WYOMING WOLF RECOVERY
2011 ANNUAL REPORT

A cooperative effort by the U.S. Fish and Wildlife Service, National Park Service, and USDA Wildlife Services

Photo: USFWS

This cooperative report presents information on the status, distribution, and management of wolves in Wyoming, including Yellowstone National Park, from January 1, 2011 through December 31, 2011.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

EXECUTIVE SUMMARY

The wolf (*Canis lupus*) population remained healthy and robust, making 2011 the tenth consecutive year that Wyoming has exceeded the numerical, distributional, and temporal recovery goals established by the U.S. Fish and Wildlife Service (USFWS). At least 328 wolves in ≥48 packs (including ≥27 breeding pairs) inhabited Wyoming, including Yellowstone National Park (YNP).

WY (outside YNP): Hereafter Wyoming (outside YNP) will be referred to as WY. From 2009 through 2011, the 3-year mean wolf population size in WY was 233 (SD = 11.4; range = 224-246). In 2011, the WY wolf population was ≥230 wolves in ≥38 packs including ≥19 breeding pairs which represented a slight decline in the total number of wolves from 2010 (246); however, the population remained at the 3-year average. At least 15 lone wolves were identified and located throughout the western portion of the state. Average pack size was 6.1 wolves per pack and average litter size was 3.6 pups per litter as of 31 December 2011. We documented 51 mortalities (18% of the population). Causes of mortality included: agency control = 36; under investigation or unknown = 6; human caused = 6; and natural = 3.

We managed wolf population growth and wolf distribution to minimize chronic loss of livestock from wolves and promote wolf conservation by maintaining the WY wolf population well above recovery objectives. We recorded 65 livestock (35 cattle and 30 sheep), 1 dog, and 1 horse as confirmed wolf-kills. Fourteen packs (37% of WY packs in 2011) were involved in ≥1 depredation; 6 packs (16%) were involved in ≥2 depredations; and 5 packs (13%) were involved in ≥3 depredations in 2011. Agency control efforts removed 36 depredating wolves (13% of the population) to reduce livestock losses due to wolves. The State of Wyoming paid $123,703.00 to compensate cattle producers and wool growers who lost livestock to wolves in 2011.

YNP: At the end of 2011, at least 98 wolves in 10 packs (8 breeding pairs), with 2 loners, occupied Yellowstone National Park (YNP). This is the same population size as 2010 (97 wolves) and represents possible population stabilization within YNP. Breeding pairs were also stable at eight. The northern range wolf population has declined approximately 60% since 2007 mostly because of a smaller elk population, the main food of northern range wolves, which has resulted in increased intraspecific competition for fewer resources. The interior wolf population has declined less, probably because they augment their diet with bison. The severity of mange continued to decline in 2011, although some packs still showed signs of the mite. There was no evidence of distemper being a mortality factor as it was in 1999, 2005 and 2008. Pack size ranged from 3 (Agate Creek) to 19 (Mollie's) and averaged 10.2, equal to the long-term average (10). Nine of 9 (100%) packs that we had information on had pups (the reproductive status of the Bechler pack was unknown). The average number of pups/pack in early winter for packs that had pups was 4.1, slightly lower than the 2010 average of 4.8 pups/pack, but higher than 2009 (3.8). A total of 34 pups survived to year end in YNP, four less than in 2010.

During the wolf-prey relationship study, project staff detected 343 kills (definite, probable, and possible combined) made by wolves in 2011, including 267 elk (78%), 15 bison (4%), 18 deer (5%), 1 moose (<1%), 2 pronghorn (<1%), 2 bighorn sheep (<1%), 2 badgers (< 1%), 1 jackrabbit (<1%), 14 coyotes (4%), 1 raven (< 1%), 7 wolves (2%), and 13 unknown prey (4%).

The composition of elk kills was 27% calves, 3% yearlings, 44% cows, 18% bulls, 3% adults of unknown sex, and 6% of unknown sex and age. Bison kills included 5 calves, 1 yearling, 2 cows, 6 bulls, and 1 unknown sex adult.

Other research included population genetics, population regulation, disease, hunting behavior, spatial analyses of territory use, wolf pack leadership, multi-carnivore-scavenger interactions, breeding behavior, dispersal, and observations of wolf, grizzly bear and bison interactions in Pelican Valley.

Wolf management activities included den site closures, several hazing events, and one removal of a food conditioned wolf. Twelve wolves were captured and collared in 6 packs. At year's end 17% of the wolf population was collared. Staff continued to manage wolf viewing areas in Slough Creek and Lamar Valley and other hot spots where wolves were frequently sighted leading to 25,000 people observing wolves and 17,635 visitor contacts by Wolf Project staff. Wolf Project public outreach included 241 talks and 84 interviews.

GREATER YELLOWSTONE RECOVERY AREA - WYOMING

PERSONNEL

Personnel in WY

In 2011, the USFWS monitored and managed wolves in WY with assistance from the U.S. Department of Agriculture APHIS Wildlife Services (WS), the National Park Service (NPS), and the Wyoming Game and Fish Department (WGFD). USFWS personnel included Project Leader Mike Jimenez; biologist Scott Becker; law enforcement agents Terry Thibeault (Resident Agent-in-Charge, Billings, MT), Roy Brown (Special Agent, Lander), David Rippeto (Special Agent, Cody); and Scott Darrah (Special Agent, Casper); and volunteers Catherine Brown, William Deacy, and Danny Kinka.

WS personnel involved with wolf management in WY during 2011 were: Craig Acres, Grant Belden, Dan Braig, Arnold Debock, David Fowler, Tracy Frye, Jeff Hansen, Miles Hausner, John Hodnett, Rory Hook, Matt Hotovec, Ted Jensen, Paul Kokes, Rod Merrell, Monty Nicholson, Brandon Obrien, James Pehringer, Michael Peterson, Nordell Putnam, Steve Richins, Brad Seaman, Calvin Taylor, Tracy Villwok, Bob Wells, Rod Krischke.

NPS biologists John Stephenson and Sarah Dewey monitored wolves in Grand Teton National Park (GTNP) and adjacent areas in WY with assistance from volunteers Sarah Hegg, Danielle Fagre, Pete Lundberg, and Alex May.

Personnel in YNP

Four full-time NPS employees worked for the Yellowstone Wolf Project in 2011: Project Leader Douglas Smith, Project Biologist Daniel Stahler, and Biological Science technicians Erin Stahler and Rick McIntyre. Other paid and volunteer staff were Colby Anton, Nate Bowersock, Lisa

Baril, Nick Bromen, Brannon Forrester, Jared Green, Allison Greenleaf, Josh Irving, Ryan Kindermann, Ky Koitzsch, Lisa Koitzsch, Hans Martin, Matthew Metz, Nathan Muhn, Brendan Oates, Mark Paulson, Emily Perry, Rebecca Raymond, Julie Tasch, Liv Visgirda, Jamie Walton, and Hilary Zaranek.

MONITORING

Monitoring wolves in WY

Radio Collars

A total of 26 wolves were radio collared in 2011 (helicopter darting/net gunning = 19 and trapping = 7). We monitored a total of 52 radio collared wolves (23% of the population) in 27 packs (71% of all packs). From 1999 through 2011, we maintained radio collars on approximately 20-25% of the wolf population each year to monitor their movements, locate den and rendezvous sites, document breeding success, locate wolves to mitigate livestock conflicts, and aid in law enforcement investigations. We used VHF radio collars for general monitoring purposes and used various types of GPS and ARGOS collars for specific research projects.

Population Status

As of 31 December 2011, we estimated that $\geq$230 wolves in $\geq$38 packs ($\geq$19 breeding pairs) inhabited western WY. Another $\geq$15 single wolves were identified and located throughout the western portion of the state (Figure 1 and Table 1). Pack size ranged from 2 to 13 and averaged 6.1 wolves per pack.

