is not known.

Nonlethal measures including livestock carcass pickup, range riders, and aversive tools such as Radio Activated Guard (RAG) boxes and fladry are routinely deployed where applicable and as available. In Northwest Montana, FWP was involved in a collaborative proactive risk management project in the Blackfoot Valley. The Blackfoot Challenge Range Rider Project employed seasonal range riders to monitor livestock and predators in areas occupied by the Arrastra Creek, Chamberlain, Morrell Mountain, Inez, Union Peak wolf packs.

Miscellaneous / Lone Individuals in Northwest Montana

Dixie Queen (ID) Disperser: A radio-collared wolf dispersing from the Dixie Queen pack in Northern Idaho was killed by a landowner (SB200) south of Augusta, Montana in May, 2015.

Savenac NW2071F: This adult female wolf was seen with one other wolf at the end of the year, but it is unknown if they are holding a territory.

Superior: An adult male wolf from an unknown pack was struck by a vehicle on County Road 257 near Trout Creek.

Verified Border Packs Counting in Idaho Population Estimate

Copper Falls, Lost, and Lost Peak packs are believed spend most of their time in Idaho.

Verified Border Packs Counting in Canada Population Estimate

Spruce Creek and Belly River packs are believed spend most of their time in Canada.

Western Montana
Montana portion of the Central Idaho Experimental Area

Overview

At the end 2015, we documented a minimum estimate of 78 wolves and 22 packs in the Montana portion of the Central Idaho Experimental Area. This is a decrease in estimated wolves from the 2014 estimate of 94 wolves. However, there was an increase of 2 packs from the documented 20 packs in 2014. There was one newly identified pack in 2015. One pack was added to Montana this year that was previously counted in Idaho in 2014.

Previously verified packs that still existed in 2015 were the Alta, Ambrose, Anaconda, Black Pine, Bloody Dick, Divide Creek, East Fork Rock Creek, Flint, Fool Hen, Four Eyes, Gash Creek, Gird Point, Jeff Davis, One Horse, Overwhich, Pyramid, Ross' Fork, Sliderock Mountain, Sula, Tepee Point, Trapper Peak, and Watchtower packs. The newly documented pack in 2015 was El Capitan. One pack, the Jeff Davis pack, was removed in 2015 due to livestock depredations. No packs were removed by harvest.

During 2015, 10 of 23 (43%) Montana CID verified packs were monitored using ground and aerial telemetry at some point during the year. At the end of 2015, 6 (27%) of 22 Montana CID verified packs were being monitored using ground and aerial telemetry. Five wolves in 4 packs were captured and radio collared in the Montana portion of the CID in 2015. Four wolves were radio collared during MFWP trapping efforts and 1 was radio collared by WS. Radio collared wolves were located 1- 2 times per month by fixed-wing aircraft when possible.

During 2015, 9 of 23 Montana packs monitored in the MT portion of the CID occupied the Montana/ Idaho border: Alta, Bloody Dick, Four Eyes, Gash Creek, Jeff Davis, Overwhich, Pyramid, Sula, and Watchtower. Six of these 9 packs were verified to spend time in Idaho. The others may spend time in Idaho, based on proximity of sightings or telemetry locations near the Montana/Idaho border. Because 6 of these packs denned in Montana, or were known to have spent most of their time in Montana, they were counted as Montana packs for 2015. The other 3 packs were not verified to spend time in Idaho, so were MT packs. MFWP conducts most of the monitoring of these packs in close coordination with IDFG and the NPT.

The Big Hole, Hawley, Pleasant Valley, and Silverlead (Idaho/Montana border packs) denned and spent most of their time in Idaho in 2015 and will therefore count in the Idaho population estimate.

Reproduction was confirmed in 8 packs: Alta, Ambrose, Divide Creek, Flint, Four Eyes, Jeff Davis, Overwhich, Ross' Fork, packs. At the end of 2015 4 packs met the breeding pair requirement: Alta, Flint, Four Eyes, and Overwhich. Reproductive status of the Blackpine, El Capitan, East Fork Rock Creek, Gash Creek, Gird Point, One Horse, Sliderock Mountain, Sula, Tepee Point, Trapper Peak, and Watchtower packs was unknown. Two dispersals were documented in the CID in 2015.

Three packs were confirmed to have killed livestock: Bloody Dick, El Capitan, Jeff Davis. Single or unknown wolves were responsible for killing seven calves and fifteen sheep. Cattle killed by lone or unknown wolves remained the same as 2014. The number of packs involved in depredation dropped by 1 from last year, and the number of sheep killed by lone or unknown wolves increased by 4 sheep over 2014. In total, 18 cattle and 15 sheep were confirmed wolf depredations in 2015. This is an increase from 2014 when 13 cattle and 15 sheep were confirmed kills. Two guard dogs, 5 sheep, and 4 cattle were also confirmed injured. Forty-three wolf mortalities were documented in 2015, down from forty-seven in 2014. Thirteen wolves were killed in response to depredations: 12 were killed by WS in management actions and one was killed legally by a landowner defending property. One wolf was killed illegally and one was killed in a vehicle collision. Twenty-eight wolves were harvested legally during the 2015 hunting season, down from thirty in 2014.

In the CID in 2015, FWP was involved in three collaborative proactive risk management projects. The first of these projects, a range rider project in the upper Big Hole near Jackson, completed its fifth season in 2015. This project will continue into 2016. The second collaborative project started four years ago utilizing Livestock Guarding Dogs to protect cattle in the upper Big Hole near Wisdom, and will continue into 2016. The third project was a carcass pickup program that began in 2015. Planning and development for a compost facility continued in 2015. Both carcass pickup and compost facility projects with continue in 2016.

Miscellaneous / Lone Individuals in Montana CID

<u>*Anaconda area:*</u> A single wolf in the Anaconda/Feely area at the end of the year.

Verified Border Packs Counting in Idaho Population Estimate

Big Hole: See 2015 Idaho Annual Report. This pack lives around the Lolo Pass area West of Missoula.

Hawley: See 2015 Idaho Annual Report. This pack lives around the area South and Southeast of Bannock pass.

Pleasant Valley: See 2015 Idaho Annual Report. This pack lives around the area South of Monida

Silverlead: See 2015 Idaho Annual Report. This pack lives around the Big Hole Pass area West of Wisdom.

Suspected Packs in Montana CID

East Pioneers area: FWP received reports of wolves in several areas of the East Pioneers. Further work is needed to determine whether a new pack is establishing in the area or if dispersers were passing through.

West Pioneers area: FWP received some reports of wolves in the West Pioneers. Further work is needed to determine whether a new pack is establishing in the area or if dispersers were passing through.

Other Miscellaneous Information in Montana CID

Dell area: Two wolves were legally harvested in separate incidents and it is unknown if they were lone dispersers or associated with area packs. One wolf was struck by a car and one wolf was an illegal mortality.

Grant/Horse Prairie: One wolf was killed and two calves were confirmed kills in separate incidents. It was unknown which pack was involved or if it was a lone disperser. Fifteen sheep were killed in three separate incidents.

Middle Big Hole: One wolf was legally killed by a landowner in defense of property.

Upper Big Hole: Four calves were killed by unknown wolves. Three wolves were legally harvested in this area. These were likely associated with a newly formed pack that did not exist at the end of 2015. One wolf was legally harvested and it is unknown if it was a lone disperser or associated with a newly formed Idaho pack.

Southwestern Montana
Montana Portion of the Greater Yellowstone Experimental Area (GYA)

Overview

Packs in the Montana portion of the GYA were documented from the Redlodge area, north to I-90 and west to Dillon, south to the Idaho and WY borders. Agencies (YNP, MFWP), primarily monitored these packs through flights and ground tracking. The location of the den site and the percent area / time in an area determines where that pack will be tallied in each state's population estimates.

In 2015, we documented a minimum estimate of 109 wolves in 19 verified packs, 8 of which qualified as a breeding pair within the GYA. This represents a 12% decrease in the minimum count compared with 2014 (122 wolves). This year's number of breeding pairs (8) decreased from eleven breeding pairs last year and the number of packs (19) was four less than the 23 packs reported in the GYA in 2014. Four new packs were documented in 2015, including: Sweetwater, Highlands Cinnabar, and Parker Peak. There were 15 packs that were verified in 2014 and still existed in 2015: Baker Mountain, Beartrap, Cedar Creek, Cougar 2, Fridley, Hayden, Hogback, Meadow Creek, Price creek, Rosebud, Shinglemill, Slip n' Slide, Steamboat Peak, Tanner Pass, and Toadflax packs. Efforts to document the Brackett Creek, Buffalo Fork, Carmichael, Elkhorns, Lebo Peak, Mill Creek, Romy Lake and Wilson Creek packs indicated there was not enough evidence to confirm the packs were still intact and maintaining territories at the end of the calendar year.

One border pack was shared between Montana, Idaho and Yellowstone National Park (the Madison pack). Four other pack territories were adjacent to or crossed the border with YNP (Cinnabar, Parker Peak, Cougar 2 and Hayden) and were counted toward the MT population in 2015. Three border packs (Eightmile, Prospect peak, and Cougar) were documented to have spent some time in MT, but were counted toward the WY (YNP) population.

The number of collared wolves and the number of wolf packs with at least one member fitted with a radio collar varies throughout the year as new wolves are collared. Additionally, the total number changes as collared wolves die, radio collars malfunction, or collared wolves disperse and are not relocated. At the end of 2015, 7 of 19 (37%) verified packs were being monitored using ground and aerial telemetry. Radio-collared wolves were located around one to two times per month by fixed-wing aircraft and ground telemetry.

In the GYA in 2015, 8 of 19 packs (42%) that existed at one time during the year were confirmed to have killed livestock (Table 1b). This resulted in agency lethal removal of a total of 11 wolves, with 2 wolves legally removed by citizens using the defense of property law. A total of 13 cattle and six sheep were confirmed as wolf kills in the GYA in 2015. Additionally, three calves and one cow were determined to be probable wolf kills. The Romy Lake pack was eliminated due to chronic livestock conflicts, whereas one, zero, two, one, and four packs were eliminated during 2014, 2013, 2012, 2011, and 2010, respectively.

Ninety-nine total wolf mortalities were documented in the GYA in 2015, an increase from the 60 wolf mortalities recorded in 2014. All of the documented mortalities except for two were human-caused. In 2015, 70 total wolves were harvested – 55 by hunters and 15 by trappers. Harvested wolves that were not clearly accounted for by a particular pack, or were harvested in MT but belonged to a pack accounted for by another state, were included as misc/lone (Table 1b). Two wolves were found to have died of natural causes. Other human-related mortalities included 6 killed under the 2012 SB200 law; 2 killed by a vehicle strike; and 6 illegally killed. All wolves killed in agency control actions or legally harvested are precise numbers, while the number of mortalities from all other causes is a minimum that MFWP documented. The actual number is unknown. Further, these numbers can only be applied to an overall population count because they are known numbers, not comparable to the minimum count which is a portion of the total population (minimum verified).

One dispersal was documented for the MT GYA population in 2015. SW5014M dispersed from the Hogback pack to the Cinnabar pack.

Miscellaneous/ Lone individuals:

Paradise valley/ Gardiner: Yellowstone disperser wolf # 968F was harvested (hunting) near Big Creek. Two wolves were harvested in the Cutler Meadows/ Sphinx Creek area, and we were unable to confirm pack of origin.

Stillwater area: One wolf was trapped near Limestone Butte and another hunted a ways up the Stillwater river. Both were believed to be alone.

Gallatin/ Madison: Four lone wolves were harvested by hunters in the Madison valley, Two wolf was harvested in the upper Gallatin and one in the Centennial Valley

Centennial Valley: One lone wolf was legally harvested by a hunter in the centennial valley

Tobacco Root Mountains: One lone wolf was legally harvested in the North Tobacco root mountains prior to the formation of the Carmichael pack

Suspected Packs

Castle Mountains: FWP received scattered reports of wolves in the Castle Mountains and Southeastern Little Belt Mountains in the Fall of 2015. Field efforts are ongoing to determine whether a pack is establishing a territory in the area.

Flathead Pass area (N. Bridgers): A small number of reports came in for wolf sightings in this area. FWP was not able to verify wolf activity in the area but will continue to attempt to document wolf presence.

OUTREACH AND EDUCATION

FWP’s wolf program outreach and education efforts are varied, but significant. Outreach activities take a variety of forms including field site visits, phone and email conversations to share information and answer questions, media interviews, and formal and informal presentations. FWP also prepared and distributed a variety of printed outreach materials and media releases to help Montanans become more familiar with the Montana wolf population and the state plan. An increasingly important aspect of outreach is the Internet.

The “Report a Wolf” application continued to generate valuable information from the public in monitoring efforts for existing packs and documenting wolf activity in new areas. Several hundred reports were received through the website. Countless more were received via postal mail and over the phone.

Most wolf program staff spent some time at hunter check stations in FWP Regions 1-5 to talk with hunters about wolves, wolf management, and their hunting experiences.

LAW ENFORCEMENT

The USFWS Office of Law Enforcement was the lead agency to investigate wolf deaths until delisting during May 2011. Upon delisting, FWP personnel led law enforcement efforts for state-based laws, rules, and FWP Commission regulations. All wolf mortalities that are not the result of an authorized agency lethal control, a shoot on sight permit, a legal sport harvest, a vehicle/train strike or apparent natural causes, are reported to law enforcement personnel. These mortalities are under investigation until a full determination is made regarding cause of death and any potential criminal activity.

Two cases of illegal wolf mortality occurring during 2014 were closed during 2015. In FWP’s Region Four, northcentral Montana, one person was charged with hunting without a valid license and found guilty in absentia for having taken a wolf less than 24 hrs after purchasing a license. A warrant for arrest is currently in effect. In FWP’s Region Two, southwest Montana, two people were charged with attempting to snare wolves, attempting to trap bobcats out of season, and failure to attach tags to traps; one of the people was also charged with trapping without a license. In a plea agreement in Mineral County, both of these persons pled guilty to attempting to snare wolves and failure to attach tags to traps, and one of these persons also pled guilty to trapping without a license for two years. One wolf pelt was seized due to having been obtained without a license and fines of $590 and $320 were paid.

Eight wolves were illegally taken during 2015. Three of these illegal takes occurred in Park County, and one each in Stillwater, Madison, Beaverhead, Mineral, and Lincoln Counties. Details cannot be provided due to ongoing investigations.

FUNDING

Montana Fish, Wildlife & Parks Funding

A five-year funding agreement between the USFWS and FWP was signed in 2011, and $372,778 was obligated for Federal Fiscal Year 2014 (October 1, 2014 - September 30, 2015, includes indirect costs). In the 2011 Montana Legislative session, House Bill 363 became law. This law requires that a wolf management account be set up and that all wolf license revenue be deposited into this account for wolf collaring and control. Specifically, it states that subject to appropriation by the legislature, money deposited in the account must be used exclusively for the management of wolves and must be equally divided and allocated for the following purposes:

(a) wolf-collaring activities conducted pursuant to 87-5-132; and

(b) lethal action conducted pursuant to 87-1-217 to take problem wolves that attack livestock.

Senate Bill 348 also passed during the 2011 Montana Legislative session. SB 348 requires FWP to allocate $900,000 toward wolf management. "Management" includes the entire range of activities that constitute a modern scientific resource program, including but not limited to research, census, law enforcement, habitat improvement, control, and education. The term also includes the periodic protection of species or populations as well as regulated taking. During the 2015 legislative session, this amount was reduced to $500,000 of spending authority.

