Yellowstone Center for Resources
Yellowstone National Park
Mammoth Hot Springs, Wyoming

National Park Service
U.S. Department of the Interior

YELLOWSTONE NATIONAL PARK
Natural & Cultural Resources

WOLF PROJECT

ANNUAL REPORT

2012

AR-Yellowstone Bison

Doug Smith, Wolf Project Leader, with wolf 661M of the Yellowstone Delta pack.

Dear Reader:

This is the Wolf Project's seventeenth annual report. Beginning with the biennial report for 1995–1996, from 1997 through this year the Yellowstone Wolf Project has summarized the year's activities and important findings about wolves in Yellowstone National Park (YNP). Our goal is not to compete with websites, email postings, and blogs, but rather to communicate important scientific findings about wolves, present calendar-year summaries of numbers and packs, and broadly interpret key events to provide a perspective about wolves and how they function within the park.

Important highlights of 2012 were that wolf numbers were down to approximately the level that was present in the late 1990s, and that state hunting seasons outside of the park harvested 12 wolves that primarily lived inside YNP. These results generated a lot of comment and discussion about state and national park policy objectives, and what factors contributed to the drop in wolf numbers. Our work, some of which is presented here, suggests that there are multiple influences on wolves in YNP and, as importantly, it is misleading to consider wolves in YNP and those living adjacent to the park as two distinct populations—they are essentially one. There is no question, though, that wolves living in YNP are the largest assemblage of protected packs living in the northern Rockies of Idaho, Montana, and Wyoming. This is as it should be and, because it is national park policy, we take this responsibility seriously. Understanding the factors contributing to the decline in wolf numbers is important; you will find this question is raised and, to some extent, addressed within the pages that follow.

An interesting finding from 2012 data is that wolves utilized more bison than any other year so far. Greater exposure to bison due to increasing numbers on the northern range was likely a factor. Also, winter 2011–2012 was mild, so there were fewer vulnerable elk in spring, and this is when most of the bison were consumed by wolves. In short, wolves ate neonate bison because bison calve earlier than elk, and adult elk are hard to kill. This shift toward bison will be an important development to track in the future. Ironically, this was a year when Mollie's pack, a pack that traditionally kills bison during winter, did not kill many bison; in 2012, they ate fewer bison because bison numbers were low after the hard winter of 2010–2011.

We also held a symposium to gather oral history from key players in the reintroduction of wolves. Most of these people were interviewed for archival purposes. This was a significant event in 2012 and represented the largely untold, human side to wolf recovery; we encourage you to visit the park and learn more about this historic part of the story.

As before, wolves continued to be a draw for visitors, which is vitally important to our mission. Balancing visitor enjoyment and wolf protection is a continuing challenge for all park staff.

Lastly, we thank all of those involved over the last year with the wolves of Yellowstone. Your support comes in many forms, but most important is your interest in the wolves and the larger park that they inhabit.

Sincerely,

Suggested citation: Smith, D.W., D.R. Stahler, E. Stahler, M. Metz, K. Quimby, R. McIntyre, C. Ruhl, H. Martin, R. Kindermann, N. Bowersock, and M. McDevitt. 2013. Yellowstone Wolf Project: Annual Report, 2012. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming, YCR-2013-02.

All photos not otherwise marked are NPS photos.

Table of Contents

Background

Although wolf packs once roamed from the Arctic tundra to Mexico, they were regarded as dangerous predators, and gradual loss of habitat and deliberate extermination programs led to their demise throughout most of the United States. By 1926, when the National Park Service (NPS) ended its predator control efforts, there were no gray wolf (*Canis lupus*) packs left in Yellowstone National Park (YNP).

In the decades that followed, the importance of the wolf as part of a naturally functioning ecosystem came to be better understood, and the gray wolf was eventually listed as an endangered species in all of its traditional range except Alaska. Where possible, NPS policy calls for restoring native species that have been eliminated as a result of human activity. Because of its large size and the abundant prey, the greater Yellowstone area was identified in the recovery plan as one of three areas where the recovery of wolves had a good chance of succeeding.