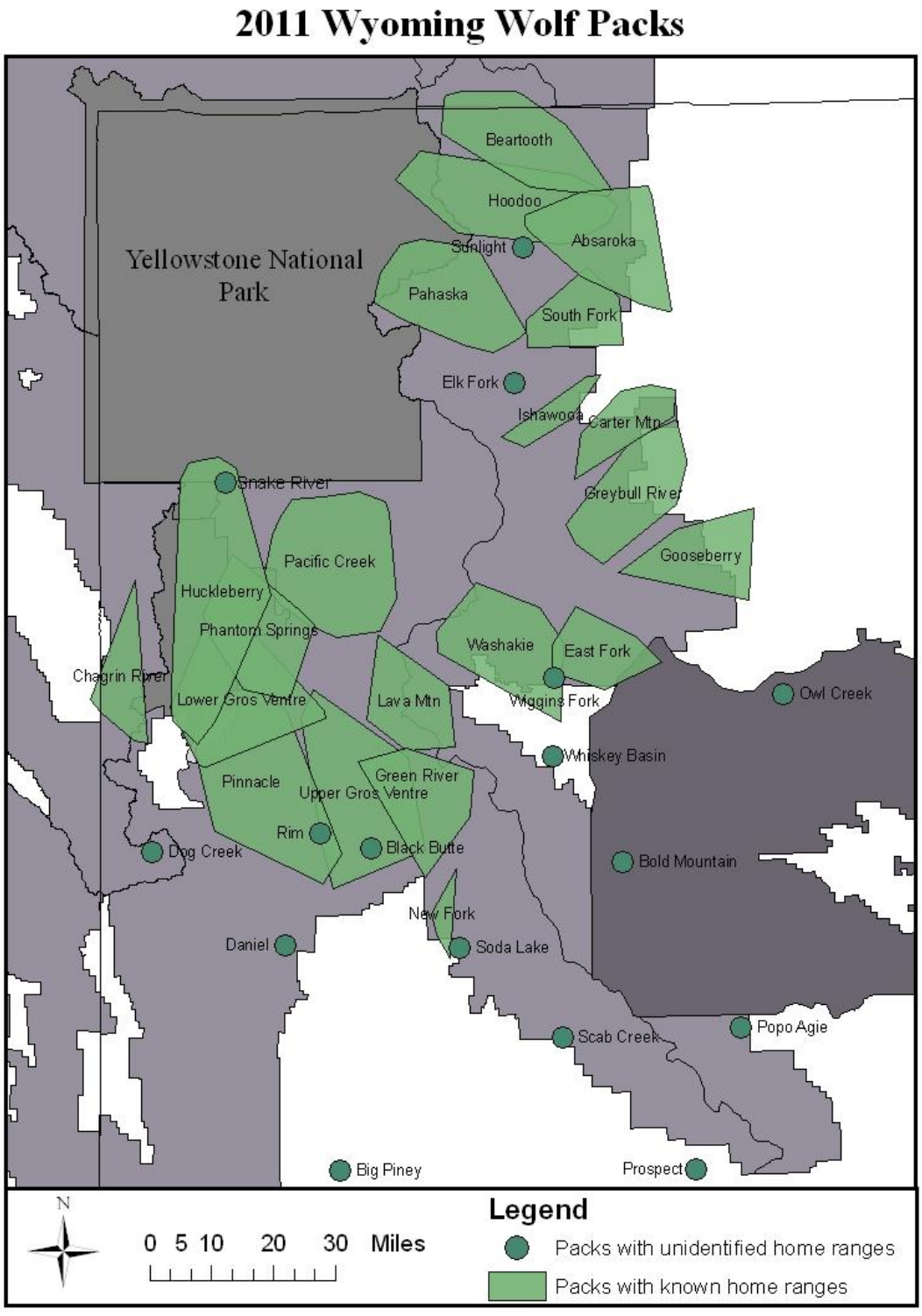

Figure 1. Home ranges of 38 known wolf packs in WY in 2011.

REF		RECOV		MINIMUM ESTIMATED PACK SIZE DEC 2011				OTHER	CONFIRMED LOSSES			
#	WOLF PACK	AREA	STATE	ADULT	PUPS	TOTAL	CONTROL	MORTS	CATTLE	SHEEP	DOGS	OTHER
	Wyoming Outside Yellowstone National Park											
1	Absaroka	GYA	WY	3	0	3	2		3	0	0	0
2	Beartooth	GYA	WY	7	4	11	2		1	0	1	0
3	Big Piney	GYA	WY	4	?	4	0		0	0	0	0
4	Black Butte	GYA	WY	4	?	4	0		0	0	0	0
5	Bold Mtn	GYA	WY	3	0	3	0		0	0	0	0
6	Carter Mtn.	GYA	WY	3	0	3	0		0	0	0	0
7	Chagrin River	GYA	WY	4	3	7	0	1	0	0	0	0
8	Clark	GYA	WY	4	0	4	0		0	0	0	0
9	Daniel	GYA	WY	4	?	4	0		0	0	0	0
10	Dog Creek	GYA	WY	2	4	6	4		0	17	0	0
11	East Fork	GYA	WY	3	3	6	2		1	0	0	0
12	Elk Fork Creek	GYA	WY	2	?	2	0		0	0	0	0
13	Gooseberry	GYA	WY	4	4	8	0		0	0	0	0
14	Green River	GYA	WY	3	4	7	5		15	0	0	0
15	Greybull River	GYA	WY	6	5	11	2		2	0	0	0
16	Hoodoo	GYA	WY	3	1	4	4	4	3	0	0	0
17	Huckleberry	GYA	WY	5	1	6	0		0	0	0	0
18	Ishawooa	GYA	WY	3	4	7	0		0	0	0	0
19	Lava Mtn	GYA	WY	3	0	3	10		5	0	0	0
20	Lower Gros Ventre	GYA	WY	3	0	3	0	1	0	0	0	0
21	New Fork	GYA	WY	2	2	4	2		1	0	0	0
22	Owl Creek	GYA	WY	3	0	3	0		1	0	0	0
23	Pacific Creek	GYA	WY	8	4	12	0		0	0	0	0
24	Pahaska	GYA	WY	7	4	11	0		0	0	0	0
25	Phantom Springs	GYA	WY	10	3	13	1	1	0	0	0	1
26	Pinnacle Peak	GYA	WY	8	5	13	0	1	0	0	0	0
27	Popo Agie	GYA	WY	2	0	2	0		0	0	0	0
28	Prospect	GYA	WY	3	3	6	2		1	0	0	0
29	Rim	GYA	WY	5	?	5	0		0	0	0	0
30	Scab Creek	GYA	WY	2	0	2	0		0	0	0	0
31	Snake River	GYA	WY	3	4	7	0		0	0	0	0
32	Soda Lake	GYA	WY	2	2	4	0		0	0	0	0
33	South Fork	GYA	WY	4	?	4	0	1	0	0	0	0
34	Sunlight	GYA	WY	2	0	2	0		0	0	0	0
35	Upper Gros Ventre	GYA	WY	3	3	6	0	2	0	0	0	0
36	Washakie	GYA	WY	4	4	8	0		1	0	0	0
37	Whiskey Basin	GYA	WY	3	0	3	0		0	0	0	0
38	Wiggins Fork	GYA	WY	2	2	4	0		1	0	0	0
39	Others/lone wolves	GYA	WY	15	0	15	0	4	0	13	0	0
	Sub-total			**161**	**69**	**230**	**36**	**15**	**35**	**30**	**1**	**1**

Underlined packs are counted as breeding pairs toward recovery goals.

Strike through indicates pack no longer exists.

Population Growth

From 2009 through 2011, the 3-year mean wolf population size in WY was 233 (SD = 11.4; range = 224-246). In 2011, the WY wolf population was 230 wolves which represented a slight decline from 2010 (246); however, the population remained at the 3-year average (Figure 2).