In summary, wolf management funding for state fiscal year 2015 (July 1, 2014 – June 30, 2015) consisted of the $372,778 of federal money from the USFWS cooperative agreement, $216,000 of federal PR funds, $479,059 of state license dollars, and $50,000 provided by the Rocky Mountain Elk Foundation.

Funding is and will primarily be used to pay for FWP's field presence to implement population monitoring, collaring, outreach, hunting, trapping, and livestock depredation response. In addition to the ongoing efforts by Montana FWP wolf specialists, additional efforts to meet the intent of SB 348 and HB 363 include:

- The wolf program increased to a total of 5.5+ FTE in state fiscal year 2012 (wolf specialists dedicated to wolf management plus seasonal technicians and volunteers). Those staffing levels continued in 2015 with the exception of temporary vacancies resulting from employees taking new positions.
- FTE's were added for technicians in Region 1 and Region 2 during state fiscal year 2012 to increase collaring efforts in wolf packs associated with livestock. Those staffing levels were continued during 2015.
- Funding was dedicated for aerial darting and collaring of wolves in the Madison, Gallatin, and Yellowstone drainages where conflicts with grizzly bears limit trapping and collaring efforts.

- Renewed agreement with Wildlife Services and commitment of $110,000 towards wolf management efforts.

Other wolf management services provided by FWP include law enforcement, harvest/quota monitoring, legal support, public outreach, and overall program administration. Exact cost figures have not been quantified for the value of these services.

USDA Wildlife Services Funding

Wildlife Services (WS) is the federal agency that assists FWP with wolf damage management. WS personnel conduct investigations of injured or dead livestock to determine if it was a predation event and, if so, what predator species was responsible for the damage. Based on WS determination, livestock owners may be eligible to receive reimbursement through the Montana Livestock Loss Program. If WS determines that the livestock depredation was a confirmed wolf kill or was a probable wolf kill, the livestock owner is eligible for 100% reimbursement on the value of the livestock killed based on USDA market value at the time of the investigation.

Under an MOU with FWP, the Blackfeet Nation (BN), and the Confederated Salish and Kootenai Tribes (CSKT), WS conducts the control actions on wolves as authorized by FWP, BN, and CSKT. Control actions may include radio-collaring and/or lethal removal of wolves implicated in livestock depredation events. FWP, BN, and CSKT also authorize WS to opportunistically radio-collar wolf packs that do not have an operational radio-collar attached to a member of the pack.

As a federal agency, WS receives federal appropriated funds for predator damage management activities but no funding directed specifically for wolf damage management. Prior to Federal Fiscal Year (FFY) 2011, the WS Program in Montana received approximately $250,000 through the Tri-State Predator Control Earmark, some of which was used for wolf damage management operations. However, that earmark was completely removed from the federal budget for FFY 2011 and not replaced in FFY 2012-2016.

In FFY 2015, WS spent $246,343 conducting wolf damage management in Montana (not including administrative costs). The FFY 2015 expenditure included $111,243 Federal appropriations, $110,000 from FWP, and $25,000 from the Rocky Mountain Elk Foundation.

PERSONNEL AND ACKNOWLEDGEMENTS

The 2015 FWP wolf team was comprised of Nathan Lance, Kent Laudon, Abigail Nelson, Mike Ross, and Ty Smucker. Wolf specialists work closely with regional wildlife managers including Neil Anderson, Howard Burt, Ray Mule, Mark Sullivan, Graham Taylor, Mike Thompson, John Ensign, and Jim Williams, as well as Wildlife Management Bureau Chief John Vore and Carnivore and Furbearer Coordinator Bob Inman. The wolf team is part of a much bigger team of agency professionals that make up Montana Fish, Wildlife & Parks including regional supervisors, biologists, game wardens, information officers, front desk staff, and many others who contribute their time and expertise. FWP Helena and Wildlife Health Lab staff contributed time and expertise including Ron Aasheim, Keri Carson, Justin Gude, Quentin Kujala, Ken McDonald, Adam Messer, Tom Palmer, Kevin Podruzny, and Jennifer Ramsey.

During 2015, the Montana wolf management program benefited from the contributions of seasonal technicians, Tyler Parks and Brady Dunne, who excelled at their jobs and contributed enormously. The Montana wolf management volunteer program was very fortunate to have Austin Koenig, Molly Parks, Grant Samsill, Tanner Saul, Justine Vallieres, and Chad White. Also, a thank you to Blackfoot range riders: Eric Graham and Molly Parks, Kate Whitney, and Sigrid Olson. We thank the Tom Miner Basin Association for wolf monitoring information and range rider efforts. We thank the Beartooth Backcountry Horsemen's Association for their interest and efforts in monitoring wolf activity in the Stillwater and the Beartooths.

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We thank Confederated Salish and Kootenai Tribal biologists Stacey Courville and Shannon Clairmont, and Blackfeet Tribal biologist Dan Carney and wildlife technicians Dustin Weatherwax and Glenn Hall for capturing and monitoring wolves in and around their respective tribal reservations.

We acknowledge the work of the citizen-based Montana Livestock Loss Board which oversees implementation of Montana's reimbursement program and the conflict prevention grant money, as well as its coordinator, George Edwards.

We thank Mike Jimenez (USFWS) for his coordination and oversight of state wolf management in the Northern Rockies.

USDA APHIS WS investigates all suspected wolf depredations on livestock and under the authority of FWP, carries out all livestock depredation-related wolf damage management activities in Montana. We thank them for contributing their expertise to the state's wolf program and for their willingness to complete investigations and carry out lethal control and radio-collaring activities in a timely fashion. We also thank WS for assisting with monitoring wolves in Montana. WS personnel involved in wolf management in Montana during 2015 included state director John Steuber, western district supervisor Kraig Glazier, eastern district supervisors Mike

Foster and DalenTidwell, western assistant district supervisor Chad Hoover, eastern assistant district supervisor Alan Brown, wildlife disease biologist Jerry Wiscomb, helicopter pilots Tim Graff and Eric Waldorf, helicopter/airplane pilot Stan Colton, wildlife specialists Denny Biggs, Steve DeMers, Mike Hoggan, Cody Knoop, John Maetzold, Graeme McDougal, John Miedtke, Kurt Miedtke, Brian Noftsker, Ted North, Scott Olson, Jim Rost, Bart Smith, Pat Sinclair, and Dan Thomason.

The Montana Wolf Management program field operations also benefited in a multitude of ways from the continued cooperation and collaboration of other state and federal agencies and private interests such as the USDA Forest Service, Montana Department of Natural Resources and Conservation ("State Lands"), U.S. Bureau of Land Management, Plum Creek Timber Company, Glacier National Park, Yellowstone National Park, Idaho Fish and Game, Wyoming Game and Fish, Nez Perce Tribe, Canadian Provincial wildlife professionals, Turner Endangered Species Fund, People and Carnivores, Wildlife Conservation Society, Keystone Conservation, Boulder Watershed Group, Big Hole Watershed Working Group, the Madison Valley Ranchlands Group, the upper Yellowstone Watershed Group, the Blackfoot Challenge, Tom Miner Basin Association, and the Granite County Headwaters Working Group.

We deeply appreciate and thank our pilots whose unique and specialized skills, help us find wolves, get counts, and keep us safe in highly challenging, low altitude mountain flying situations. They include Joe Rahn (FWP Chief Pilot), Neil Cadwell (FWP Pilot), Ken Justus (FWP Pilot), Trever Throop (FWP Pilot), Mike Campbell (FWP Pilot), Jim Pierce (Red Eagle Aviation, Kalispell), Roger Stradley (Gallatin Flying Service, Belgrade), Steve Ard (Tracker Aviation Inc., Belgrade), Lowell Hanson (Piedmont Air Services, Helena), Dave Horner (Red Eagle Aviation), Joe Rimensberger (Osprey Aviation, Hamilton), and Mark Duffy (Central Helicopters, Bozeman). We also thank Quicksilver Aviation for their safe and efficient helicopter capture efforts.

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LITERATURE CITED

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(9):e7042.

Mitchell, M. S., D. E. Ausband, C. A. Sime, E. E. Bangs, J. A. Gude, M. D. Jiminez, C. M. Mack, T. J. Meier, M. S. Nadeau, and D. W. Smith. 2008. Estimation of self-sustaining packs of wolves in the U.S. northern Rocky Mountains. J. Wildlife Management 72:881-891.

Becker, E. F, M. A. Spindler, and T. O. Osborne. 1998. A population estimator based on network sampling of tracks in the snow. Journal of Wildlife Management 62:968-977.

Erb, J. 2008. Distribution and abundance of wolves in Minnesota, 2007–08. Minnesota Department of Natural Resources, Grand Rapids, Minnesota, USA.

Fiske, I., and R. Chandler. 2011. Unmarked: An R Package for Fitting Hierarchical Models of Wildlife Occurrence and Abundance. Journal of Statistical Software 43:1-23.

Fuller, T. K., L. D. Mech, and J. F. Cochrane. 2003. Wolf Population Dynamics. Pages 161-191 in LD Mech and L Boitani, editors. Wolves: behavior, ecology, and conservation. The University of Chicago Press, Chicago, Illinois, USA.

Glenn, E. S., L. N. Rich, and M. S. Mitchell. 2011. Estimating numbers of wolves, wolf packs, and Breeding Pairs in Montana using hunter survey data in a patch occupancy model framework: final report. Technical report, Montana Fish, Wildlife and Parks, Helena Montana.

Hamlin, K. L., and M. S. Ross. 2002. Effects of hunting regulation changes on elk and hunters in the Gravelly-Snowcrest Mountains, Montana. Federal Aid in Wildlife Restoration Project W-120-R, Montana Department of Fish, Wildlife, and Parks, Helena, Montana, USA.

Hines, J. E. 2006. PRESENCE- Software to estimate patch occupancy and related parameters. USGS-PWRC. http://www.mbr-pwrc.usgs.gov/software/presence.html.

Idaho Department of Fish and Game and Nez Perce Tribe. 2012. 2011 Idaho wolf monitoring progress report. Idaho Department of Fish and Game, 600 South Walnut, Boise, Idaho; Nez Perce Tribe Wolf Recovery Project, P.O. Box 365, Lapwai, Idaho. 94 pp.

Jimenez, M. D., E. E. Bangs, C. Sime, and V. Asher. 2010. Sarcoptic mange found in wolves in the Rocky Mountains in western United States. J. Wildlife Disease 46:1120-1125.

Mitchell, M. S., D. E. Ausband, C. 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.

Miller, D. A. W., J. D. Nichols, J. A. Gude, K. M. Podruzny, L. N. Rich, J. E. Hines, M. S. Mitchell. 2013. Determining occurrence dynamics when false positives occur: estimating the range dynamics of wolves from public survey data. PLOS ONE 8:1-9.

Mitchell, M. S., D. E. Ausband, C. A. Sime, E. E. Bangs, J. A. Gude, M. D. Jiminez, C. M. Mack, T. J. Meier, M. S. Nadeau, and D. W. Smith. 2008. Estimation of self-sustaining packs of wolves in the U.S. northern Rocky Mountains. J. Wildlife Management 72:881-891.

Rich, L. N., R. E. Russell, E. M. Glenn, M. S. Mitchell, J. A. Gude, K. M. Podruzny, C. Sime, K. Laudon, D. E. Ausband, and J. D. Nichols. 2013. Estimating occupancy and predicting numbers of gray wolf packs in Montana using hunter surveys. Journal of Wildlife Management. 77:1280-1289.

Rich, L. N., M. S. Mitchell, J. A. Gude, and C. A. Sime. 2012. Anthropogenic mortality, intraspecific competition, and prey availability structure territory sizes of wolves in Montana. Journal of Mammalogy 93:722–731.

Vander Wal, E., P. D. McLoughlin, and R. K. Brook. 2011. Spatial and temporal factors influencing sightability of elk. Journal of Wildlife Management 75:1521-1526.

APPENDIX 1

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USDA WS State Director, Billings
(406) 657-6464 (w)

Kraig Glazier
USDA WS West District Supervisor, Helena
(406) 458-0106 (w)

Dalen Tidwell
USDA WS East District Supervisor, Columbus
(406) 657-6464 (w)

TO REPORT A DEAD WOLF OR POSSIBLE ILLEGAL ACTIVITY:

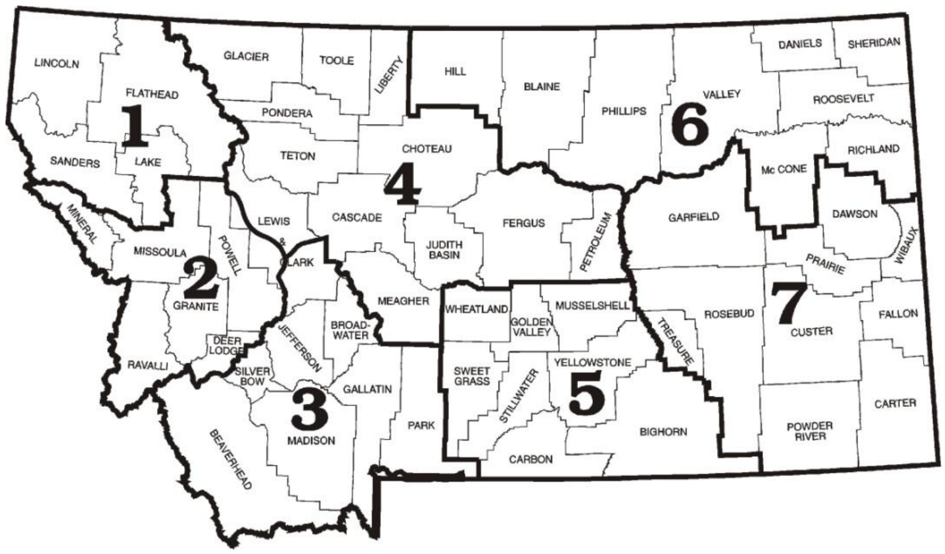
<u>Montana Fish, Wildlife & Parks</u>

- Dial 1-800-TIP-MONT (1-800-847-6668) or local game warden

TO SUBMIT WOLF REPORTS ELECTRONICALLY AND TO LEARN MORE ABOUT THE MONTANA WOLF PROGRAM, SEE:

- http://fwp.mt.gov/fishAndWildlife/management/wolf/

MONTANA FISH WILDLIFE & PARKS
ADMINISTRATIVE REGIONS



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APPENDIX 2

BRIEF GRAY WOLF CHRONOLOGY IN MONTANA

1915

- Federal authorities begin wolf control in the West. Wolf populations eliminated by about 1925.

1973

- Montana protects wolves as state endangered species, and wolves protected under federal Endangered Species Act.

1993

- An estimated 45 wolves in five packs occupy the federal Northwestern Montana Recovery Area.

1994

- Federal EIS completed and wolves are to be reintroduced into Yellowstone National Park and central Idaho for three to five years under the Endangered Species Acts experimental, non-essential rules. **Wolf recovery is defined as 30 breeding pairs**--an adult male and an adult female raising two or more pups to Dec. 31--**in Montana, Idaho, and Wyoming for three successive years**.

1995-1996

- Seventy-nine wolves are relocated to Yellowstone National Park (42) and central Idaho (37).