Following an extended period of public planning and input, wolf restoration to the Yellowstone area began in 1995, when 14 wolves were brought to the park from Alberta, Canada, held in acclimation pens for 10 weeks, and then released into the northern portion of YNP (i.e., the northern range). In 1996, an additional 17 wolves were transplanted from British Columbia and released in more widespread locations throughout the park. In 1995–96, a companion effort to restore wolves to central Idaho occurred, using a simpler technique without acclimation. Although the original plan, outlined in *The Reintroduction of Gray Wolves to Yellowstone and Central Idaho, Final Environmental Impact Statement* (1994), called for annual translocations from Canada for up to five years, additional transplants were deemed unnecessary by 1997 because the founder wolves had higher reproduction, lower mortality, and less movement from the greater Yellowstone area than was originally expected.

The US Fish and Wildlife Service (USFWS) has primary responsibility for ensuring compliance with the Endangered Species Act and oversees the multi-state wolf recovery program. Wolves reintroduced into YNP were classified by the USFWS as "nonessential experimental" under section 10(j) of the Endangered Species Act and were managed outside the park under special rules that permit flexibility in addressing wolf conflicts with livestock and other wildlife management goals. It was anticipated that as the wolf packs established their territories, some would hunt and/or reside outside the park on other public or private land, and that some of the 412,000 livestock in the Yellowstone area would be preyed upon. The special rules contained provisions for addressing the possibility of conflicts with livestock.

The USFWS had proposed that 30 breeding wolf pairs with an equitable and uniform distribution throughout the three Rocky Mountain recovery areas (greater Yellowstone, central Idaho, and northwest Montana) for three successive years would constitute a viable and recovered wolf population. Recovery goals were met in 2002, and gray wolves were removed from the endangered species list in Idaho and Montana in 2009; the USFWS did not accept the wolf management plan proposed by the state of Wyoming. In August 2010, a United States district judge ruled against a 2009 USFWS decision to remove the wolf from the endangered species list in only part of the recovery area (only Montana and Idaho had USFWS-approved wolf management plans), and wolves were protected in all three states again. In May 2011, the USFWS delisted gray wolves in a portion of the Northern Rocky Mountain Distinct Population Segment encompassing Idaho, Montana, and parts of Oregon, Washington, and Utah. In September 2012, wolves were delisted in Wyoming following approval of the state's management plan. Idaho, Montana, and Wyoming manage wolf harvest seasons now that wolves are delisted (hunting in all three states; trapping in Idaho and Montana). The USFWS, NPS, and these states will monitor wolves in the northern Rocky Mountain area and collectively gather population data for at least five years.

To facilitate monitoring and research, all of the wolves brought from Canada were radio-collared before release, and YNP maintains radio collars in all wolf packs within the park. Wolf project staff monitor demographics, life history, dispersal, distribution, disease, genetics, predator–prey dynamics, and ecosystem impacts. Monitoring and management activities for the first two years of the project are documented in *The Yellowstone Wolf Project, Biennial Report 1995–96*. Subsequent project activities are presented in annual reports.

Four full-time NPS employees worked for the Yellowstone Wolf Project in 2012: 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, Aidan Beers, Nate Bowersock, Sarah Cubaynes, Cayley Faurot-Daniels, Jared Green, Josh Irving, Ryan Kindermann, Hans Martin, Jack Massey, Molly McDevitt, Matthew Metz, Nathan Muhn, Peter Mumford, Rebecca Raymond, Steve Ruff, Michael Roesch, Joel Ruprecht, Caitlin Ruhl, Kira Quimby, Aimee Tallian, Julie Tasch, Jamie Walton, Tanya Wolf, and Travis Wyman. Some of these staff members were paid technicians with funding provided by the Yellowstone Park Foundation.