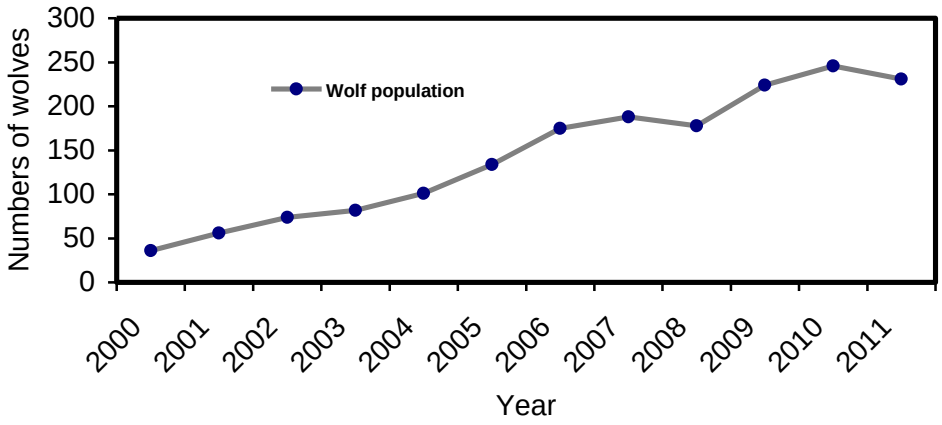

Figure 2. Wolf population growth in WY: 2000 - 2011.

Reproduction

A total of ≥19 packs met the USFWS breeding pair definition (≥1 adult male and ≥1 adult female in a pack producing ≥2 pups that survived through 31 December of that year). A total of 69 pups survived to 31 December 2011 (Table1). Mean litter size was 3.6 pups per litter and ranged from 2-5 pups (Figures 3 and 4).

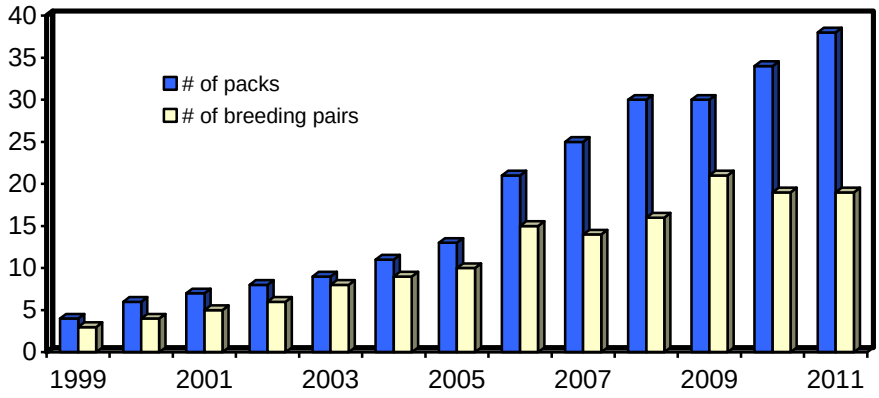

Figure 3. Number of wolf packs and breeding pairs in WY: 1999 – 2011.

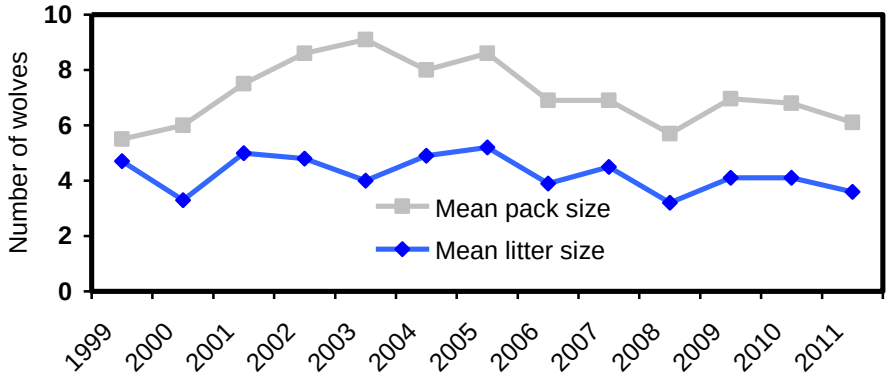

Figure 4. Mean pack size and mean litter size for wolves in WY: 1999 - 2011.

Mortalities

In 2011, 51 wolves (18% of the population) were known to have died in WY. Causes of mortality included: agency control = 36 (70.6% of all documented mortality); unknown = 6 (11.8%); human =6 (11.8%), and natural = 3 (5.9%).

Disease

Mange: Sarcoptic mange is a highly contagious skin disease caused by mites (*Sarcoptes scabiei*) and is commonly found in wolf populations throughout the world. Mange was first detected in WY in 2002. Between 2002 and 2008, we suspected that four packs east of YNP were infested with mange and at least one pack near Jackson, WY had mange (Jimenez et al. 2010). This year we observed signs of mange (alopecia and seborrhea) in the Beartooth pack west of Cody, WY. The adjacent Absaroka pack has frequently shown signs of mange in previous years; however, in 2011 we saw no indication of manage in the pack.

Canine Distemper and Canine Parvovirus: Canine distemper (CDV) and canine parvovirus (CPV) are highly contagious diseases that infect domestic dogs, coyotes, fox, raccoons, skunks, and wolves. Over 80% of the wolves in WY routinely test positive for CDV and CPV. Based on other areas of the world that have experienced epizootic CDV and CPV infections, these diseases will most likely occasionally cause some mortality, particularly among pups, but will be localized in specific areas/years, and not threaten regional wolf population viability.

Monitoring in YNP

Wolf Capture and Collaring

Twelve wolves in six packs were captured and radio-collared in 2011 and 17% of the population was collared at year end. One old adult, 5 adults, 1 yearling, and 5 pups were captured of which 8 were males and 4 were females. Both VHF and downloadable GPS collars were deployed.

Population and Territory Status

There were significantly fewer wolves in 2011 than the park-wide population peak of 174 in 2003, a decline that was brought about by disease and food stress. At the end of 2011, at least 98 wolves in 10 packs (8 breeding pairs), with 2 loners occupied YNP. This suggests a long-term lower population equilibrium for YNP wolves, especially on the northern range. Northern range wolves have declined 60% since 2007 compared to only 23% for interior wolves during the same period. Northern range wolves are much more dependent on elk as a food source compared to interior wolves which prey on elk and bison which are still widely available.

Disease impacts have also likely played a larger role in the wolf decline on the northern range because of higher canid density (wolves, coyotes and foxes) compared to the interior where canid densities are lower. The severity of mange continued to decline in 2011, although some packs still showed signs of the mite. There was no evidence of distemper being a mortality factor as it was in 1999, 2005 and 2008. Pack size ranged from 3 (Agate Creek) to 19 (Mollie's) and averaged 10.2, equal to the long-term average (10).

Two packs were lost in YNP during 2011, but one was replaced by a pack from outside the park. The Quadrant Mountain pack was lost, but was replaced by the 8-mile pack and the Grayling pack was lost without replacement (the Madison pack was not considered a YNP pack although they did spend time in the park).

Reproduction

Nine of 9 (100%) packs that we had information on had pups (the reproductive status of the Bechler pack was unknown). The average number of pups/pack in early winter was 4.1, slightly lower than the 2010 average of 4.8 pups/pack, but higher than 2009 (3.8). A total of 34 pups in YNP survived to year end, four less than in 2010.

Mortalities

Ten radio-collared wolves died in YNP in 2011. Intraspecific competition accounted for 60% of all documented mortalities (four were from the Agate Creek pack). One wolf died from a vehicle strike, another from an elk or bison, one from legal human harvest (park wolf outside YNP), and one was illegally killed. Continued high mortality from wolf-wolf strife suggests food stress.

MANAGEMENT

Management in WY

Livestock Depredations

Potential livestock depredations in WY were investigated by WS, USFWS, and WGFD. Depredations were classified as confirmed, probable, or other based on specific criteria agreed upon by the USFWS and WS. The following livestock depredation statistics were based on reported livestock losses and do not reflect lost or missing livestock. In 2011, wolves in WY were responsible for killing ≥65 livestock, 1 dog, and 1 horse. Confirmed livestock depredations included 35 cattle (28 calves and **7** cows/yearlings) and 30 sheep (Table 2; Appendix Tables 2a, 5a, and 5b). One horse had to be euthanized after it was chased by wolves and broke its leg. Three calves, 1 dog, and 6 horses were injured by wolves, but survived.