1999

- Governors of Montana, Idaho, and Wyoming renew a 1997 MOU to coordinate public involvement to pursue plans to manage a recovered wolf population and assure a timely delisting.

2000

- USFWS determines there are 30 breeding pairs in the tri-state Rocky Mountain Recovery Area, marking 2000 as the first year of the three-year countdown to meet wolf population recovery goals.

2001

- Montana Legislature removes the gray wolf from Montana's list of predatory species once the wolf is delisted. Montana Fish, Wildlife & Park's draft of the Montana Wolf Conservation and Management Planning Document is reviewed, amended and approved by the Montana Wolf Management Advisory Council.
- An estimated 35 breeding pairs, in 51 packs, are counted in the tri-state Rocky Mountain Recovery Area, totaling about 550 wolves. The USFWS determines 2001 is second year of the three year countdown to trigger an official proposal to delist the wolf.

2002

- Montana Fish, Wildlife & Parks begins to develop an environmental impact statement (EIS) on the state management of wolves. The public is invited to participate at community work sessions around the state and asked to identify issues and help develop management alternatives.
- An estimated 43 breeding pairs are counted in the tri-state Rocky Mountain Wolf Recovery Area, totaling about 663 wolves. The USFWS determines 2002 is the third year of the three-year countdown to trigger official proposal to delist wolves.

• USFWS announces that the northern Rockies gray wolf population has achieved biological recovery under the federal Endangered Species Act.

2003

• State conservation and management plans completed by MT, ID, and WY and submitted to USFWS.
• USFWS begins the official administrative process of delisting gray wolves in the northern Rockies.
• An estimated 761 wolves in 51 breeding pairs are counted in the tri-state Rocky Mountain Wolf Recovery Area at the end of the year.

2004

• USFWS approves state management plans from Montana and Idaho and rejects Wyoming's plan. Delisting is officially delayed until the impasse is resolved.
• An estimated 835 wolves in 66 breeding pairs are counted in the tri-state Rocky Mountain Wolf Recovery Area at the end of the year.

2007

• USFWS approves Wyoming's wolf management plan and state laws.
• A minimum of 422 wolves in 39 breeding pairs are counted **in Montana**.

2008

• USFWS publishes the final delisting rule, recognizing the NRM DPS and removing it from the List of Endangered and Threatened Wildlife.
• Twelve parties filed a lawsuit challenging the identification and delisting of the NRM DPS. The plaintiffs also moved to preliminarily enjoin the delisting.
• The U.S. District Court for the District of Montana granted the plaintiffs motion for a preliminary injunction and enjoined the USFWS implementation of the final delisting rule for the NRM DPS of the gray wolf. The ruling placed the gray wolf back under the ESA. The three main issues identified were the regulatory framework in Wyoming, connectivity, and defense of property laws. The NRM DPS wolf population was officially delisted from March 28 to July 18 and preparations for a 2008 wolf hunting season were suspended.
• USFWS asked the Court to vacate the delisting rule and remand it back to the agency for further consideration. The Court agreed. USFWS re-opens a 30-day public comment period on the February 2007 delisting proposal specific to issues raised in the preliminary injunction.
• A minimum of 497 wolves in 34 breeding pairs are counted in Montana.

2009

• USFWS determined and notified Wyoming that its state plan and regulatory framework were not adequate and no longer approved.
• USFWS publishes the final delisting rule which designated the NRM distinct population segment and delists the gray wolf throughout the DPS except WY. In Wyoming, the wolf remained listed as experimental /non-essential under the federal Endangered Species Act.
• The final delisting rule takes effect. Wolves in MT are classified as a species in need of management statewide under Montana law; state rules and the state management plan take full effect. MFWP Commission adopts tentative wolf quotas for public comment in May. Commission adopts the final 2009 wolf quotas of 75.
• Litigation over the 2009 delisting decision was again initiated in federal court in Missoula by the same coalition of organizations. An injunction was requested, based on arguments presented by the

plaintiffs that the hunting seasons planned for Idaho and Montana would harm the regional wolf population. The injunction request was denied.

- The first fair chase wolf hunting season occurred in fall 2009. The statewide quota was 75, and 72 wolves were taken.
- Wolf license sales generate $326,000 for wolf management. Funding is and will primarily be used to pay for FWP's field presence to implement population monitoring, collaring, outreach, hunting, trapping, and livestock depredation response.
- A minimum of 524 wolves in 37 breeding pairs are counted in Montana.

2010

- Federal District Court ruled that delisting within the NRM DPS could not occur without Wyoming and vacated the delisting of the entire DPS. Wolves throughout the NRM DPS were relisted under ESA.
- The Montana Congressional Delegation and other parties began pursuing federal legislation (as a standalone bill or as a rider amended to budget bills) that would delist the wolf.
- No wolf season is held.
- No wolf license dollars are generated for wolf management.
- A minimum of 566 wolves in 35 breeding pairs are counted in Montana.

2011

- A congressional budget bill directed the Secretary of the Interior to reissue the final delisting rule for Northern Rocky Mountain wolves originally published in April of 2009.
- USFWS publishes the final delisting rule designating wolves throughout the NRM DPS, except Wyoming, as a delisted species.
- Wolves in Montana became a species in need of management statewide under Montana law; state rules and the state management plan took full effect. Using a combination of federal funds and license dollars, FWP implements the state management plan by monitoring the wolf population, directing problem wolf control and take under certain circumstances, coordinating and authorizing research, regulating sport harvest, and leading wolf information and education programs.
- Litigation is filed challenging the constitutionality of the Congressional rider under the Separation of Powers clause of the U.S. Constitution. Decision is upheld in federal court. Decision is appealed and an emergency motion for an injunction is made to stop the wolf hunt. Appeal and motion fail.
- Montana holds its second wolf season. Statewide quota is 220, and 160 wolves are taken by hunters.
- Wolf license sales generate $407,000 for wolf management.
- A minimum of 653 wolves with 39 breeding pairs are counted in Montana.

2012

- FWP Commission adds trapping to the wolf season, increases the bag limit to 3 wolves (no statewide quota), and adopts pan tension rule to minimize non-target captures.
- FWP instructs the first wolf trapper education course in Montana - 2,414 students.
- Wolf license sales generate $441,000 for wolf management.
- Montana holds its third wolf season. 225 wolves are taken, ~60% by hunters, 40% by trappers.
- A minimum of 625 wolves and 37 breeding pairs are counted in Montana.

2013

- FWP Commission increases bag limit to 5 wolves.
- Wolf license sales generate $537,000 for wolf management.
- Montana holds its fourth wolf season. 230 wolves are taken, ~60% by hunters, 40% by trappers.

• A minimum of 627 wolves and 28 breeding pairs are counted in Montana.

2014

•Wolf license sales generate $455,000 for wolf management.
•Montana’s wolf season approved by USFWS CITES program.
• Montana holds its fifth wolf season. 206 wolves are taken, ~60% by hunters, 40% by trappers.
• A minimum of 554 wolves and 34 breeding pairs are counted in Montana.

2015

• Wolf license sales generate $417,000 for wolf management.
• Montana holds its sixth wolf season. 210 wolves are taken, ~65% by hunters, 35% by trappers.
• A minimum of 536 wolves and 32 breeding pairs are counted in Montana.

APPENDIX 3

RESEARCH, FIELD STUDIES, AND PROJECT PUBLICATIONS

Each year in Montana, there are a variety of wolf-related research projects and field studies in varying degrees of development, implementation, or completion. These efforts range from wolf ecology, predator-prey relationships, wolf-livestock relationships, policy, or wolf management. In addition, the findings of some completed projects get published in the peer-reviewed literature. The 2015 efforts are summarized below, with updates or project abstracts.

1. WOLF-LIVESTOCK CONFLICT IN MONTANA: SPATIAL AND TEMPORAL FACTORS INFLUENCING LIVESTOCK LOSS

Investigators: Nick DeCesare, Liz Bradley, Justin Gude, Nathan Lance, Kent Laudon, Abigail Nelson, Mike Ross, Ty Smucker (Montana Fish, Wildlife and Parks) and Seth Wilson (Montana Livestock Loss Board, Northern Rockies Conservation Cooperative).

Status: In Preparation

ABSTRACT: Successful wolf recovery in Montana has brought with it some negative impacts on livestock producers in certain areas and time periods. We assessed the spatial and temporal patterns of wolf depredations on livestock in Montana at a broad, statewide scale during the past decade (2005–2014). These analyses highlighted areas of concentrated and consistent wolf-livestock conflicts, such that, for example, 50% of the statewide conflicts occur in 5% of the state. We then used generalized linear mixed-models to test covariates potentially predictive of both conflict presence (zero vs. non-zero depredation events) and conflict severity (number of events given at least 1), including the assessment of lethal controls and hunter harvest as tools to reduce conflicts. Using administrative hunting districts (HDs) as the unit of analysis, we found that conflict presence increased for HD-years with wolves present ($P<0.001$), higher wolf pack densities ($P=0.006$), higher livestock densities ($P<0.001$), and intermediate proportionate areas of agricultural land ($P<0.001$). HDs with depredations the previous year were more likely to continue having them ($P<0.001$), though lethal removal of wolves significantly reduced this effect ($P=0.038$). Direct effects of wolf hunter harvest were shown to marginally ($P=0.152$) reduce year-to-year conflicts, but indirect effects of harvest would also be expected given its role in determining wolf numbers, a primary driver of conflicts. Minimizing livestock losses is a top priority for successful wolf management, and these results shed light on the broad-scale patterns behind chronic problems and the tools used to address them.

2. EFFECTS OF WOLF REMOVAL ON LIVESTOCK DEPREDATION RECURRENCE AND WOLF RECOVERY IN MONTANA, IDAHO, AND WYOMING

Investigators: Liz Bradley (Montana Fish, Wildlife & Parks), Hugh Robinson (University of Montana), Ed Bangs (U. S. Fish and Wildlife Service), Kyran Kunkle (University of Montana), Mike Jimenez (U. S. Fish and Wildlife Service), Justin Gude (Montana Fish, Wildlife and Parks), Todd Grimm (U.S.D.A. Wildlife Services).

Status: Published in the Journal of Wildlife Management, 79(8):1337–1346

ABSTRACT: Wolf (Canis lupus) predation on livestock and management methods used to mitigate conflicts are highly controversial and scrutinized especially where wolf populations are recovering. Wolves are commonly removed from a local area in attempts to reduce further depredations, but the effectiveness of such management actions is poorly understood. We compared the effects of 3 management responses to livestock depredation by wolf packs in Montana, Idaho, and Wyoming: no removal, partial pack removal, and full pack removal. We examined the effectiveness of each management response in reducing further depredations using a conditional recurrent event model. From 1989 to 2008, we documented 967 depredations by 156 packs: 228 on sheep and 739 on cattle and other stock. Median time between recurrent depredations was 19 days following no removal (n¼593), 64 days following partial pack removal (n¼326), and 730 days following full pack removal (n¼48; recurring depredations were made by the next pack to occupy the territory). Compared to no removal, full pack removal reduced the occurrence of subsequent depredations by 79% (hazard ratio [HR]¼0.21, P<0.001) over a span of 1,850 days (5 years), whereas partial pack removal reduced the occurrence of subsequent depredations by 29% (HR¼0.71, P<0.001) over the same period. Partial pack removal was most effective if conducted within the first 7 days following depredation, after which there was only a marginally significant difference between partial pack removal and no action (HR¼0.86, P¼0.07), and no difference after 14 days (HR¼0.99, P¼0.93). Within partial pack removal, we found no difference in depredation recurrence when a breeding female (HR¼0.64, P¼0.2) or 1-year-old male was removed (HR¼1.0, P¼0.99). The relative effect of all treatments was generally consistent across seasons (spring, summer grazing, and winter) and type of livestock. Ultimately, pack size was the best predictor of a recurrent depredation event; the probability of a depredation event recurring within 5 years increased by 7% for each animal left in the pack after the management response. However, the greater the number of wolves left in a pack, the higher the likelihood the pack met federal criteria to count as a breeding pair the following year toward population recovery goals. Published 2015. This article is a U.S. Government work and is in the public domain in the USA.

3. THE BITTERROOT ELK STUDY: EVALUATING BOTTOM-UP AND TOP-DOWN EFFECTS ON ELK SURVIVAL AND RECRUITMENT IN THE SOUTHERN BITTERROOT VALLEY, MONTANA

Investigators: Kelly Proffitt, Benjamin Jimenez, Craig Jourdonnais, Justin Gude, and Mike Thompson (Montana Fish, Wildlife & Parks), Mark Hebblewhite and Daniel Eacker (University of Montana).

Status: Final Report

EXECUTIVE SUMMARY: Elk (Cervus elaphus) populations in the Bitterroot Valley in west-central Montana steadily increased throughout the 1980s – early 2000s. Changes in management objectives and harvest levels, increasing and expanding carnivore communities, and large-scale changes in fire activity, timber harvest and land use coincided with changes in overall elk population size and calf recruitment trends from 2000 – 2010. From 2005 – 2009, elk population counts in the 6 Bitterroot Valley hunting districts declined by 25%, and calf recruitment reached a historic low. Low recruitment and elk population declines raised concerns that an increasing carnivore populations, and in particular, increasing wolf populations, may be reducing elk populations and hunting opportunities in the Bitterroot Valley. With a goal of better understanding the causes of declining elk numbers and calf recruitment, Montana Fish, Wildlife and Parks (MFWP) and the University of Montana initiated a research project in 2011 designed to evaluate factors affecting elk survival and calf recruitment in the Bitterroot Valley. The purpose of the project was to evaluate bottom-up habitat and top-down predation factors, as well as weather, that may affect elk vital rates and population dynamics.

The study area included the West Fork of the Bitterroot (Hunting District [HD] 250), an area that experienced severe declines in elk numbers and recruitment, and the East Fork of the Bitterroot (HD 270), an area that experienced relatively stable elk numbers and only moderate declines in recruitment. The West Fork area is more forested and mountainous, while the East Fork area contains a mosaic of lower elevation grasslands and higher elevation forested areas. Both areas support mountain lion (Puma concolor), black bear (Ursus americanus), coyote (canis latrans) and wolf (Canis lupus) populations.

From 2011 – 2014, we sampled and radiocollared 120 adult female elk to collect information about elk movements, and estimated adult female survival and cause-specific mortality rates. In the East Fork, elk were primarily migratory (78%), but in the West Fork only 32% of elk were migratory. Mean adult female survival from February 2011 through February 2014 was 0.90 (95% confidence interval [CI] = 0.83, 0.94) in both the West Fork and East Fork. Adult female survival was lower in winter than in summer, and 77% of all adult female mortalities occurred between March and May. Of the 13 adult female mortalities that occurred, 5 were due to predation (3 killed by mountain lions, 2 by wolves); 4 were due to natural, non-predation causes; 1 was due to a vehicle collision; and 3 died from unknown causes. Winter survival rate was lower than summer survival rate, and 77% of all adult elk mortalities occurred between March and May.