2012 Summary

At the end of 2012, at least 83 wolves in 10 packs (6 breeding pairs) occupied YNP. This is approximately a 15% decline from the previous three years when wolf numbers had stabilized around 100 wolves. Breeding pairs declined 25% from eight the previous year to six in 2012. Wolf numbers have declined by about 50% since 2007 mostly because of a smaller elk population, the main food of wolves in YNP. The number of wolves living in the park interior has declined less, probably because they supplement their diet with bison. State-managed wolf hunts harvested 12 wolves that lived primarily in YNP when these animals moved into Montana, Idaho, and Wyoming. The severity of mange, a skin disease caused by non-native mites, continued to decline in 2012, 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 4 (Blacktail and Snake River) to 11 (Lamar Canyon, Cougar, and Yellowstone Delta) and averaged 10 which is the long-term average. Seven of 11 (64%) packs had pups. The average number of pups per pack in early winter (for packs that had pups) was 2.5, which is lower than previous years' averages of 4.1 (2011) and 4.8 (2010). A total of 20 pups in YNP survived to the end of the year (14 fewer than in 2011).

Project staff detected 255 kills (definite, probable, and possible combined) made by wolves in 2012, including 159 elk (62%), 32 bison (13%), 13 mule deer (5%), 2 whitetail deer (1%), 5 deer unknown species (2%), 4 pronghorn (2%), 2 moose (1%), 2 Canada geese (1%), 9 wolves (4%), 1 bighorn sheep (<1%), 1 otter (<1%), 1 grizzly bear cub (<1%), 1 coyote (<1%), and 23 unknown prey (9%). The composition of elk kills was 40% cows, 28% calves, 21% bulls, 4% yearlings, 4% adults of unknown sex, and 3% of unknown sex and age. Bison kills, which were recorded as the highest proportion of total kills since monitoring has been occurring, included 17 calves, 8 cows, 1 yearling, 1 bull, 2 adults of unknown sex, and 3 of unknown sex and age.

Other research included genetics, 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. During 2012, 19 wolves were captured and collared in 9 packs. At year's end, 21% of the wolves living in YNP were collared. Other wolf-management activities included den site closures and several hazing events. Staff continued to manage wolf viewing areas in Slough Creek and Lamar Valley and other spots where wolves were frequently sighted, leading to a minimum estimate of 27,500 people observing wolves and 17,978 visitor contacts by wolf project staff. Wolf project public outreach included 280 educational talks and 89 interviews.

Additional information on wolves in Yellowstone National Park is available at *www.nps.gov/yell/naturescience/wolves.htm, www.greateryellowstonescience.org*, and *www.fws.gov/mountain-prairie/species/mammals/wolf/*.