Confirmed	Injured
28 calves	3 calves
7 cows/yrlgs	1 dog
30 sheep	6 horses
1 horse	

Table 2. Depredations in WY in 2011 (confirmed losses, injured livestock, and horses).

Depredations	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cattle	3	18	23	34	75	54	123	55	41	20	26	35
Sheep	25	34	0	7	18	27	38	16	26	195	33	30
Dogs	6	2	0	0	2	1	1	2	0	7	0	1
Goats	0	0	0	0	10	0	0	0	0	0	0	0
Horses	0	0	0	2	0	1	0	1	0	0	1	1
Wolves Controlled	2	4	6	18	29	41	44	63	46	31	40	36

Table 3. Confirmed livestock depredations in WY: 2000 – 2011.

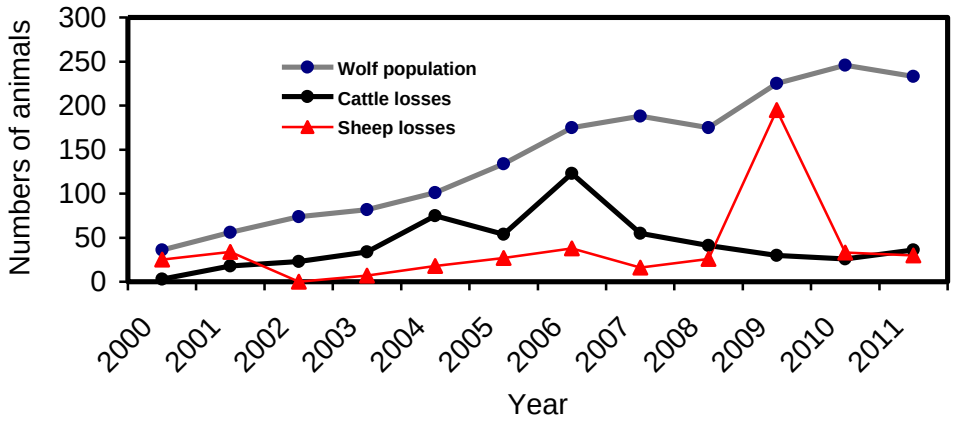

Figure 5. Annual wolf population size and number of confirmed cattle and sheep losses/year in WY: 2000 - 2011.

Number of Packs Involved in Depredations

Since 1999, the WY wolf population has increased annually and wolves have recolonized new areas in northwest WY. Wolves living in areas with relatively high native ungulate densities and relatively low exposure to domestic livestock have caused fewer conflicts than wolves that recolonized areas where large numbers of livestock grazed on private and public lands.

Fourteen packs (37% of WY packs in 2011) were involved in ≥1 depredation (Figure 6); 6 packs (16%) were involved in ≥2 depredations; and 5 packs (13%) were involved in ≥3 depredations in 2011. Two packs (Green River [15 cattle] and Dog Creek [17 sheep]) and 1 wolf in the Big Horn Mountains (10 sheep) were responsible for 42 depredations (65% of the total number of depredations).

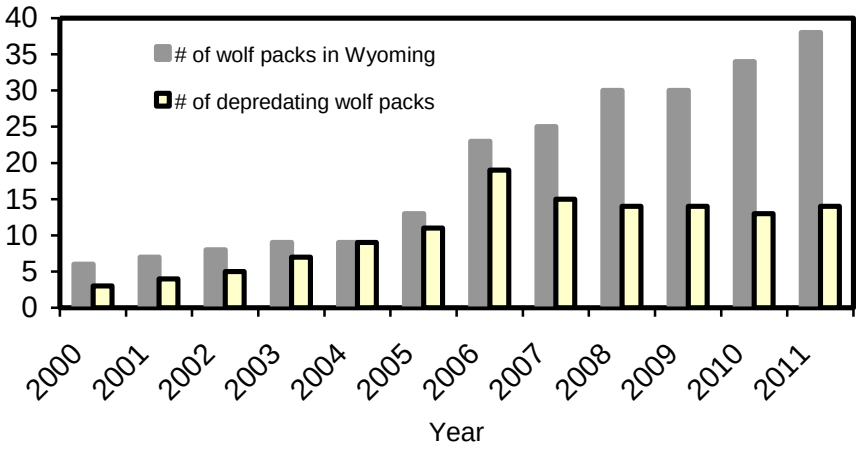

Figure 6. Annual number of wolf packs in WY and number of wolf packs that were involved in at least 1 livestock depredation/given year.

Time of Year of Livestock Depredations

Cattle depredations followed a seasonal pattern in 2011 with the highest number of depredations occurring in summer/fall from July through September (Figure 7). Most sheep depredations occurred in July and August (Figure 8).

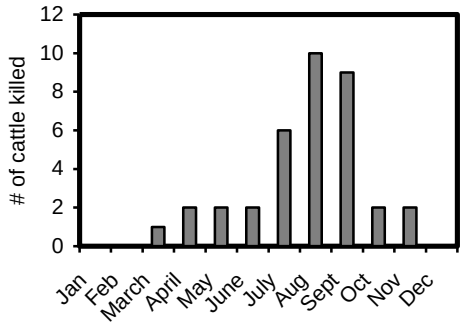

Figure 7. Number of confirmed cattle depredations/month.

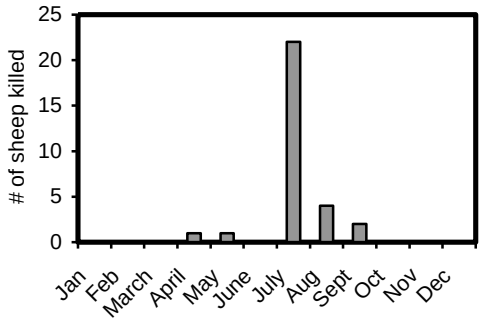

Figure 8. Number of confirmed sheep depredations/month.

Location of Livestock Depredations

Sixty-five percent (n=42) of all confirmed wolf depredations (25 cattle and 17 sheep) were on public land and 35% (n=23) of all depredations (10 cattle and 13 sheep) were on private land. Seventy-one percent (n=25) of cattle depredations were on public land and 29% (n=10) of cattle depredations were on private property. Fifty-seven percent (n=17) of sheep depredations occurred on public land and 43% (n=13) on private property (Figure 9).

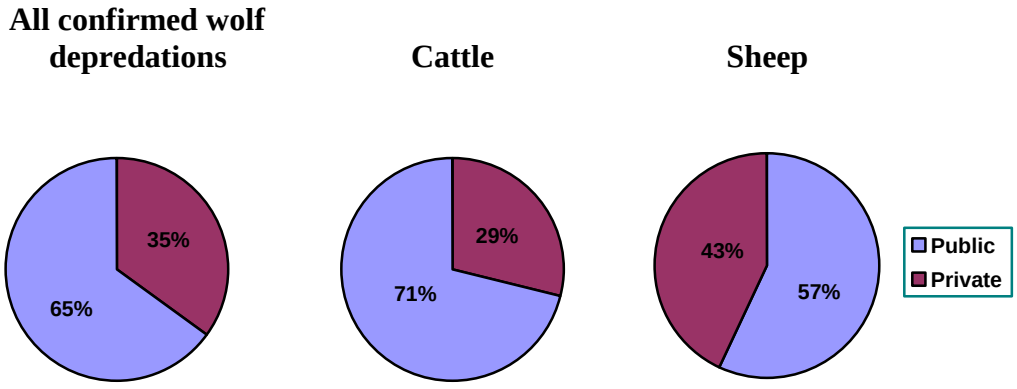

Figure 9. Land status where confirmed wolf depredations occurred in 2011.

Counties: In 2011, confirmed cattle depredations occurred in 5 counties: Sublette 46% (n=16), Park 29% (n=10), Fremont 14% (n=5), Teton 9% (n=3), and Hot Springs 3% (n=1). Wolves killed sheep in 3 counties: Lincoln 63% (n=19), Washakie 33% (10), and Campbell 3% (n=1; Table 4).