To better understand the factors affecting calf elk recruitment (i.e. survival to age 1), we radiotagged 226 neonatal and 60 6-month-old calf elk to estimate calf survival and cause-specific mortality rates. Mean annual survival for calf elk throughout the study area was 0.41 (95% CI = 0.33, 0.48). The summer calf elk survival rate was 0.55 (95% CI = 0.47, 0.63), and was lower for calves born later in the calving period. Overwinter survival rate was 0.74 (95% CI = 0.64,0.81), and was unrelated to birth weight or date. Calves born in the East Fork had a higher survival rate (0.47, 95% CI = 0.36, 0.56) than calf elk born in the West Fork (0.32, 95% CI = 0.22, 0.43). Overall, female calf elk survived at a higher rate (0.50, 95% CI = 0.39, 0.60) than males (0.32, 95% CI = 0.22,0.43). Despite the recent recolonization of the study area by wolves, mountain lions caused more elk calf mortality than wolves in summer and winter. These results are broadly consistent with the relative densities of mountain lions and wolves in our study area.

To evaluate the effects of habitat on elk populations, we first developed a spatial modeling approach to estimate landscape-level nutritional resources for elk. Second, we tested the effects of nutritional resources on elk body condition and pregnancy rates. We measured the available biomass, phenology, and digestibility of forage plant species and then used this information together with spatial data on landscape attributes to estimate forage quality at the landscape-scale. We then tested for the effect of East Fork and West Fork summer range forage quality on the body condition and pregnancy rates of elk during fall in the East Fork and West Fork. We found forage quality varied across landcover types and between East Fork and West Fork summer ranges as a function of differences in landcover and recent fire history. These differences in nutritional resources resulted in differences in elk body fat levels and pregnancy rate, with average pregnancy rates of 89% (95% CI 0.81, 0.98) for East Fork elk exposed to higher forage quality and 72% (95% CI = 0.61, 0.83) for West Fork elk exposed to lower forage quality. Our results suggest that the nutritional resources, or forage quality, on summer range limited West Fork elk pregnancy rate and calf production. These nutritional limitations may predispose the West Fork population to be more sensitive to the effects of harvest, predation, weather events or other factors.

Because multiple factors such as pregnancy rates, calf survival and adult survival interact to drive elk population trajectories, predicting the effectiveness of various management actions at increasing elk survival and recruitment is challenging. To address this challenge, we developed a Bayesian integrated population model to 1) estimate East Fork and West Fork elk population growth rate, 2) investigate the relative importance of different vital rates on elk population dynamics, and 3) simulate the effects of various hypothetical management scenarios on elk population growth rate. We estimated that the mean population growth rate (λ) for the East Fork population (λ = 1.06, 95% Bayesian Credibilty Interval [BCI] = 1.02, 1.10) was about 3% higher than the West Fork population (λ = 1.03, 95% BCI = 0.99, 1.07). The East Fork population was increasing during all study years except 2010 – 2011 when the growth rate was near stable at 0.99 (95% BCI = 0.88, 1.10). The West Fork population was stable during 2010 – 2011 (1.00, 95% BCI = 0.87, 1.11), declined in 2011 – 2012 (0.95, 95% BCI = 0.87, 1.05), and increased during the latter half of the study.

Our analysis of the relative importance of different vital rates on population growth rate revealed that in the East Fork population, the most important vital rates were first adult female survival (measured by the slope [β] of the regression of population growth rate on each vital rate, and the amount of variation in population growth rate explained by each vital rate [R2]; β = 0.87, R2 = 0.43), followed by calf survival (β = 0.35, R2 = 0.38), then pregnancy (β = 0.17, R2 = 0.06). Similarly, in the West Fork, adult female survival (β = 0.89, R2 = 0.56) was the most important, followed by calf survival (β = 0.33, R2 = 0.33) and pregnancy (β = 0.12, R2 = 0.06). After decomposing annual calf survival into seasonal components, our analysis also revealed substantive differences in the relative importance of summer and winter calf survival on λ. In the East Fork, summer and winter calf survival contributed more or less similarly to λ (summer = 0.26, SE = 0.02, R2 = 0.20; winter = 0.22, SE = 0.01, R2 = 0.19), but in the West Fork, summer calf survival was more than twice as important (summer = 0.23, SE = 0.01, R2 = 0.23; winter = 0.15, SE = 0.01, R2 = 0.11) as winter calf survival. The relative magnitude of the differences in adult female and calf survival also varied between populations. In the East Fork, adult female survival was only about 5% more important than calf survival, whereas in the West Fork, adult female survival explained about 23% more of the variance in population growth rate compared to calf survival, highlighting an important population difference.

Our population modeling suggests that management actions aimed at increasing adult survival would have the greatest impact on population growth rate, especially for the more nutritionally limited West Fork population. However, it may be more difficult for managers to make changes in adult survival compared to calf survival, because nearly half of adult mortality was due to causes beyond management control, and because adult female survival varied little. Instead, focusing management actions on increasing calf survival may result in similar increases in population growth rate compared to adult survival, and be more practical to achieve because calf survival was largely driven by predation. Calf survival was most affected by mountain lion predation, and therefore management actions aimed at reducing mountain lion densities to increase calf survival may result in increasing population growth rate. Although adult survival and calf survival were predicted to be more influential on population growth than pregnancy rates in both populations, our simulations support the potential to achieve moderate increases in elk productivity from habitat treatments that improve forage for elk and result in higher pregnancy rates for adult females.

Calf survival was largely driven by mountain lion predation, indicating that management actions aimed at reducing mountain lions densities may result in higher calf survival, thus increasing population growth rates. Overall, the annual rate of predation-caused mortality for elk calves was 0.28 (95% CI = 0.22, 0.35), and mountain lion caused mortality (CIF = 0.20, 95% CI = 0.14, 0.27) dominated over wolf caused mortality (CIF = 0.03, 95% CI = 0.01, 0.07) and black bear caused mortality (CIF = 0.05, 95% CI = 0.02, 0.10). Given the strong effect of predation on elk calf survival and the strong effect of calf survival on elk population growth rate, reducing the level of predation on calf elk is predicted to increase calf survival to age 1 and increase elk population growth rate. Although our results regarding the important impacts of carnivores on elk populations through effects on calf survival are generally consistent with previous carnivore-elk studies conducted in the Greater Yellowstone Area (GYA) of southwest Montana, our results differ in that the primary predator of elk in the Bitterroot Valley was mountain lion, rather than wolves or bears. Together, the GYA and Bitterroot elk studies highlight that carnivores have an important impact on elk populations, but that carnivore communities and the relative effects of different carnivore species on elk populations vary across ecosystems.

4. IMPROVING ESTIMATION OF WOLF RECRUITMENT AND ABUNDANCE, AND DEVELOPMENT OF AN ADAPTIVE HARVEST PROGRAM FOR WOLVES IN MONTANA.

Investigators: Mike Mitchell, Sarah Sells, and Allison Keever, Montana Cooperative Wildlife Research Unit, University of Montana, Missoula MT

INTRODUCTION

Wolves (*Canis lupus*) were reintroduced in the northern Rocky Mountains (NRM) in 1995, and after rapid population growth were delisted from the endangered species list in 2011. Since that time, states in the NRM have agreed to maintain populations and breeding pairs (a male and female wolf with 2 surviving pups by December 31; USFWS 1994) above established minimums (≥150 wolves and ≥15 breeding pairs within each state). Montana estimates population size every year using patch occupancy models (POM; MacKenzie et al. 2002, Rich et al. 2013, Miller et al. 2013, Bradley et al. 2015), however, these estimates are sensitive to pack size and territory size, and were developed pre-harvest. Reliability of future estimates based on POM will be contingent on accurate information on territory size, overlap, and pack size, which are expected to be strongly affected by harvest. Additionally, breeding pairs, which has proven to be an ineffective measure of recruitment, are determined via direct counts. Federal funding for wolf monitoring is decreasing now that wolves are delisted, and future monitoring will not be able to rely on intensive counts of the wolf population. Furthermore, monitoring has become cumbersome and less effective since the population has grown. With the implementation of harvest, it is pertinent to predict the effects of harvest on the wolf population and continue to monitor to determine effectiveness of management actions to make informed decisions regarding harvest and trapping quotas.

STUDY OBJECTIVES

The 4 study objectives are to:

1. Improve estimation of recruitment.
2. Improve and maintain calibration of wolf abundance estimates generated through POM.
3. Develop framework for dynamic, adaptive harvest management based on achievement of objectives 1 & 2.
4. Design targeted monitoring program to provide info needed for robust estimates and reduce uncertainty in the AHM paradigm over time.

Two PhD students are addressing the 4 study objectives via Project 1 (Sarah Sells) and Project 2 (Allison Keever; Fig. 1).

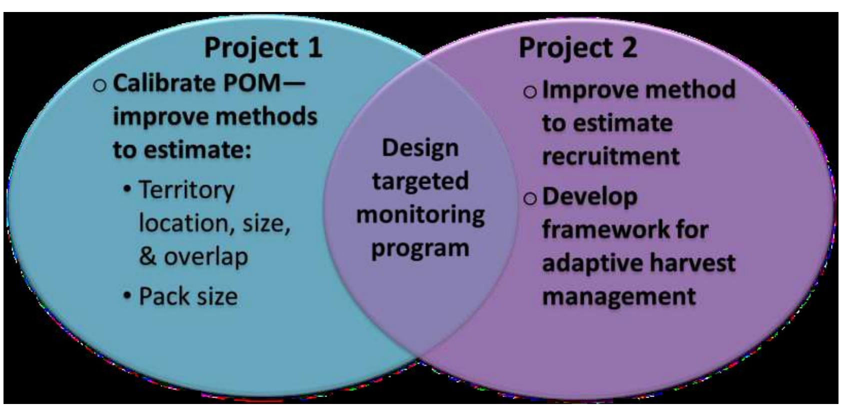

Fig. 1. Objectives for this project are being addressed under 2 separate projects.

DELIVERABLES

1. A method to estimate recruitment for Montana's wolf population that is more cost effective and biologically sound than the breeding pair metric.
2. A model to estimate territory size and pack size that can keep POM estimates calibrated to changing environmental and management conditions for wolves in Montana.
3. An adaptive harvest management model that allows the formal assessment of various harvest regimes and reduces uncertainty over time to facilitate adaptive management of wolves.
4. A recommended monitoring program for wolves to maintain calibration of POM estimates, determine effectiveness of management actions, and facilitate learning in an adaptive framework.

LOCATION

This study encompasses wolf distribution in Montana and Idaho.

STUDY PROGRESS

Work began in January 2015 (Fig. 2). Much of year 1 was devoted to literature reviews on animal behavior, carnivores, modeling, optimal foraging, etc. and determining approaches for our dissertations. We also formed and held multiple meetings with our committees, completed more coursework, and finalized research statements. Additional efforts focused on communicating with wolf specialists, identifying target packs for collaring, managing collar orders and data, and helping coordinate contracts and capture plans for winter aerial captures for January and February 2016. We also met with wolf specialists in the field to learn more about the wolves in their regions, and coordinated and held meetings with the specialists to plan future project efforts. Our dissertation proposals are currently underway as of spring 2016, which we will defend at the end of spring semester. Based on these efforts, we have formulated a general rationale and analytical approach that will facilitate achieving the project objectives, which is detailed in the below sections.

As of February 2016, 35 collars have been purchased for this project, and 2 additional are being shared among MFWP projects. MFWP field staff has successfully captured 40 wolves, deploying 10 collars in 2014, 14 collars in 2015, and 16 collars as of February 2016. Eight mortalities have occurred (5 by harvest, 1 by vehicle, 1 presumed by vehicle, and 1 from capture) and the status of 1 collared wolf remains unknown due to collar failure, mortality, or distant dispersal. Additional capture efforts will continue through ground and aerial capture efforts through 2017.

FUTURE APPROACHES AND RATIONALE

Objective 1: Improve estimation of recruitment. *Allison Keever*

Estimating recruitment (i.e., number of young produced that survive to an age at which they contribute to the population) of wolves can be difficult due to their complex social structure. Wolves are cooperative breeders, and pack dynamics (e.g., pack tenure, breeder turnover, and number of non-breeding helpers) can affect recruitment and pup survival (e.g., Ausband et al. 2015, Borg et al. 2015). Cooperative breeding oftentimes relies on the presence of non-breeding individuals that help raise offspring (Solomon and French 1997), and reduction in group size can lead to decreased recruitment in cooperative breeders (Sparkman et al. 2011, Stahler et al. 2013). Human-caused mortality through both direct and indirect means (Ausband et al. 2015) and prey biomass per wolf (Boertje and Stephenson 1992) have been shown to affect recruitment. It will be important to consider the effects of harvest, pack dynamics, wolf density, and prey availability on recruitment. Recruitment estimation is further hindered by the size of the wolf population and the large scale over which recruitment is needed. Currently, MFWP documents recruitment in wolves by visual counts of breeding pairs (a male and female wolf with 2 surviving pups by December 31; USFWS 1994). These counts, however, are likely incomplete due to the size of the wolf population and limited resources. A breeding pair estimator (Mitchell et al. 2008) could be used to estimate breeding pairs, however the breeding pair estimator requires knowing all pack sizes, data that are hard to collect given the size of the current wolf population. Federal funding for wolf monitoring is decreasing now that wolves are delisted, and future monitoring will not be able to rely on intensive counts of the wolf population. Additionally, the breeding pair metric is an ineffective measure of recruitment, as it gives little insight into population growth rate or the level of harvest that could be sustained. Recruitment could be estimated by comparing visual counts at the den site to winter counts via aerial telemetry (Mech et al. 1998) or by marking pups at den sites (Mills et al. 2008). An alternative method could include non-invasive genetic sampling (Ausband et al. 2015) at predicted rendezvous sites (Ausband et al. 2010). These methods, however, may not be feasible on large scales due to budget and staff constraints.

Objective 1 Approach
My objective is to develop an approach to estimate recruitment that is more tractable, cost effective, and biologically credible than the breeding pair metric. To do this I will focus on developing an accurate method to estimate recruitment for wolves. I will test an empirical, per capita recruitment model which will be built off of data collected for wolves in Montana and Idaho using generalized linear models. The data include numbers of packs and wolves estimated from POM and actual wolf counts, including pups, from wolf surveys conducted annually. A per capita model, however, may not be the most accurate way to predict recruitment in wolves due to their social nature, and an empirical model may require data which will be difficult to collect in the future. I will also develop and test a theoretical recruitment model which will build off of existing work on pup survival and recruitment (e.g., Sparkman et al. 2011, Stahler et al. 2013, Ausband et al. 2015, Borg et al. 2015). The theoretical model will build off of relationships found between recruitment, group size, and harvest in cooperative breeders (e.g., Sparkman et al. 2011, Stahler et al. 2013, Ausband et al. 2015, Borg et al. 2015). After constructing multiple, competing theoretical models about what is important for recruitment I will test them against actual data on recruitment to determine which model has most support. I will compare the best theoretical model with the empirical model to determine which predicts recruitment most accurately and which requires the least amount of data and can be employed within budgetary and staff time constraints.

Objective 2: Improve and maintain calibration of wolf abundance estimates generated through POM. *Sarah Sells*
Monitoring is a critical, yet challenging, management tool for gray wolves. Monitoring helps MFWP set and fulfill management objectives for minimum populations and harvest levels. Results also facilitate communicate with stakeholders and the public. Monitoring any large carnivore is challenging, however, due to their elusive nature and naturally low densities (Boitani et al. 2012). This is particularly true for wolves due to increasing populations, decreasing funding for monitoring, and changing behavioral dynamics with harvest.