Table 4. Confirmed cattle and sheep depredations by county from 2007 through 2011.

Cattle

County	2007	2008	2009	2010	2011
Fremont	12	3	3	3	5
Park	27	23	5	11	10
Sublette	14	15	10	12	16
Sweetwater	0	0	1	0	0
Converse	0	0	1	0	0
Lincoln	2	0	0	0	0
Hot Springs	0	0	0	0	1
Teton	0	0	0	0	3
Washakie	0	0	0	0	0
Total:	55	41	20	26	35

Sheep

County	2007	2008	2009	2010	2011
Johnson	4	2	54	0	0
Lincoln	12	12	45	8	19
Sublette	0	14	37	1	0
Big Horn	0	0	0	24	0
Washakie	0	0	59	0	10
Fremont	0	0	0	0	0
Cambell	0	0	0	0	1
Total:	16	28	195	33	30

Livestock Depredation Control Actions

We managed wolf population growth and wolf distribution to minimize chronic loss of livestock from wolves and promote wolf conservation by maintaining the WY wolf population (outside YNP) well above recovery objectives. In 2011, 36 depredating wolves (approximately 14% of the WY wolf population outside YNP) were removed to reduce livestock depredations.

Control actions in response to confirmed livestock depredations included trapping and radio collaring wolves; intensive monitoring; issuing Less-than-Lethal Munitions (rubber bullets) to harass wolves; lethally removing wolves through agency control actions; and issuing 16 Shoot-on-Sight (SOS) permits to livestock producers. No wolves were killed in 2011 using SOS permits. Non-lethal control was routinely considered but was often not applicable or cost effective in many areas in WY due to: 1) specific wolf packs chronically killing livestock year after year; 2) unpredictable travel patterns and movements by wolves; and 3) very large wolf home ranges that cover vast areas including public grazing allotments. When non-lethal control methods were not effective, wolves were killed through agency control actions in an attempt to prevent further livestock depredations. USDA APHIS Wyoming Wildlife Services spent $129,981.00 to investigate possible depredations and control problems.

Compensation for Livestock Depredations

The WGFD paid $123,703.00 to compensate cattle producers and wool growers who lost livestock to wolves during the 2011 calendar year. Under Chapter 28 of the Wyoming Game and Fish Commission (WGFC) Regulations, compensation for confirmed livestock depredations by wolves was authorized only in the northwest corner (approximately 12% of the state) of WY where the WGFC classified wolves as trophy game animals. Within the trophy game area, all

livestock, other than sheep and calves, are compensated for based on the value of the livestock killed. Sheep and calves are compensated using the formulas below (WGFC Chapter 28 Regulations):

(iii) "Sheep in areas set forth by Commission regulations where gray wolves are classified as trophy game animals. To determine the amount of compensation due to a claimant for sheep believed to be missing as a result of being damaged by gray wolves, in areas occupied by wolves, the Department shall utilize the following formula:

(A) Number of individual sheep confirmed by the Department or its representative killed by gray wolf multiplied by seven (7) multiplied by the value of livestock equals the amount of compensation."

(iv) "Calves in areas set forth by Commission regulations……the Department shall use the following formula:

(A) Number of individual calves confirmed by the Department or its representative killed by gray wolf multiplied by seven (7) multiplied by the value of livestock equals the amount of compensation."

Wolf Management in YNP

Area Closures

To prevent human disturbance of denning wolves during the sensitive period of pup rearing, visitor entry was closed to some of the areas surrounding dens in the park. Land surrounding the Canyon, Madison and Lamar Canyon packs' den and rendezvous areas were closed for various lengths of time this summer. One of three dens for Blacktail and Mollie's pack den site were protected from disturbance coincidental to area closures for bear management in the park. The areas around the remaining park packs' den sites were not closed because of historically low visitor use and because it was unlikely the dens would be disturbed.

Wolf Road Management

Since wolf reintroduction began in Yellowstone, the Lamar Valley has become the premier location worldwide to observe free-ranging wolves. The main pack of interest was traditionally the Druid Peak pack, which denned in or near the Lamar Valley from 1997 through 2009, but this year differed with the emergence of the Lamar Canyon pack as a very visible pack. The NPS established the Wolf Road Management Project to better deal with the opportunities and problems that accompany increasing visitor numbers. The objectives for this program are: 1) human safety, 2) wolf safety, 3) visitor enjoyment, and 4) wolf monitoring and research. A record number of visitor contacts over the 12-year lifespan of the project were made by staff in the 2011 season (17,635 people) and the summer season was characterized by high wolf viewing opportunities.

Habituated Wolves

There were three wolves that closely approached people: two were successfully hazed and the other was lethally removed. The wolf that was lethally removed was recorded approaching people seven times and was hazed seven times as a result. The hazing was not effective and the interval between close approaches decreased. After ripping apart a ranger's pack in search of food the wolf was lethally removed. This was most likely a food conditioned wolf, making it the second wolf removed in YNP due to food conditioning since wolves returned to the park.

RESEARCH

Research in WY

In 2011, the USFWS continued to provide financial and in-kind support for collaborative research projects in WY. Various projects involved universities, NGOs, and other state and federal agencies.

Title: The influence of migratory and resident elk movements on seasonal wolf habitat selection and depredation patterns.
***Graduate Student*:** Abby Nelson, University of Wyoming, Laramie, Wyoming.
Major advisors: Matt Kauffman and Steven Buskirk, University of Wyoming.
***Cooperators*:** USFWS, WS, and WGFD
Project Summary: Human conflict is a unique and persistent driver of management and conservation of large mammalian carnivores. Understanding these conflicts in space and time can assist in appropriate decision-making as managers seek to balance the population viability of carnivore species with management that curbs carnivore impacts on human livelihoods. The patchy distribution of prey-rich habitat across landscapes influences abundance and movements of wolves; however, many ungulate populations are partially migratory, and it is unclear how wolves respond behaviorally to the seasonal movements of migratory versus nonmigratory prey. In this context, wolf selection for prey-rich habitat can influence seasonal encounter rates and thus depredation rates on domestic livestock. In this study, conducted in northwest Wyoming, USA, we use three years of fine-scale wolf (n = 14) and elk (n = 70) movement information to evaluate the influence of elk distribution and other landscape features on wolf habitat selection and patterns of depredation on domestic livestock.
Project Completion Date: August 2011

Title: Comparison of Two Methods Used to Characterize the Summer Diet of Gray Wolves: A preliminary report
***Graduate Student*:** Bonnie Trejo
***Committee Chair*:** Richard Golightly, Humboldt State University
Cooperators: USFWS, GTNP, YNP, Grand Teton National Park Foundation
***Project Summary*:** Fecal (scat) analysis has been used to assess the diet of large carnivores because the method is non-invasive, economical, and suitable to the study of elusive animals. Global positioning system (GPS) telemetry has also been used to assess large carnivore diet by locating individuals so as to detect prey carcasses. Here, the summer diet of wolves (*Canis*

lupus) in northwestern Wyoming was characterized using scat analysis, and the diets of four packs were compared to two time-coinciding GPS-telemetry studies to evaluate differences in estimates of prey frequency and biomass consumed. Scats collected during the summers of 2003-2009 (n = 1772) most frequently had neonate cervid (elk, deer, and moose) remains (53% frequency of occurrence) but neonate cervids only accounted for approximately 30% of the relative biomass consumed by wolves. The percent frequency of occurrence of adult elk, adult deer, and adult moose was approximately 26%, 14%, and 3%, respectively. Combined, adult cervids comprised 63% of the relative biomass acquired by wolves. Other prey included bison, bighorn sheep, beaver, small rodents, lagomorphs, and birds; however, these prey species occurred relatively infrequently and provided little of the overall biomass consumed by wolves. Results of scat analysis significantly differed from GPS-telemetry for some prey items. Scat analysis detected small non-ungulate prey items that were not detected by GPS-telemetry. However, non-ungulates only comprised 3.6% (n = 4 packs) of the relative biomass consumed; conversely, ungulates comprised approximately 96% of the biomass acquired. GPS-telemetry failed to detect adult deer in the diets of two packs, and GPS-telemetry estimates of adult deer frequency and biomass were significantly lower than scat analysis for the other two packs. The frequency of adult elk and neonate cervids was similar between scat analysis and GPS-telemetry for three of the four packs studied, and the frequency of adult moose was similar between methods for both packs which preyed on moose. Based on scat analysis alone, wolf summer diet differed among years and among packs and was likely due to variation in prey vulnerability and abundance in time and space.
Anticipated Completion Date: May 2012

Title: Absaroka Elk Ecology Project
***Graduate Student*:** Arthur Middleton, University of Wyoming, Laramie, Wyoming.
Major advisor: Matt Kauffman, University of Wyoming.
***Cooperators*:** USFWS and WGFD
Project Summary: The Absaroka Elk Ecology Project is a research collaboration of the U.S. Fish and Wildlife Service, the University of Wyoming, and the Wyoming Game and Fish Department initiated in 2007. The project seeks to understand recent changes in the demography and distribution of the Clarks Fork elk herd, a partially-migratory population of about 4,500 individuals that ranges widely in the Absaroka Mountains between Cody, WY and the upper reaches of the Lamar River inside Yellowstone National Park. The primary objectives of this research project are to determine the proportion of migratory elk in the Clark's Fork herd; determine the geography and timing of these migrations; improve understanding of the use of key private lands by Clarks Fork elk; and to understand the relative influence of wolves versus habitat conditions on elk movements and behavior. The project relies on a sample of 90 GPS-collared elk cows in the Clark's Fork herd, and 1-2 GPS-collared wolves in each of four resident wolf packs. Preliminary project data revealed comparatively low pregnancy (<70%) in the migratory portion of the Clarks Fork herd, suggesting that nutritional stress might be contributing to low levels of migrant recruitment. To investigate the potential causes of low pregnancy, biannual recaptures of collared females were conducted in spring and fall, 2008-2010, to estimate body fat levels and determine reproductive status. This series of five recaptures was completed in March 2010. During the same period, field observations were conducted to quantify the activity budgets of these same marked females. Altogether, the field data collected on this project will help improve our understanding of the extent to which wolves and/or habitat

conditions influence the nutritional condition and reproduction of their prey. The field component of this project was concluded in summer 2010, and the analysis and reporting phase are now underway.

Title: Land use, predation, and climate effects on elk group sizes and *Brucellosis* in the Greater Yellowstone ecosystem.

Graduate Student: Angela Brennan
Major Advisors: P.C. Cross[2], S. Creel[1], M. Higgs[1], W.H. Edwards[3], and B. Scurlock[4].
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Project Summary: The Greater Yellowstone Ecosystem (GYE) is the last reservoir of brucellosis in the United States, where roughly 45-75% of wild bison (*Bison bison*) and 0-35% of elk (*Cervus elaphus*) have been exposed to the bacteria (*Brucella abortus*) that causes the disease. Elk, being distributed across much of the region, can come into contact with domestic livestock and potentially transmit *Brucella*, causing costly trade restrictions, disease testing, and culling of infected cattle herds. Critical to our understanding of elk-brucellosis dynamics and the development of effective disease control strategies, is the relationship between elk density and among elk *Brucella* transmission rates. Defining this relationship is also important to further inform theoretical models of disease transmission in a social species. As previous studies examining elk density at broad spatial scales (i.e. population densities) have shown weak support for a density effect on seroprevalence in elk, however, we suspect brucellosis dynamics are affected by fine scale variations in elk aggregation (i.e. group size and density). Therefore, we plan to conduct aerial elk surveys during 2010 and 2011 to construct elk group size distributions for 10 elk native winter ranges in western Wyoming and determine the measure of group size (i.e. median group size, largest group size) that best explains the variation in brucellosis seroprevalence. Because external factors may influence host aggregation patterns and play a large role in our understanding of disease transmission in applied and conceptual settings, we will also determine the anthropogenic, habitat, predation and climate factors associated with recorded elk groups. Human disturbance, snowpack, and habitat attributes will be quantified via GIS and remotely sensed data. Predation risk will be determined by hunter use and cumulative wolf presence. The latter will be compiled from distribution maps and pack sizes obtained from U.S. Fish and Wildlife Service annual reports, as well as howling and track surveys.

Winter Predation Study

GTNP and the USFWS monitored wolves during winter in the north end of Grand Teton National Park and the surrounding national forest to investigate wolf predation patterns in areas with relatively low winter elk density. We used radio telemetry to locate wolves daily and back tracked wolves to locate carcasses of ungulates that were killed by wolves. During winters 2010 and 2011, field crews located 105 known or probable wolf kills between 3 January and 15 April. Prey species and composition included 58 elk (28 bulls, 12 cows, 7 yearlings, 5 calves, 6 unknown); 43 moose (8 bulls, 25 cows, 1 yearling, 4 calves, 5 unknown); and 4 deer (1 buck, 1 doe, 1 yearling, and 1 unknown age/sex).

Research in YNP

Wolf-Prey Relationships

Wolf–prey relationships were documented by observing wolf predation directly and by recording the characteristics of prey at kill sites. Wolf packs were monitored for two winter-study sessions in 2011 during which wolves were intensively radio-tracked and observed for 30-day periods in March and from mid-November to mid-December. The Agate Creek, Blacktail, and Lamar Canyon packs were the main study packs monitored by three-person ground teams and aircraft during both winter-study sessions. Additionally, other park packs (Canyon, Cougar Creek, Mary Mountain, Mollie's, Quadrant) were monitored from only aircraft. The Yellowstone Delta pack was monitored less intensively because of logistical constraints and the Bechler pack (no radio collars) was unable to be located. Data from downloadable GPS collars was also utilized to detect predation events for wolves from the Agate Creek and Blacktail packs during winter studies and also during a spring-summer (May-July) monitoring period. During these established predation studies, and opportunistically throughout the year, project staff recorded behavioral interactions between wolves and prey, kill rates, total time wolves fed on carcasses, percent consumption of kills by scavengers, characteristics of wolf prey (e.g., sex, species, nutritional condition), and characteristics of kill sites.

Composition of Wolf Kills: Project staff detected 343 kills (definite, probable, and possible combined) made by wolves in 2011, including 267 elk (78%), 15 bison (4%), 18 deer (5%), 1 moose (<1%), 2 pronghorn (<1%), 2 bighorn sheep (<1%), 2 badgers (< 1%), 1 jackrabbit (<1%), 14 coyotes (4%), 1 raven (< 1%), 7 wolves (2%), and 13 unknown prey (4%). The composition of elk kills was 27% calves, 3% yearlings, 44% cows, 18% bulls, 3% adults of unknown sex, and 6% of unknown sex and age. Bison kills included 5 calves, 1 yearling, 2 cows, 6 bulls, and 1 unknown sex adult.

Given the ecological significance and controversy surrounding wolf impacts on ungulate populations, wolf and elk interactions continue to be a primary focus of predation studies in YNP. Since wolf reintroduction, the northern range elk population has declined with wolves being one of the factors. Other factors include other predators, management of elk outside YNP, and weather patterns (e.g. drought, weather severity) that influence forage quality and availability, ultimately impacting elk nutritional condition. Consequently, changes in prey selection and kill rates through time result from complex interactions between these factors, particularly the link between wolf and ungulate population dynamics and seasonal weather patterns.

Winter Studies

March - During the 2011 March winter study (30 days), study packs were observed for a combined total of 436 hours from the ground. Because of poor weather conditions, aerial observations of wolf packs were only attempted for 6 days. The number of days wolf packs were successfully located ranged from 5 (Mary Mountain) to 6 (Agate, Blacktail, Canyon, Cougar, Lamar Canyon, Mollie's, and Quadrant). A total of 83 carcasses utilized by wolves were discovered by air and ground teams. Of these, 68 (82%) were killed by wolves, which included 59 elk, 6 bison, 2 bighorn sheep, and 1 deer. Among elk, 11 (19%) were calves, 4 (7%) were yearlings, 35 (59%) were cows, 8 (14%) were bulls, and 1 (2%) was of unknown

sex and age. Wolves also fed upon 7 elk and 8 bison that they did not kill, most of which died due to the severe winter conditions. The rate at which wolves acquired prey, both through their kills and through scavenging winter-killed carcasses, was high compared to most late winters, and was likely the result of ungulates being in very poor nutritional condition due to the significantly higher than average snow depth.