Abundance estimates are a key component of monitoring (Bradley et al. 2015). Abundance is estimated with 3 parameters: area occupied, average territory size, and annual average pack size (Fig. 3, Bradley et al. 2015). Area occupied is estimated with a Patch Occupancy Model (POM) based on hunter observations and field surveys (Miller et al. 2013, Bradley et al. 2015). Average territory size is assumed to be 600 km$_2$ with minimal overlap, based on past work (Rich et al. 2012). Annual average pack size is estimated from monitoring results. Total abundance (N) is then calculated as: N = (area occupied $\bar{x}$ territory size$/$) × $\bar{x}$ pack size.

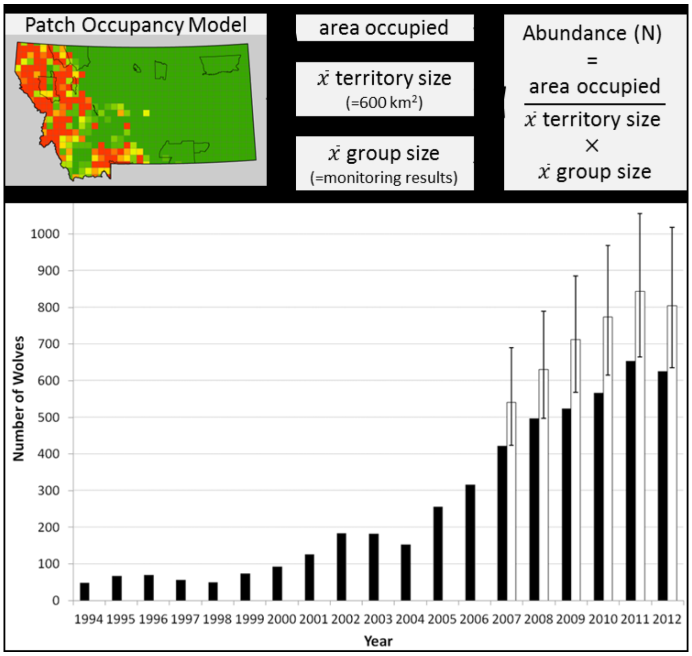

Fig. 3. Example of POM results (red indicates highest occupancy probability, green lowest), and methods for calculating abundance. Graphed abundance since 1994 is based on minimum counts (black bars) and POM-based estimates (white bars). (Adapted from Bradley et al. 2015.)

Whereas estimates of area occupied from POM are expected to be reliable (Miller et al. 2013, Bradley et al. 2015), reliability of abundance estimates hinge on key assumptions about territory 6 size, territory overlap, and pack size (Bradley et al. 2015). Assumptions of fixed territory size and minimal overlap are simplistic; in reality, territories vary spatiotemporally (Uboni et al. 2015). This variability is likely even greater under harvest (Brainerd et al. 2008). Meanwhile, pack size estimates rely on locating and accurately counting packs each year, which is increasingly difficult due to the number of packs and declining funding for monitoring (Bradley et al. 2015).

Since implementation of harvest in 2009, several factors have further compounded these challenges and decreased accuracy of pack size estimates. First, whereas larger packs are generally easier to find and monitor, average pack size has decreased under harvest (Bradley et al. 2015). Difficult-to-detect smaller packs may be more likely to be missed altogether, biasing estimates of average pack size. Harvest and depredation removals also affect social and dispersal behavior (Adams et al. 2008, Brainerd et al. 2008, Borg et al. 2014, Ausband 2015). Additionally, pack turnover is now greater than in populations with less human-caused mortality.

Development of reliable methods to estimate territory size, territory overlap, and pack size is critical for accurate estimates of abundance. Theoretical models for wolf behavior would provide predictions that can be compared to real data to identify the models with most support. Resulting models would yield reliable scientific inference and be predictive at any spatiotemporal scale. Importantly, abundant data would not be required for predictions.

Objective 2 Approach

My goal is to develop models to estimate territory and group size of wolves to calibrate estimates of abundance of wolves in the Northern Rocky Mountains (NRM). I will draw on theory and previous research to construct theoretical models for territories and group sizes of wolves. I will then conduct simulations to generate predictions, which I will test on locations and group sizes of actual packs.

The models I develop will be predictive at any spatiotemporal scale in absence of abundant empirical data. Alongside POM, the models will help accurately estimate abundance of wolves through biologically based, spatially explicit predictions for territory size, location, and overlap and group size. Data will come from multiple sources. MFWP will deploy ≤20 GPS collars per year from 2014−2017 to collect locations on wolf packs. I will also include data from GPS-collared wolves in Idaho to increase our sample size. Additionally, I will use existing data from VHF and GPS-collared wolves from past years (potentially 1995−current). I will use pack size estimates collected through monitoring efforts.

Objective 3: Develop framework for adaptive harvest management. *Allison Keever*
Wolves have been harvested in Montana since they were delisted. In 2011 there was a statewide wolf quota of 220 which was divided into 14 wolf management units (Bradley et al. 2015). Since that time the statewide quota has been discontinued, a five wolf bag limit was put in place, and season length and timing has changed (Bradley et al. 2015).

Although hunting and trapping continues to be an important tool for wolf management, there is debate about the effects of harvest on wolf populations (e.g., Creel and Rotella 2012, Gude et al. 2012). Creel and Rotella (2010) found that human-caused mortality was not compensated for and was potentially super-additive. The human-caused mortality they considered, however, was largely from control removals in unhunted populations, and hunting and trapping will likely have different effects on population growth (Haber 1996). Furthermore, Creel and Rotella (2010) only tested compensation in survival, and recruitment and dispersal are known to be very important for wolf population dynamics (Adams et al. 2008, Gude et al. 2012). There is a lot of variation in the reported level of harvest wolf populations can sustain before growth rate decreases (Mech 2001, Adams et al. 2008, Creel and Rotella 2010, Gude et al. 2012), however the reasons behind this variation have not been explored. This variation could be due to different types and timing of human-caused mortality due to the effects of breeder loss on recruitment (Borg et al. 2015), differences in prey availability and consumption as prey availability is important for wolf population growth rate (Vucetich and Peterson 2004), or differences in scale and methodology of data collection and analysis. There is additional uncertainty about the role of density dependence in wolf population dynamics (Cariappa et al. 2011, Cubaynes et al. 2014, McRoberts and Mech 2014).

Given uncertainty in wolf population dynamics and the effects of harvest on those dynamics, it is difficult to make informed harvest decisions that have a high likelihood of achieving the desired outcome. Despite uncertainty, harvest decisions must still be made. This leads to the question of how do decision-makers make the best decision with what data are available, and how do we gather information to improve decision making? Adaptive management is a tool that can help guide management when there are iterated decisions (e.g., annual harvest recommendations) while accounting for and reducing uncertainty over time (Walters 1986, Williams et al. 2009). Adaptive management is a structured approach to making decisions that is transparent and repeatable, and when applied to harvest is termed adaptive harvest management (AHM). An AHM model for wolves will allow the formal assessment of harvest regimes in meeting objectives and determination of underlying biological processes.

Objective 3 Approach
My objective is to develop an adaptive harvest management (AHM) model for wolves to help guide harvest decisions while learning about the effects of harvest on wolves through management. Developing an AHM model requires 4 components: 1) objectives, 2) alternative management actions, 3) a model of the natural resource system to predict the effects of management, and 4) a monitoring

program that allows decision-makers to determine the effectiveness of those management actions, reduce uncertainty, and learn over time. Objectives, the first component of AHM, are how one would measure success of management actions. The second component, alternative management actions, is used to determine the optimal set of decisions which can affect the system model to meet objectives. A system model (the third component; e.g., model of population dynamics) predicts the current system state, for example population size. The system model can incorporate different types of uncertainty within the model or by having alternative system models about system dynamics. Comparing predictions from alternative system models to monitoring data (fourth component of AHM) reduces uncertainty, and Bayes theorem is used to update model support, or likelihood, which influences future decisions.

Objectives: Prior work outlining objectives for wolf management was completed in 2010 with MFWP. The objectives produced by this work were to maximize sustainability of the wolf population, maximize sustainability of ungulate populations, and maximize public satisfaction. I developed an objectives hierarchy adapted from the 2010 objectives which links the fundamental objectives, those deemed most important, to means objectives which outline how to achieve the fundamental objective (Fig. 4). I will use the objectives outlined in the 2010 wolf management workshop for the AHM model for wolves.

Fig. 4. Objectives hierarchy developed from the 2010 wolf management structured decision making workshop. The blue boxes represent the fundamental objectives which are most important, and the green boxes represent the means objectives for achieving the fundamental objectives.

Alternative management actions: I will develop alternative management actions (harvest scenarios) in conjunction with MFWP. Although MFWP recommends harvest regulations to the Montana Fish and Wildlife Commission they cannot prescribe actual harvest rates, so I will predict harvest rates across the state. I will use data on hunter & trapper effort and hunter & trapper success to test how harvest rates have changed with changing regulations.

System model: I will develop and test a system model (population model in this case) for wolf population dynamics that can be informed by data from a feasible monitoring program. The population model will describe the effects of harvest on wolf population dynamics. I will test the population model by comparing model predictions of population size to estimates from POM and wolf counts.

Monitoring program: Monitoring is an essential component to AHM, as that is how learning occurs. Monitoring data are used to update the AHM model to reduce uncertainty through time. After the

AHM model is complete, I will conduct a sensitivity analysis (Clemen and Reilly 2001) to determine the influence of each type of monitoring data on decision making. This will allow us to target areas where more data should be collected in order to improve decision making over time. A monitoring program for wolves must also continue to include estimates of population size from POM to evaluate effectiveness of management actions.

To develop the complete AHM model, I will combine the above components and determine the optimal harvest strategy given objectives for wolf management. I will estimate harvest strategies for each population size using simulation optimization methods (Fu et al. 2005, Lin et al. 2013) and objectives outlined by MFWP. I will estimate optimal harvest strategies for alternative population models (e.g., compensatory vs. additive mortality and density dependence vs. independence) and then simulate the harvest strategies over each alternative model of population dynamics and compare model predicted population size with estimates from monitoring. Alternative model predictions that are closest to estimates from monitoring will gain support for models, and model support will be updated through Bayes theorem. Support for any one alternative model is not static, and can be updated over time from observations of system states (e.g., population size). I will also evaluate the usefulness of the AHM model for management by comparing the amount of uncertainty reduced to the amount of data required to inform the model.

Objective 4: Conduct sensitivity analyses & propose efficient monitoring regime.
Allison Keever and Sarah Sells
Monitoring is important for wildlife management, and a key component to adaptive management. It provides information on the starting point of the population which is used to inform a decision, and it provides a means to evaluate effectiveness of management actions and learn over time. When resources are limited, however, it is important to target monitoring as opposed to conducting surveillance monitoring (i.e., monitoring not guided by *a priori* hypotheses that include all aspects of a population's demographic and ecological factors; Nichols and Williams 2006). Monitoring for adaptive harvest management should focus on population dynamics and harvest as those variables are likely used to determine success of achieving objectives. Using sensitivity analyses can help identify other components to target with monitoring.

Objective 4 Approach
We will conduct sensitivity analyses (e.g., Clemen and Reilly 2001) and evaluate precision of components in each model outlined as part of this work to identify factors that strongly influence results and decisions. The components which most influence the results and lack precision can be targeted for monitoring to reduce uncertainty and produce robust population estimates. Based on results of these sensitivity analyses, we will recommend a monitoring program that will include sampling effort, sampling distribution, and what should be monitored.

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LITERATURE CITED

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.

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. E., L. N. Rich, E. M. Glenn, M. S. Mitchell, P. Zagar, D. A.W. Miller, L. P. Waits, B. B. Ackerman, C. M. Mack. 2014. Monitoring gray wolf populations using multiple suvey methods. Journal of Wildlife Management 78:335–346. 11

Ausband, D. E. 2015. Groups and mortality: their effects on cooperative behavior and population growth in a social carnivore. University of Montana.

Boertje, R., and R. Stephenson. 1992. Effects of ungulate availability on wolf reproductive potential in Alaska. Canadian Journal of Zoology 70:2441–2443.

Boitani, L., P. Ciucci, and A. Mortelliti. 2012. Designing carnivore surveys. Pages 8–30 *in* Carnivore Ecology and Conservation A Handbook of Techniques. Oxford University Press, Oxford, UK.

Borg, B. L., S. M. Brainerd, T. J. Meier, and L. R. Prugh. 2015. Impacts of breeder loss on social structure, reproduction and population growth in a social canid. Journal of Animal Ecology.

Bradley, L., J. Gude, N. Lance, K. Laudon, A. Messer, A. Nelson, G. Pauley, M. Ross, T. Smucker, and J. Steuber. 2015. Montana gray wolf conservation and management 2014 annual report. Montana Fish, Wildlife and Parks, Helena, Montana.

Brainerd, S. M., H. Andren, 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 on wolves. Journal of Wildlife Management 72:89–98.

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.

Clemen, R. T., and T. Reilly. 2001. Making hard decisions. South-Western, Mason, Ohio.

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.

Cubaynes, S., D. R. MacNulty, D. R. Stahler, K. A. Quimby, D. W. Smith, and T. Coulson. 2014. Density-dependence intraspecific aggression regulates survival in northern Yellowstone wolves (*Canis lupus*). Journal of Animal Ecology 83:1344–1356.

Fu, M. C., F. W. Glover, and J. April. 2005. Glover FW, April J. Simulation optimization: a review, new developments, and applications. In: Proceedings of the winter simulation conference, 2005. p. 83–95.

Glenn, E. S., L. N. Rich, and M. S. Mitchell. 2011. Estimating numbers of wolves, wolf packs, and breeding pairs in Montana using hunter survey data in patch occupancy model framework: final report. Technical report, Montana Fish, Wildlife and Parks, Helena, Montana.

Gude, J. A., M. S. Mitchell, R. E. Russell, C. A. Sime, E. E. Bangs, L. D. Mech, and R. R. Ream. 2012. Wolf population dynamics in the U.S. Northern Rocky Mountains are affected by recruitment and human-caused mortality. Journal of Wildlife Management 76:108–118. 12

Lin, R., M. Y. Sir, and K. S. Pasupathy. 2013. Multi-objective simulation optimization using data envelopment analysis and genetic algorithm: specific application to determining optimal resource levels in surgical services. Omega 41:881–892.

MacKenzie, D. I., J. D. Nichols, G. B. Lachman, S. Droege, J. A. Royle, and C. A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83:2248–2255.

McRoberts, R. E., and L. D. Mech. 2014. Wolf population regulation revisited-again. Journal of Wildlife Management 78:963–967.

Mech, L. D. 2001. Managing Minnesota's recovered wolves. Wildlife Society Bulletin 29:70–77.

Mech, L. D., L. G. Adams, T. J. Meier, J. W. Burch, and B. W. Dale. 1998. The wolves of Denali. Minnesota: University of Minnesota Press.

Miller, D. A. W., J. D. Nichols, J. A. Gude, L. N. Rich, K. M. Podruzny, J. E. Hines, and M. S. Mitchell. 2013. Determining Occurrence Dynamics when False Positives Occur: Estimating the Range Dynamics of Wolves from Public Survey Data. PLoS ONE 8.

Mills, K. J., B. R. Patterson, and D. L. Murray. 2008. Direct estimation of early survival and movements in eastern wolf pups. Journal of Wildlife Management 72:949–954.