November-December - During the 2011 November-December winter study (30 days), study packs were observed for a combined total of 253 hours from the ground. Air crews attempted to locate packs on 13 days, and the number of days wolf packs were successfully located ranged from 3 (Yellowstone Delta) to 13 (Agate, Blacktail, Cougar, Lamar Canyon, Mary Mountain, and Mollie's). A total of 32 carcasses utilized by wolves were discovered by air and ground teams. Of these, 29 (91%) were killed by wolves, which included 26 elk, 2 bison, and 1 deer. Among elk, 3 (12%) were calves, 1 (4%) was a yearling, 11 (42%) were cows, and 11 (42%) were bulls. Additionally, wolves also fed upon 3 bull elk that they did not kill. In comparison to other early winter study periods, kill rates were low, as was the percentage of calves in wolves' diet.

GPS Collars and Winter Predation: During March, we successfully searched GPS clusters of wolves 775M of the Agate Creek pack and 777M of the Blacktail pack. For the Agate Creek pack, all carcasses were detected by GPS clusters, and traditional monitoring methods found ~85% of all carcasses. However, for the Blacktail pack, traditional monitoring methods found ~ 80% of all carcasses, and only ~70% were detected through GPS clusters.

By November-December, we were unable to download the GPS locations of Agate wolf 775M (although he was still present, his GPS collar had malfunctioned). However, Blacktail wolf 777M was still present and we searched GPS clusters of his locations for the first week of winter study. During this period, most carcasses detected by GPS clusters were not found via our traditional monitoring methods. Unfortunately, 777M and 3 other Blacktail wolves then left the pack for the remainder of winter study. As such, we did not search his GPS locations for the remainder of winter study.

As in previous years, we suspect that differences in the detection of carcasses between GPS clusters and traditional monitoring methods were influenced by prey size, pack size, carcass location, and the time of day that wolves were present at a carcass. We plan to continue this work in 2012 as our results in 2011 further suggest that both our traditional methods and GPS clusters fail to always detect predation events during winter, and our most complete assessment of prey composition and kill rate may therefore come through combining data acquired through these methods.

Summer Predation: In 2011, the Yellowstone Wolf Project continued to search GPS clusters to assess the predation patterns of wolves during spring-summer (1 May – 31 July). We searched the GPS clusters of Blacktail wolf 777M for this entire period, and GPS clusters of Agate wolf 775M during June (his collar malfunctioned at the end of June). Through this effort, we found 67 suspected kills or fresh carcasses among ungulate prey, which included 59 elk, 2 deer, 5 bison, and 1 unknown species. Accordingly, 88% of the ungulates detected through GPS clusters from 1 May – 31 July were elk, which is similar to most previous years. Among elk, 53% were neonate calves, 3% were 11-14 month old elk, 29% were cows, and 15% were bulls.

Population Genetics

Collaborative efforts between the Yellowstone Wolf Project and the University of California, Los Angeles (UCLA) continued in 2011 working with genetic samples from YNP wolves. Dan Stahler received his doctorate at UCLA in the summer, and submitted one of several manuscripts for publication resulting from his research involving molecular data on YNP wolves. Stahler and Smith continued to collaborate on a National Science Foundation grant awarded to co-principal investigators Dr. Robert Wayne and Dr. John Novembre at UCLA that aims to further understand the evolutionary and ecological dynamics of coat color in wolves. Previous work has shown that black wolves get their dark coat color from a genetic mutation that first occurred in dogs, and was likely introduced and selected in wild wolf populations following successful mating with dogs that came into North America with humans thousands of years ago. Given the frequency of both gray and black colored wolves in Yellowstone is roughly equal, it has been hypothesized that there are fitness trade-offs associated with the gene responsible for coat color. Separately, Smith and Stahler became co-PIs on a Natural Environment Research Council (NERC) grant with collaborators Dr. Tim Coulson (Imperial College) and Dr. Dan MacNulty (Utah State University) that integrates population genetic data on YNP wolves with ecological, population dynamics, and life history datasets. This research has so far resulted in a paper in the journal *Science* that evaluates and explores wolf adaptation to climate change under varying environmental conditions, and helps explain the maintenance of coat color genetics in YNP wolves by showing that black heterozygotes have survival advantages over gray and black homozygous genotypes. Work is ongoing with both studies.

The Wolf Project is also collaborating with UCLA on a new project that will be the first to sequence entire genomes of wild wolves. A DNA sample of the well-known wolf 302M is being used for whole genome sequencing that will create the entire genetic map of 302M, allowing us to better understand how genes may impact wolf behavior, health, life history, and canid evolution.

Disease

Our most active area of disease research this past year continued to be on sarcoptic mange, an infection caused by the mite, *Sarcoptes scabiei*, which reached epidemic proportions on the Northern Range in 2009. The mite is primarily transmitted through direct contact and burrows into its host's skin where it feeds and lays its eggs. This process can initiate an extreme allergic reaction in the host, causing the host to scratch infected areas resulting in hair loss and secondary infections. While the epidemic of mange continued to subside this past year, the infection is still present at lower prevalences throughout the park.

In 2008, the Yellowstone Wolf Project began a partnership with the U.S. Geological Survey to rigorously address questions about how mange is affecting individual wolves and their overall population in the Yellowstone region. This collaboration continues to include Paul Cross, Mike Ebinger, and Catherine Haase of the U.S. Geological Survey, Rebecca Raymond, Colby Anton and Nate Bowersock of the Wolf Project, Emily Almberg and Peter Hudson of Penn State University, and Andy Dobson of Princeton University. This team submitted a manuscript to be published in 2012 that describes the invasion of mange into the park and documents its negative impacts on pack size and growth rates. Ongoing analyses will assess the individual and pack-

level risk factors for infection and will explore the impacts of mange on individual survival and reproduction.

Headway has been made on the project that is using thermal imagery to measure the heat loss associated with mange-induced hair loss. In collaboration with the Grizzly Wolf Discovery Center in West Yellowstone, we have undertaken pilot work with several of their captive wolves to develop the methods needed to model heat loss from wolves in the wild. Ultimately, these measurements will allow us to estimate the caloric costs of infection and infer how mange alters the energy balance that wolves must maintain for survival.

Ongoing disease surveillance detected two animals infected with canine distemper virus on the western boundary of the park in 2010. However, serological data from the rest of the park suggested that these were isolated cases and that canine distemper did not spread into the park. Furthermore, we detected our first two cases of bordetella, a respiratory infection caused by the bacterium, *Bordetella brochiseptica*, in a wolf and a coyote.

Collaborative Research

The Wolf Project and the Yellowstone Park Foundation provided financial and in-kind support for collaborative research with scientists at other institutions, including universities, interagency divisions, and non-government research organizations. These investigations required Wolf Project staff to assist graduate students and outside researchers in their efforts to better understand wolf ecology, ecosystem function, and conservation, much of which is pioneering research.

Wolf Project Students: Direct Assistance

Two graduate students worked in collaboration with the Wolf Project in 2011: Kira Cassidy-Quimby and Alessia Uboni. Cassidy-Quimby is a long-time employee on the project that moved on to work in a new capacity and is partially supported by project funding. Uboni became a collaborator after working as a GIS technician in Yellowstone Center for Resources.