Mitchell, M. S., D. E. Ausband, C. A. Sime, E. E. Bangs, M. Jimenez, C. M. Mack, T. J. Meier, M. S. Nadeau, and D. W. Smith. 2008. Estimation of successful breeding pairs for wolves in the U.S. northern Rocky Mountains. Journal of Wildlife Management. 72:881–891.

Nichols, J. D., and B. K. Williams. 2006. Monitoring for conservation. Trends in Ecology and Evolution 21:668–673.

Rich, L. N., M. S. Mitchell, J. A. Gude, and C. A. Sime. 2012. Anthropogenic mortality, intraspecific competition, and prey availability influence territory sizes of wolves in Montana. Journal of Mammalogy 93:722–731.

Rich, L. N., R. E. Russell, E. M. Glenn, M. S. Mitchell, J. A. Gude, K. M. Podruzny, C. Sime, K. Laudon, D. E. Ausband, and J. D. Nichols. 2013. Estimating occupancy and predicting numbers of gray wolf packs in Montana using hunter surveys. Journal of Wildlife Management 77:1280–1289.

Solomon, N. G., and J. A. French. 1997. Cooperative breeding in mammals. Cambridge University Press, UK.

Sparkman, A.M., J. Adams, A. Beyer, T. D. Steury, L. Waits, and D. L. Murray. 2011. Helper effects on pup lifetime fitness in the cooperatively breeding red wolf (*Canis rufus*). Proceedings of the Royal Society of London, B 278:1381–1389. 13

Stahler, D. R., D. R. MacNulty, R. K. Wayne, B. VonHoldt, and D. W. Smith. 2013. The adaptive value of morphological, behavioral and life-history traits in reproductive female wolves. The Journal of Animal Ecology 82:222–234.

Uboni, A., J. Vucetich, D. Stahler, and D. Smith. 2015. Interannual variability: a crucial component of space use at the territory level. Ecology 96:62–70.

U.S. Fish and Wildlife Service. 1994. The reintroduction of gray wolves to Yellowstone National Park and central Idaho. Final Environmental Impact Statement. Denver, Colorado. Appendix 9.

Vucetich, J. A., and R. O. Peterson. 2004. The influence of prey consumption and demographic stochasticity on population growth rate of Isle Royale wolves *Canis lupus*. OIKOS 107:309–320.

Walters, C. J. 1986. Adaptive management of renewable resources. McMillan, New York, New York, USA.

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive management: the U.S. Department of the Interior technical guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

5.LIVESTOCK GUARD DOG PROJECT

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Status: March 2016 Update

In 2015, USDA's National Wildlife Research Center, in collaboration with Utah State University, completed the third of four field seasons of a research study investigating the effectiveness of certain breeds of livestock guard dogs (LGDs) for reducing domestic sheep depredations by carnivores. At the start of the project in the spring of 2013, nine kangal-breed LGDs were placed with sheep producers in Montana through collaboration with Montana Fish, Wildlife and Parks and USDA's Wildlife Services. In addition to the nine new LGDs, six extant "whitedog" LGDs were monitored. The dogs were divided into trios and each trio was assigned to a band of sheep. Since 2013 the project has expanded every year. Outside of Montana, the project now operates concurrently in Idaho, Oregon, Washington, and Wyoming (Figure 1). Throughout the five states and over the course of three years, the project has collected data from 107 individual LGDs from four breeds (kangal, karakachan, transmontano, and whitedog) through collaboration with 21 different livestock producers (Table 1).

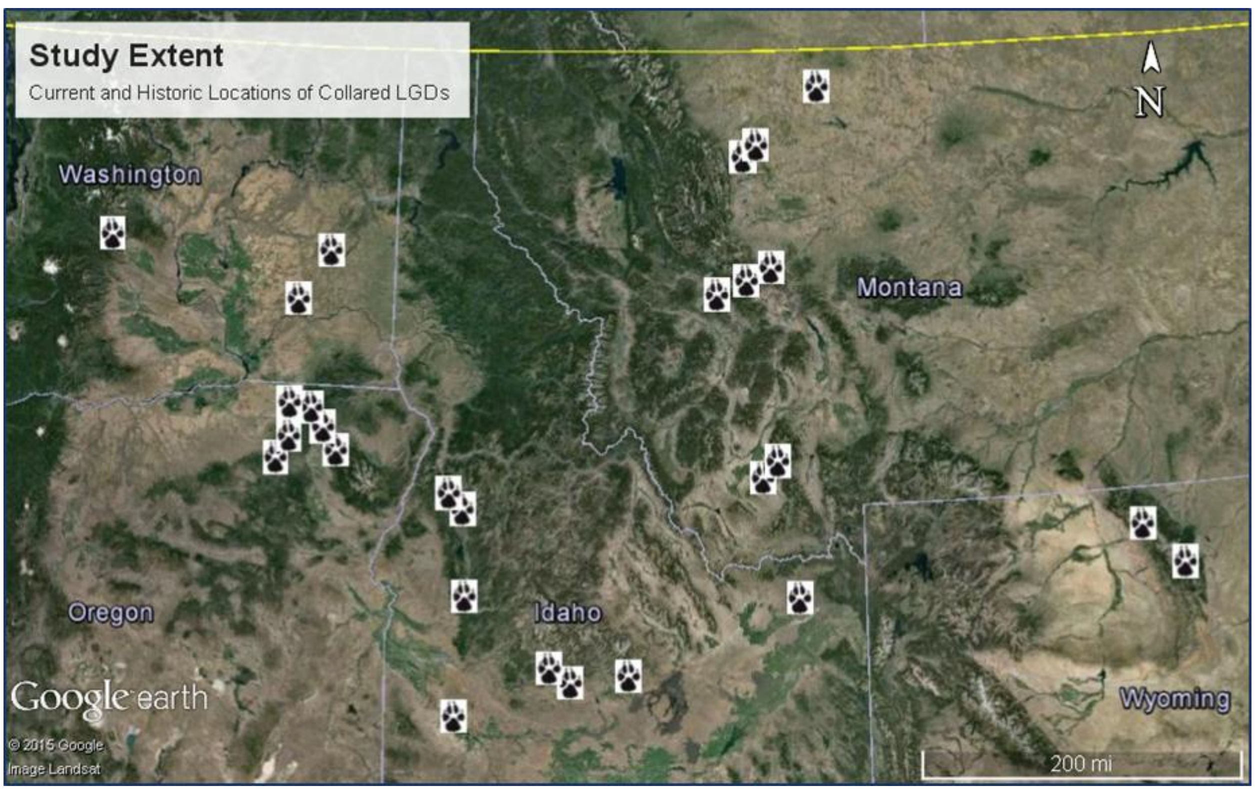

Figure 1. Paw prints indicate all locations where LGDs have been monitored since the study began in 2013.

Table 1. Counts of producer, sheep bands, kangals, karakachans, transmontanos and whitedogs by state and year. Note that totals do not necessarily represent individual producers, bands, or LGDs, but rather the sum of counts by year as a measure of effort.

	Producers	Sheep Bands	Kangals	Karakachans	Transmontanos	Whitedogs
Montana						
2013	3	5	6	0	0	9
2014	5	6	6	3	0	9
2015	3	4	6	0	2	6
2016	4	5	7	0	1	6
Total	15	20	25	3	3	30
Idaho						
2014	3	5	6	3	0	6
2015	5	7	3	4	5	6
2016	4	7	2	3	6	9
Total	12	19	11	10	11	21
Oregon						
2014	3	6	6	3	0	9
2015	4	6	7	3	3	6
2016	5	7	3	1	5	6
Total	11	19	16	7	8	21
Washington						
2014	1	2	0	0	3	3
2015	3	4	2	3	3	3
2016	2	3	0	3	3	3
Total	6	9	2	6	9	9
Wyoming						
2015	2	2	4	3	0	3
2016	2	2	3	0	0	3
Total	4	4	7	3	0	6
TOTAL	48	71	65	29	28	87

While the majority of LGDs bond well with sheep and become socialized to the producers and herders with whom they are accustomed, LGDs occasionally fail to become effective guardians. In these situations LGDs are generally transferred to other producers who may provide a better fit for a specific LGD, due to type of operation (i.e., pasture vs. open-range), temperament of other LGDs, or some other latent variable. LGDs that fail to bond in a different environment are removed from the study. In 2015, 13 LGDs were removed from the study, generally due to a failure to bond with livestock.

During the 2015 field season we documented 53 sheep depredations in monitored sheep bands, including eight from wolves and two from grizzly bears. These mortality counts should be considered minimums, as they only included mortalities investigated and verified by project staff and/or USDA-WS specialists and do not include unaccounted sheep. We are currently working with producers and USDA-WS to merge our mortality records and season-end head counts. At this time there is too little data to draw inference on the effectiveness of whitedogs versus new-breed LGDs as breeds are sometimes mixed in sheep herds and records are not complete. The numbers presented here are only a preliminary summary.

In addition to sheep mortalities, the project also collects data on LGD behavior, space-use of LGDs and sheep, and occupancy of large carnivores. An ethogram of LGD responses to threatening and nonthreatening decoys (n=26) shows an increase in aggressive behaviors (i.e., barking, moving, and scanning) towards threatening stimuli, and potentially more investigative or apathetic behaviors (i.e., investigating, and not visible) towards non-threatening stimuli ($\chi2(1)=187.71$, $p<0.001$, Figure 2). While these data are preliminary, they suggest LGDs respond selectively and aggressively towards potential predators. Additional data will allow us to compare LGD behavior as a function of breed.

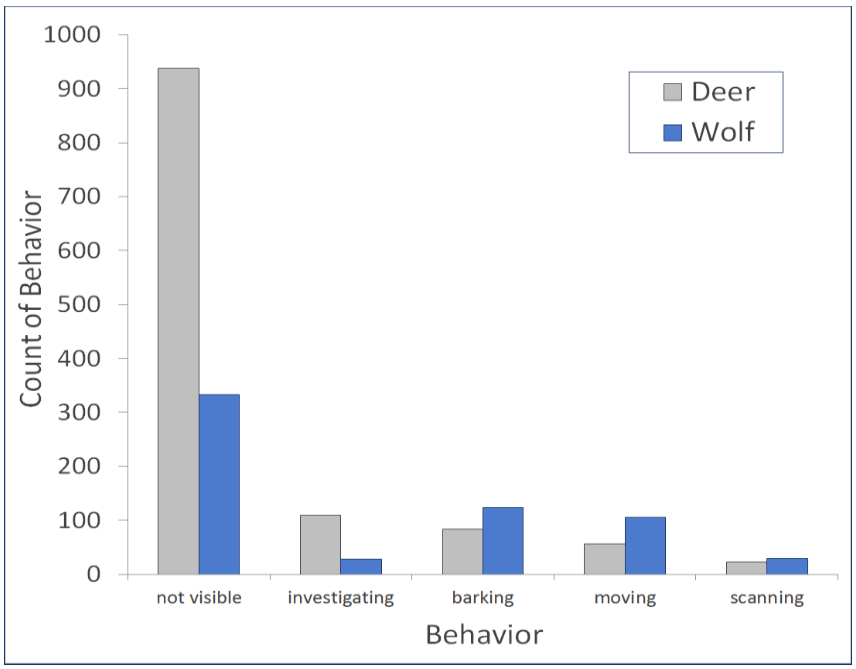

Figure 2. Count of five most common LGD behaviors in response to a threatening (Wolf) and non-threatening (Deer) decoy.

Mixed effect models of space-use data for LGDs and sheep indicate no breed differences in LGDs' proximity to sheep when controlling for sex and age ($\chi2(1)=0.876$, $p=0.35$, Figure 3), although greater variance is observed in kangals. On average, this pattern does not vary as a function of time of day. However, at the individual level there is large variation in proximity of LGDs to sheep as a function of time of day. Thus, some LGDs wander further from sheep at night, while others are further from sheep during the day. These patterns, although not observed in aggregate, may be the result of breed differences in LGD-sheep proximity or an artifact of different grazing practices. Future analysis will also include LGD experience as a covariate independent of age. Additional data will help determine whether such differences are truly an effect of breed.

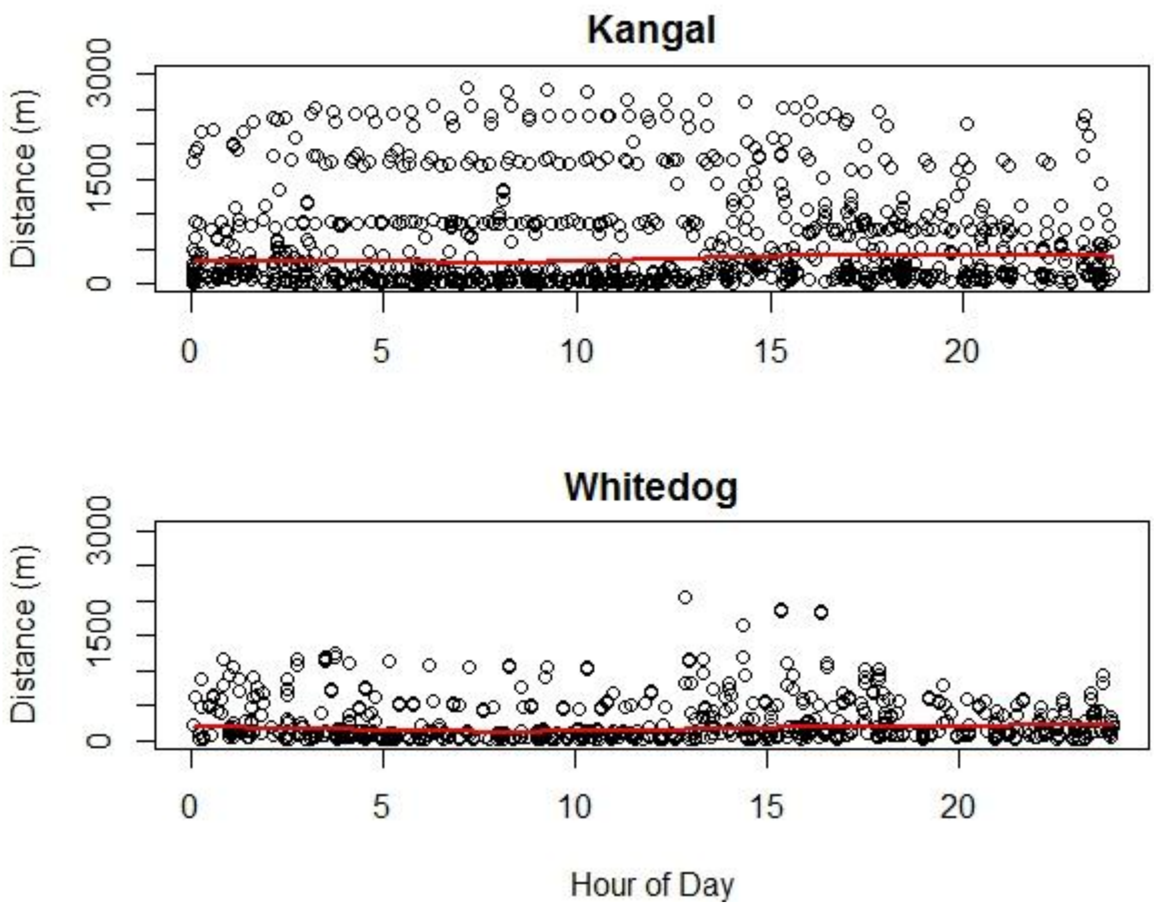

Figure 3. Proximity of LGDs to sheep as a function of breed and hour of the day. Best fit line is drawn in red.