Title: Individual participation in intraspecific encounters and the benefits of aggression in gray wolves of Yellowstone National Park
Graduate Student: Kira Cassidy-Quimby, Master of Science candidate
Committee Chair: Dr. L. David Mech, University of Minnesota, St. Paul

Title: Wolf spatial analysis: habitat use and territorial patterns
Graduate Student: Alessia Uboni
Committee Chair: Dr. John Vucetich, Michigan Technological University

Title: Seasonal patterns in foraging and predation of gray wolves in Yellowstone National Park

Other Yellowstone Wolf Project Research

Hunting Behavior. This aspect of wolf-prey relationships has been a research focus in Yellowstone largely through the efforts of long-term collaborator Dr. Dan MacNulty. With the availability of longitudinal data from repeated observations of individually-known wolves hunting prey, behavioral, ecological and evolutionary dynamics of predation have been uniquely studied. Recent published research has focused on predatory performance of wolves with respect to age, body size, and group size and their relationship to ecological and evolutionary dynamics.

Pelican Valley Wolf, Grizzly Bear, and Bison. Starting in 1999, the Yellowstone Wolf Project has monitored wolves, bison, and grizzly bears from a hilltop observation point in Yellowstone's Pelican Valley for 2-4 weeks during March. The primary goal for this study is to document the behavioral interactions between wolves, bison, and grizzly bears to: 1) identify patterns of wolf predation on bison; 2) determine how the risk of wolf predation influences bison foraging behavior, movement, and habitat use; and 3) assess the importance of wolf-killed ungulates for grizzly bears emerging in early spring.

Population Dynamics. Using data from a radio-marked population, year-round research focuses on understanding the major components of wolf population dynamics (births, deaths, immigration, and emigration). Monitoring efforts through ground and aerial tracking and observations provide annual census size, territory size and use, reproductive success, cause-specific mortality, survival, and other life history patterns. Data on social behavior and pack structure are collected to investigate patterns of dispersal, social stability, territoriality, and age structure. Necropsies of all recovered radio-collared individuals and uncollared wolves provide cause-specific mortality data.

Dispersal. The ecological, demographic, and genetic implications of dispersal is an important research focus for Yellowstone wolf biologists. Using radiocollar tracking information and genetic techniques under the umbrella of other project objectives, current research aims to understand basic demographic patterns of dispersal (age, sex, distance, season), along with the influence of wolf density, pack structure and size, kinship, and breeder loss in a naturally regulated system. Additionally, migrant detection analysis using molecular techniques will assess gene flow and genetic connectivity to other regional wolf populations.

Breeding Behavior. During January and February each year, project staff monitor Yellowstone packs for courtship and breeding behaviors. The opportunity to study breeding behavior in wild wolves is unprecedented, and this study is designed to investigate the role of interacting social and ecological factors influencing individuals' attempts to breed and their relative fitness consequences.

Wolf Pack Leadership. The purpose of this study is to determine the nature of leadership in wild wolf packs. Ultimately, this project will define when leadership is asserted and by which wolves in the hierarchy. Due to the difficulty of observing wild wolves in a natural environment, leadership has been an unexplored aspect of wolf behavior. By observing packs with recognizable individuals, leadership behavior can be distinguished between identified dominant (alpha) and non-dominant (non-alpha) wolves. This study gathers data to determine under what circumstances leadership behavior is demonstrated and how it is correlated to breeding status, social status, environmental conditions and season.

Wolf Capture and Handling. Each year, wolves are helicopter darted and radio-collared. Handling of individuals provides data on morphometrics, disease, genetic sampling, age, sex, breeding status, and condition. Both VHF and GPS collars are deployed, and provide the basis for nearly all other aspects of Yellowstone's wolf research program.

Disease. Research on the disease ecology of Yellowstone wolves is ongoing. The majority of disease monitoring comes from extracting and analyzing blood samples. Serum and blood profile analyses record disease exposure and prevalence. Nasal, rectal, and ocular swabs collected on both live and dead wolves also aide in documenting disease and cause of death. Disease screening includes parvovirus, distemper, and infectious canine hepatitis. Additionally, a population-wide sarcoptic mange monitoring effort has begun using an individual-based monthly documentation of mange occurrence, severity, and recovery in all packs through the use of direct observations, handling, aerial photographs, and thermal imagery.

Population Genetics. Annual genetic sampling (blood, tissue, and scats) from live and dead wolves is used to study genetic diversity, population structure, parentage and kinship, gene flow, and selection of fitness related traits. In combination with ecological and behavioral datasets, genetic data supports research on both evolutionary and ecological dynamics in the Yellowstone population. Examples of current research questions include regional population genetic structure, evolutionary history and selection for coat color, evolution of life history traits, effect of kinship on breeding strategies, territoriality and strife. Additionally, whole genome sequencing on Yellowstone wolves is underway through collaboration with UCLA.

Multi-carnivore and Scavenger Interactions. Research is ongoing to understand the degree to which exploitative and interference competition is occurring among Yellowstone's carnivores. Data is collected on all observed wolf-bear, wolf-cougar, and wolf-coyote interactions. Additionally, data on scavenger species diversity, abundance, and carcass utilization at wolf kills are collected to understand how these interactions influence structure and function of the ecosystem.

Wolf Spatial Dynamics. Thousands of wolf radio locations, both VHF and GPS, have been gathered since wolves were reintroduced to YNP in 1995. Rigorous analyses using these locations have begun examining many questions concerning habitat use and territoriality. Year-to-year changes in territory use are being related to variables such as elk density and distribution, intraspecific strife, pack size, and reproduction. Other analyses underway are habitat use (using Resource Selection Functions; RSF), travel and territory size, summer vs. winter, and night vs. day, as well as comparisons between GPS and VHF collars.

OUTREACH

Outreach in WY

In 2011, the WY wolf recovery program continued to give numerous formal presentations to public schools, universities, wildlife symposiums, state and federal management agencies, livestock association meetings, state legislature committees, and environmental groups. We were also interviewed for numerous magazine, newspaper, and television feature stories.

Outreach in YNP

Yellowstone Wolf Project staff gave 241 formal talks and 84 interviews. Talks were at both scientific conferences and to general audiences. Interviews were to all forms of media. Staff assisted visitors in the field helping 25,000 people view wolves, making 17,635 visitor contacts and giving 664 informal talks in the field.

Visiting Scholars: Once an annual program that involved a scientist or manager from another agency or university to visit and work with YNP Wolf Project personnel, several years elapsed where there were no visitors. This year Olof Liberg, project lead for SKANDULV the wolf research and management organization for Scandinavia, visited in September. Dr. Liberg gave a public presentation to YNP staff and canoed and rode horseback in the Yellowstone backcountry gaining a true feel for Rocky Mountain wolf country. Dr. Liberg, one of the leading experts on wolves in Europe, also advised YNP staff on wolf management issues in Scandinavia, particularly the trade-off in social tolerance between wolf protection and legalized wolf hunting – a pressing issue of concern in Europe.

WYOMING CONTACT INFORMATION

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We thank all of the Wolf Project field technician volunteers, especially winter study volunteers, without whom we could not carry on the vital research and management of wolves. We also thank donations and support from six major institutions and organizations: an anonymous donor, Annie Graham of Tapeats Foundation, Frank and Kay Yeager, Canon, Inc., the Yellowstone Park Foundation, and the National Science Foundation grant DEB -0613730. We recognize the above because our work would not be possible without their support and involvement. These are our major donors, and we also are supported by numerous smaller donors, especially ones through the collar sponsorship program, that add significantly and are also necessary for our research, management, outreach, education and publications.

In YNP, we continue to be impressed by and thank the many interested people who come forward every year to work with and help Yellowstone wolves. First and foremost are the Wolf Project staff including volunteers, whom without we would accomplish much less. The Yellowstone wolf watching community over the years has always helped when they can and to them we are appreciative. We also thank the many generous individuals, foundations and organizations that have provided approximately $5 million in grants through the Yellowstone Park Foundation to the Wolf Project since 1996. Continued support from Canon U.S.A, Inc., and anonymous donor, The Tapeats Fund, the Twin Spruce Foundation, the Perkin-Prothro Foundation, the participants in the wolf collar sponsorship program, and the National Science Foundation grant DEB-0613730 is also critical to our success and we thank all of those mentioned above.

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