Occupancy of large carnivores is detected through the use of remote trail cameras. In addition to verifying the presence of predators near monitored sheep bands, these photos allow us to draw inference on how LGDs and sheep influence the space-use of large carnivores. Utilizing a BACI design, we are able to calculate how carnivore occupancy varies as a function of sheep presence while sheep move through public lands, as well as the probability that sheep and carnivores co-occur at any point during the grazing season. Processing of photo data from 2015 is ongoing, but simple occupancy estimates from 25 camera locations in Idaho in 2014 confirm the overlap of LGDs and sheep with wolves in the same habitats on public land during the typical grazing season (Figure 4). Further, co-occurrence data seems to suggest a decreased likelihood of LGDs and wolves occupying the same landscape patches concurrently, however these models are inconclusive at this time due to small sample sizes (ϕ=0.74, 95% CI= -1.83–3.32). Once all photo data is processed and simple occupancy calculated for LGDs, sheep, and large carnivores, a similar co-occurrence model will be constructed to help determine whether LGDs and sheep affect large carnivore space-use at a fine scale.

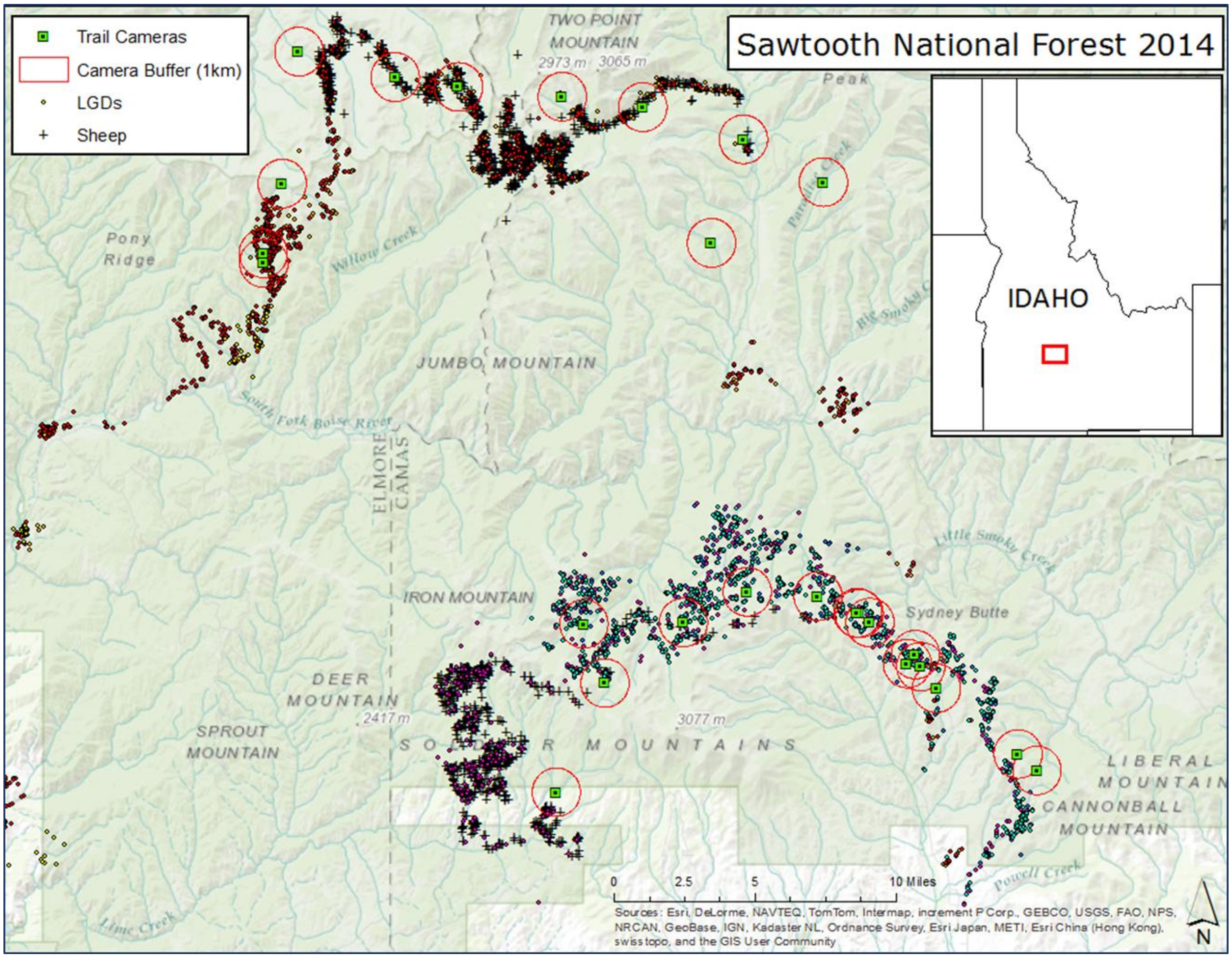

Figure 4. Map of 2014 GPS collar data from LGDs and sheep in Sawtooth National Forest, as well as location of trail cameras. GPS data was collected over four months, as two sheep bands moved from West to East across public grazing land.

The 2016 field season will begin in May and the project will continue to operate in Idaho, Montana, Oregon, Washington, and Wyoming. In Montana, the project will be collecting data from five sheep bands managed by four different producers. A total of 14 LGDs will be fitted with GPS collars and monitored (see Table 1). LGD collar frequencies for the 2016 field season will be provided to state and federal wildlife managers upon request. Additionally, brief project updates will be sent out each month during the 2016 field season. Please contact Julie Young at julie.k.young@aphis.usda.gov about receiving these updates. Daniel Kinka and a regional field technician will be collecting data and working with producers in Montana during the 2016 grazing season.

Lastly, the project is conducting a survey of attitudes toward LGDs and large carnivores directed towards those involved in the livestock industry. Hard copies of the survey are available in English and will soon be available in Spanish as well. We are using a snowball sampling method to disseminate this survey. The survey comes with a pre-paid return envelope and responses are kept strictly anonymous. If you are aware of individuals who would be interested in completing the survey, please contact Daniel Kinka at kinkadan@gmail.com and survey packets will be provided to you. The survey is a recent effort and there are currently too few responses to present preliminary findings.

The fourth and final season of the project will conclude in mid-October of 2016. At that time, data from all four field seasons will be combined to form a master dataset and analysis will begin. Final results are expected to be submitted for publication throughout 2017. As final results become available they will also be communicated directly to wildlife managers and sheep producers. The project will conclude at the end of 2017.

Preliminary analysis suggests that, on average, LGD breeds may exhibit different behavioral patterns in response to threatening stimuli. Even if sheep survival does not significantly differ as a function of breed, detailed behavioral data may allow managers to make tailored recommendations as to which LGD breed is likely to benefit a producer the most. In addition, modeling the effect of sheep presence on carnivore occupancy has never been examined and will help managers and producers better understand how LGDs work and what effect they have on wildlife. Lastly, surveying how human attitudes towards LGDs affects tolerance for large carnivores may add credence to the use of LGDs, not just as a management tool but as a conservation tool as well.

APPENDIX 4

MONTANA MINIMUM COUNTS BY AREA

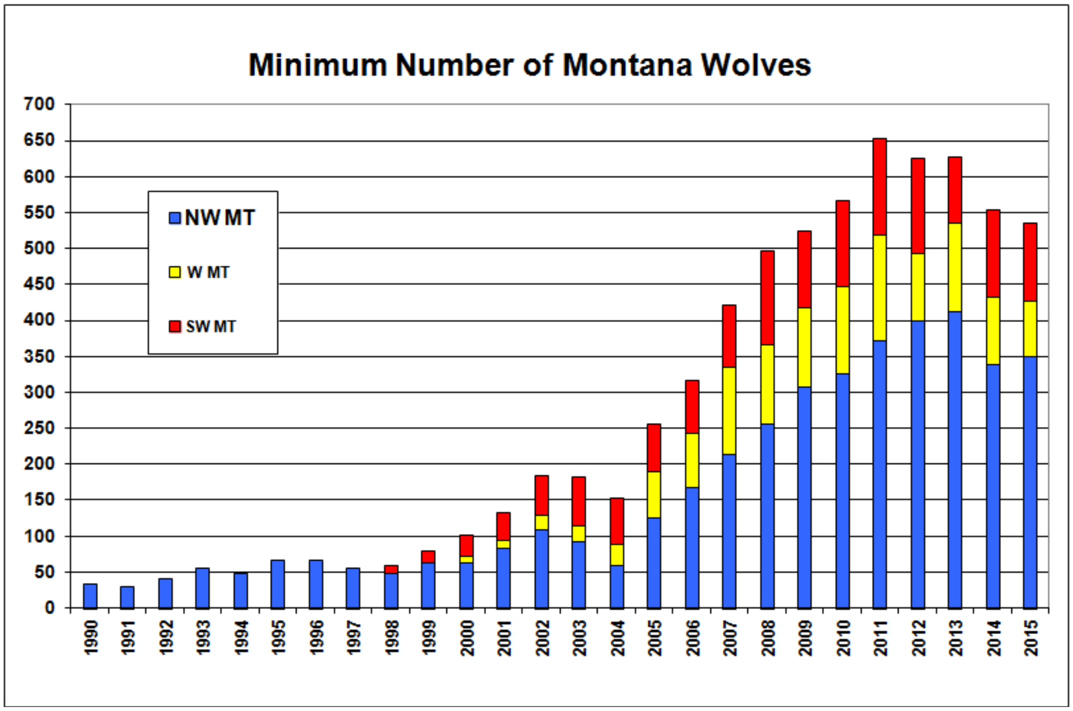

Figure A41. Minimum number of wolves in Montana by recovery area, 1990-2015.

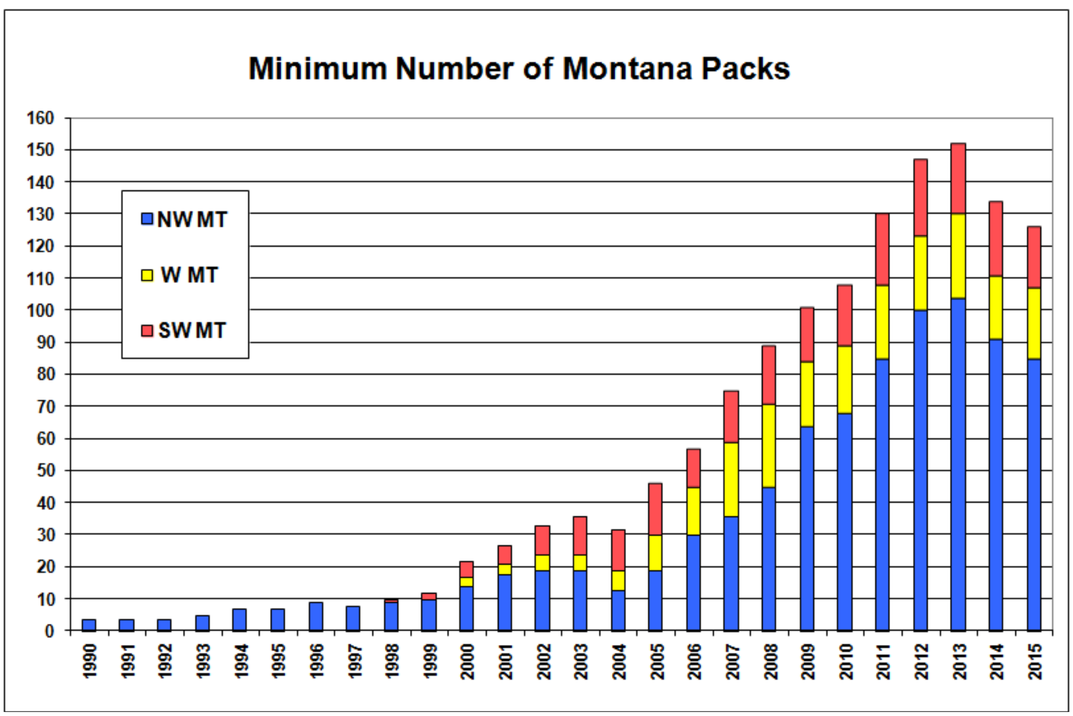

Figure A42. Minimum number of wolf packs in Montana by recovery area, 1990–2015.

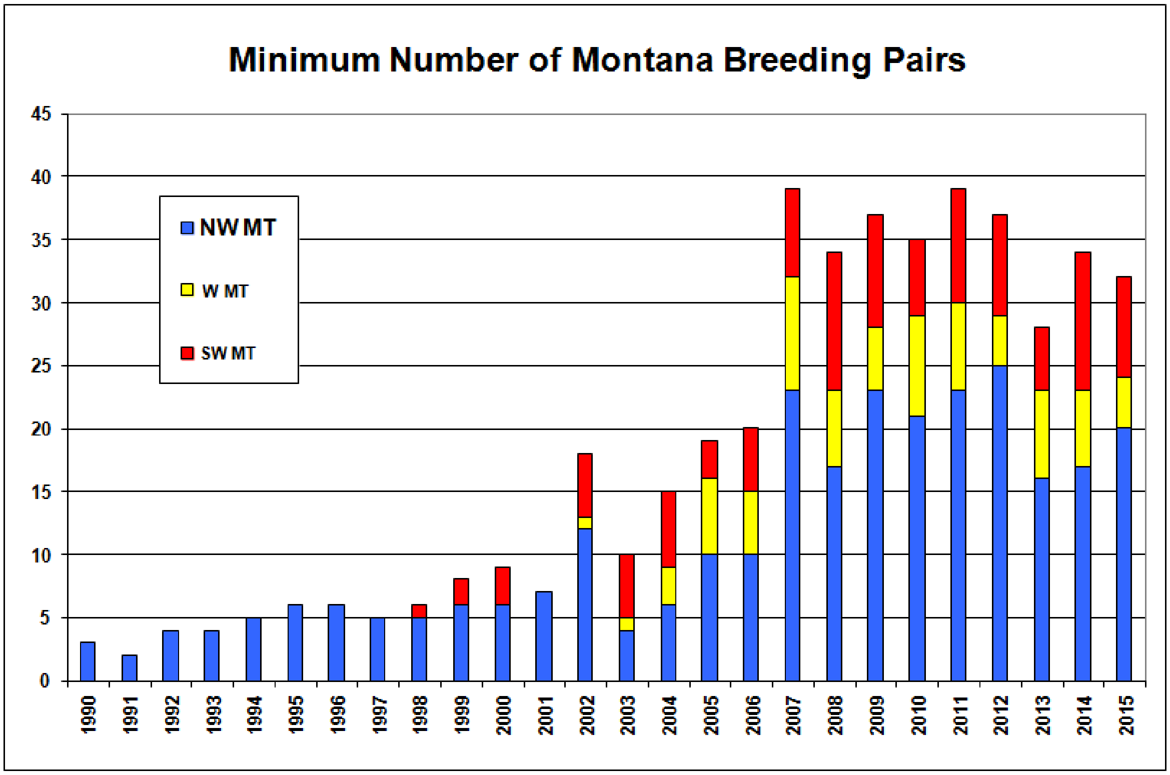

Figure A43. Minimum number of breeding pairs in Montana by recovery area, 1990–2015.

APPENDIX 5

NORTHERN ROCKIES WOLF PACK TABLES

Table 1a. Wolf Packs and Population Data for the Northwest Montana Recovery Area, 2015.

Table 1b. Wolf Packs and Population Data for the Greater Yellowstone Recovery Area, 2015.

Table 1c. Wolf Packs and Population Data for the Central Idaho Recovery Area and Montana Statewide Totals, 2015.

Table 1a: Montana Wolf Packs and Population Data for Montana's Portion of the Northwest Montana Recovery Area, 2015.

REF #	WOLF PACK [1,7]	RECOV AREA	STATE	MIN. ESTIMATED PACK SIZE DEC 2015	DOCUMENTED MORTALITIES NATURAL	HUMAN [2]	UNKN [3]	HARVEST [8]	CONTROL [5]	KNOWN DISPERSED	MISSING [4]	CONFIRMED LOSSES [6] CATTLE	SHEEP	DOGS	OTHER
1	Akokala	NWMT	MT	5											
2	Arrastra Creek	NWMT	MT	5											
	~~Ashley~~	NWMT	MT	0				3							
3	Baptiste	NWMT	MT	8											
4	Bearfite	NWMT	MT	5	1			2							
5	Belmont	NWMT	MT	5				4							
6	Bennie	NWMT	MT	5				1							
	~~Bisson (CSKT)~~	NWMT	MT	0											
7	Blowout Mountain	NWMT	MT	8				3							
8	Bugle Mountain	NWMT	MT	2											
9	Cabinet	NWMT	MT	2											
10	Cache Creek #	NWMT	MT	9				1							
11	Candy Mountain	NWMT	MT	2				2							
	~~Cataract~~	NWMT	MT	0						2					
	~~Cedar~~	NWMT	MT	0											
12	Chamberlain	NWMT	MT	2			1	4							
13	Chief Mtn (BFN)	NWMT	MT	10											
	~~Chippy~~	NWMT	MT	0											
14	Cilly	NWMT	MT	5											
15	Condon	NWMT	MT	13				6							
16	Conger Point	NWMT	MT	2											
17	Corona	NWMT	MT	3				5							
18	Crown Mtn	NWMT	MT	4		1		3	6			1			
19	DeBorgia #	NWMT	MT	8				1							
20	Dog Gun (BFN)	NWMT	MT	4											
21	Dutch	NWMT	MT	9				1							
22	Echo	NWMT	MT	2				1							
23	Evaro	NWMT	MT	2											
24	Firefighter	NWMT	MT	7				1							
25	Flathead Alps	NWMT	MT	3											

Continued…

Table 1a: Montana Wolf Packs and Population Data for Montana's Portion of the Northwest Montana Recovery Area, 2015.

REF #	WOLF PACK [1,7]	RECOV AREA	STATE	MIN. ESTIMATED PACK SIZE DEC 2015	DOCUMENTED MORTALITIES NATURAL	HUMAN[2]	UNKN[3]	HARVEST[4]	CONTROL[5]	KNOWN DISPERSED	MISSING[6]	CONFIRMED LOSSES[5] CATTLE	SHEEP	DOGS	OTHER
26	Flesher Pass	NWMT	MT	2				1	1			1			
27	Garden (CSKT)	NWMT	MT	2											
28	Great Bear	NWMT	MT	2				1							
29	Great Northern	NWMT	MT	2											
30	Humbug	NWMT	MT	10				2							
31	Inez	NWMT	MT	8		1		2							
	~~Kerr~~	NWMT	MT	1				5	4			1			
32	Kintla	NWMT	MT	2				2							
33	Kootenai North	NWMT	MT	2											
34	Kootenai South	NWMT	MT	2											
35	Ksanka	NWMT	MT	2				3	1			1			
36	Landers Fork	NWMT	MT	5				2							
37	Livermore (BFN)	NWMT	MT	3											2
38	Looking Glass (BFN)	NWMT	MT	3											
39	Lost Dog	NWMT	MT	5				4							
40	Lost Girl	NWMT	MT	2				2							
41	Lost Soul	NWMT	MT	2											
42	Lydia	NWMT	MT	2								1			
43	Marias	NWMT	MT	2											
44	McDonald	NWMT	MT	2											
45	McKay	NWMT	MT	2				1							
46	Mineral Mountain	NWMT	MT	2		1									
47	Moore	NWMT	MT	2		1			1			1			
48	Morrell Mountain	NWMT	MT	3		1		1							
49	Mullan	NWMT	MT	3											
50	Murphy Lake	NWMT	MT	5		1		3							
51	Ninemile	NWMT	MT	8				3							
52	No	NWMT	MT	5				1							
	~~Noisy~~	NWMT	MT	0											
53	Nyack	NWMT	MT	2											

Continued...

Table 1a: Montana Wolf Packs and Population Data for Montana's Portion of the Northwest Montana Recovery Area, 2015.

REF #	WOLF PACK [1,7]	RECOV AREA	STATE	MIN. ESTIMATED PACK SIZE DEC 2015	DOCUMENTED MORTALITIES NATURAL	HUMAN [2]	UNKN [3]	HARVEST [4]	CONTROL [5]	KNOWN DISPERSED	MISSING [6]	CONFIRMED LOSSES [5] CATTLE	SHEEP	DOGS	OTHER
54	O'Brien	NWMT	MT	2											
55	Olson Peak	NWMT	MT	3								1			
56	Petty Creek	NWMT	MT	2											
57	Pierce	NWMT	MT	2											
58	Pistol Creek (CSKT)	NWMT	MT	4											
59	Preacher #	NWMT	MT	4											
60	Pretty Prairie	NWMT	MT	10				1							
61	Quartz Creek	NWMT	MT	5				1							
62	Quintonkon	NWMT	MT	5											
63	Red Shale	NWMT	MT	10				1							
64	Satire	NWMT	MT	4				6							
65	Savenac	NWMT	MT	2				2		1					
	~~Silcox~~	NWMT	MT	0											
66	Silver Lake #	NWMT	MT	5				1							
67	Sleeping Woman (CSKT)	NWMT	MT	4											
68	Smoky	NWMT	MT	2											
69	Solomon Mountain #	NWMT	MT	2											
70	Spotted Bear	NWMT	MT	6				5							
71	Stonewall Mountain	NWMT	MT	6				1							
	~~Sugarloaf~~	NWMT	MT	0											
72	Sundance	NWMT	MT	9				1							
73	Sunrise Mountain	NWMT	MT	2											
74	Tallulah	NWMT	MT	7											
75	Telephone Butte	NWMT	MT	3				2							
76	Teton	NWMT	MT	4				4							
77	Thunderbolt	NWMT	MT	2											
78	Tom Meier	NWMT	MT	4		1		1							
79	Twilight #	NWMT	MT	2											
80	Union Peak	NWMT	MT	2											
81	Valley Creek (CSKT)	NWMT	MT	3											

Continued…

Table 1a: Montana Wolf Packs and Population Data for Montana's Portion of the Northwest Montana Recovery Area, 2015.

REF #	WOLF PACK [1,7]	RECOV AREA	STATE	MIN. ESTIMATED PACK SIZE DEC 2015	DOCUMENTED MORTALITIES: NATURAL	HUMAN[2]	UNKN[3]	HARVEST[8]	CONTROL[5]	KNOWN DISPERSED	MISSING[4]	CONFIRMED LOSSES[6]: CATTLE	SHEEP	DOGS	OTHER
82	Vermillion	NWMT	MT	2											
83	Weigel	NWMT	MT	2				1							
84	Wiggletail #	NWMT	MT	2				1							
85	Wolf Prairie	NWMT	MT	2											
	Misc/Lone	NWMT	MT	2		4	1	8				4			
	MT in NWMT (Table 1a)	NWMT	MT	349	1	11	2	107	13	3	0	11	0	0	2
	ID in NWNMT (Table 3b)	NWMT	ID	0	0	0	0	0	0	0	0	0	0	0	0
	NWMT RECOVERY AREA	NWMT	MT/ID	349	1	11	2	107	13	3	0	11	0	0	2

1 Underlined packs are counted as breeding pairs toward recovery goals. CSKT = Flathead Indian Reservation; BFN = Blackfeet Indian Reservation.

2 Excludes wolves killed in control actions to address livestock depredation and lawful public harvest.

3 Does not include pups that disappeared before winter.

4 Collared wolves that became missing in 2015.

5 Agency lethal control whether under state or federal regulations. Includes wolves killed by private citizens to defend livestock or under terms of a kill permit.

6 Includes only domestic animals confirmed killed by wolves.

7 Strikethrough indicates pack did not exist on Dec. 31 2015 and is not displayed on the map.

8 Number legally harvested by humans in 2015.

Border pack shared with the State of Idaho; dens in Montana.

Table 1b: Wolf Packs and Population Data for Montana's Portion of the Greater Yellowstone Recovery Area, 2015.

REF		RECOV		MIN. ESTIMATED	DOCUMENTED MORTALITIES					KNOWN		CONFIRMED LOSSES[6]			
#	WOLF PACK[1,7]	AREA	STATE	PACK SIZE DEC 2015	NATURAL	HUMAN[2]	UNKN[3]	HARVEST[8]	CONTROL[5]	DISPERSED	MISSING[4]	CATTLE	SHEEP	DOGS	OTHER
86	Baker Mountain	GYA	MT	5		1		6							
87	Beartrap	GYA	MT	16	1	1		1	1						
	~~Brackett Creek~~	GYA	MT	1				1							
	~~Buffalo Fork Pack~~	GYA	MT	1				1							
	~~Carmichael~~	GYA	MT	0				2							
88	Cedar Creek	GYA	MT	4				4							
89	Cougar 2*	GYA	MT	3			1	4							
	~~Elkhorns~~	GYA	MT	0											
90	Fridley	GYA	MT	4				2							
91	Hayden*	GYA	MT	7				1							
92	Highlands	GYA	MT	3					5			7			
93	Hogback	GYA	MT	12		1		6		1		1			
	~~Lebo Peak~~	GYA	MT	0											
94	Meadow Creek	GYA	MT	2				2	3			1			
	~~Mill Creek~~	GYA	MT	0											
95	Parker Peak*	GYA	MT	2		1									
96	Price Creek	GYA	MT	4		2		7					4		
	~~Romy Lake~~	GYA	MT	0		1		2	1			1			
97	Rosebud	GYA	MT	6		1		2	2			1			
98	Shinglemill	GYA	MT	8				4							
99	Slip n' Slide	GYA	MT	5		1		4							
100	Steamboat Peak	GYA	MT	9		1									
101	Sweet Water	GYA	MT	2								1	2		
102	Tanner Pass	GYA	MT	3											
103	Toadflax	GYA	MT	5		1		6	1						

Continued…

Table 1b: Wolf Packs and Population Data for Montana's Portion of the Greater Yellowstone Recovery Area, 2015.

REF #	WOLF PACK[1,7]	RECOV AREA	STATE	MIN. ESTIMATED PACK SIZE DEC 2015	DOCUMENTED MORTALITIES NATURAL	HUMAN[2]	UNKN[3]	HARVEST[8]	CONTROL[5]	KNOWN DISPERSED	MISSING[4]	CONFIRMED LOSSES[6] CATTLE	SHEEP	DOGS	OTHER
	~~Wilson Creek~~	GYA	MT	0											
104	Cinnabar*	GYA	MT	3	1	1		2							
	Misc/Lone	GYA	MT	4		1		13							
MT in GYA (Table 1b)		GYA	MT	109	2	13	1	70	13	1	0	12	6	0	0

1 Underlined packs are counted as breeding pairs toward recovery goals.

2 Excludes wolves killed in control actions.

3 Does not include pups that disappeared before winter.

4 Collared wolves that became missing in 2015.

5 Agency lethal control whether under state or federal regulations. Includes wolves killed by private citizens to defend livestock, under terms of a kill permit, or under

6 Includes only domestic animals confirmed killed by wolves.

7 Strikethrough indicates pack did not exist on Dec. 31 2015 and is not displayed on the map.

8 Number legally harvested by humans in 2015.

* Border pack shared with Yellowstone National Park; more time in Montana.

Table 1c: Wolf Packs and Population Data for Montana's Portion of the Central Idaho Recovery Area and Montana Statewide Totals, 2015.

REF.		RECOV		MIN. ESTIMATED	DOCUMENTED MORTALITIES					KNOWN		CONFIRMED LOSSES[6]			
#	WOLF PACK[1,7]	AREA	STATE	PACK SIZE DEC 2015	NATURAL	HUMAN[2]	UNKN[3]	HARVEST[8]	CONTROL[5]	DISPERSED	MISSING[4]	CATTLE	SHEEP	DOGS	OTHER
105	Alta #	CID	MT	5				1							
106	Ambrose	CID	MT	6				1							
107	Anaconda	CID	MT	4				3							
108	Black Pine	CID	MT	2											
109	Bloody Dick #	CID	MT	3				2				5			
110	El Capitan	CID	MT	5				2	2			5			
111	Divide Creek	CID	MT	5				2							
112	East Fork Rock Creek	CID	MT	2											
113	Flint	CID	MT	4				1							
114	Foolhen	CID	MT	2											
115	Four Eyes #	CID	MT	5				1							
116	Gash Creek #	CID	MT	2				2							
117	Gird Point	CID	MT	2											
	~~Jeff Davis #~~[7]	CID	MT	0					5			1			
118	One Horse	CID	MT	2				2							
119	Overwhich #	CID	MT	6				1							
120	Pyramid #	CID	MT	5				2							
121	Ross' Fork	CID	MT	4				1							
122	Sliderock Mtn	CID	MT	3						1					
123	Sula #	CID	MT	2											
124	Tepee Point	CID	MT	2											
125	Trapper Peak	CID	MT	4											

Continued…

Table 1c: Wolf Packs and Population Data for Montana's Portion of the Central Idaho Recovery Area and Montana Statewide Totals, 2015.

REF. #	WOLF PACK[1,7]	RECOV AREA	STATE	MIN. ESTIMATED PACK SIZE DEC 2015	DOCUMENTED MORTALITIES NATURAL	HUMAN[2]	UNKN[3]	HARVEST[8]	CONTROL[5]	KNOWN DISPERSED	MISSING[4]	CONFIRMED LOSSES[6] CATTLE	SHEEP	DOGS	OTHER
126	Watchtower #	CID	MT	2											
	Misc/Lone	CID	MT	1		2		7	6	1		7	15		
	MT Total in CID	CID	MT	78	0	2	0	28	13	2	0	18	15	0	0
	MT in NWMT total (Table 1a)	NWMT	MT	349	1	11	2	107	13	3	0	11	0	0	2
	MT in GYA total (Table 1b)	GYA	MT	109	2	13	1	70	13	1	0	12	6	0	0
	MT in CID total (Table 1c)	CID	MT	78	0	2	0	28	13	2	0	18	15	0	0
	MT STATE TOTAL		**MT**	**536**	**3**	**26**	**3**	**205**	**39**	**6**	**0**	**41**	**21**	**0**	**2**

1 Underlined packs are counted as breeding pairs toward recovery goals.
2 Excludes wolves killed in control actions.
3 Does not include pups that disappeared before winter.
4 Collared wolves became missing in 2015.
5 Includes agency lethal control and take by private citizens under state regulations.
6 Includes only domestic animals confirmed killed by wolves.
7 Strikethrough indicates pack did not exist on December 31, 2015 and is not displayed on the map.
8 Number legally harvested by humans in 2015.
Border pack shared with State of Idaho; dens in Montana and majority of time in Montana.