Yellowstone Wolf Pack Territories, 2012

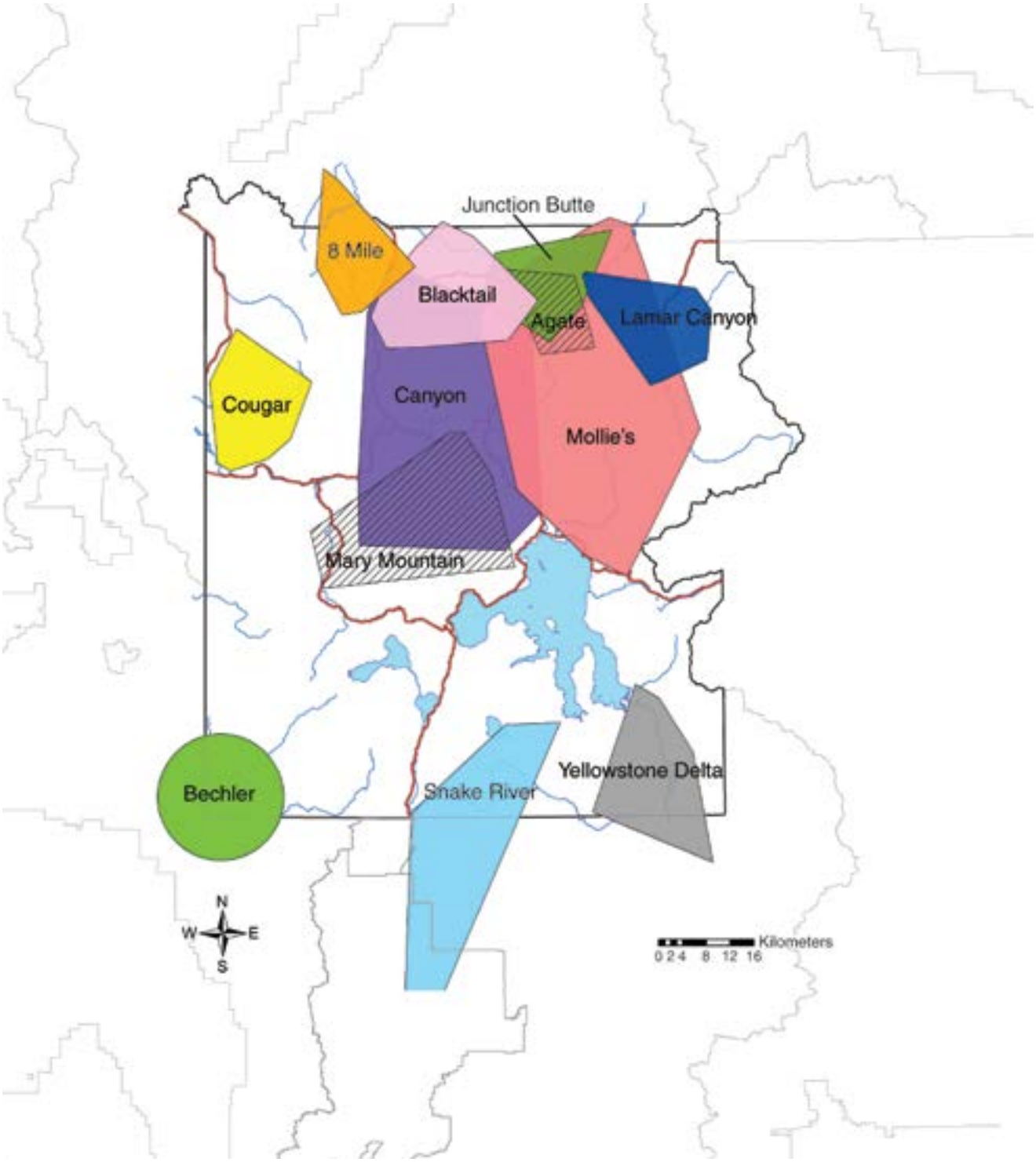

Figure 1. Wolf packs that had some or all of their territory within Yellowstone National Park in 2012; hashed territories represent packs that did not persist until the end of the year.

Members of Lamar Canyon pack including three collared wolves: 754M, 755M, 832F (at top of photo), March 2012.

Wolves in Yellowstone

Numbers and Territory Status

At the end of 2012, at least 83 wolves in 10 packs (6 breeding pairs) occupied YNP (fig. 1; table 1). This is approximately a 15% decline from the previous three years when numbers had stabilized at around 100 wolves (fig. 2). Breeding pairs declined slightly from eight the previous year. Wolf numbers in YNP have declined by about 50% since 2007, mostly because of a smaller elk population, the main food of wolves in YNP. State-managed wolf hunts harvested 12 wolves that lived primarily in YNP when these animals moved into Montana and Wyoming. The number of wolves living in the park interior has declined less, probably because they supplement their diet with bison. The severity of mange continued to decline in 2012, although some packs still showed signs of the mite. There was no evidence that distemper was a mortality factor in 2012 as it was in 1999, 2005, and 2008. Pack size ranged from 4 (Blacktail and Snake River) to 11 (Lamar Canyon, Cougar, and Yellowstone Delta) and averaged 10, which is the long-term average. Seven of 11 (64%) packs had pups.

The number of wolves observed spending most of their time in the park was significantly fewer than the parkwide peak of 174 in 2003, a decline that was brought about by disease and food stress, and suggests a long-term lower equilibrium for wolves living in YNP, 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 more dependent on elk as a food source,

Table 1. Estimated number of wolves in Yellowstone National Park on December 31, 2012.

Pack	Adults	Pups	Total
Northern Range:			
8-Mile	7	3	10
Blacktail	4	-	4
Junction Butte	7	2	9
Lamar Canyon	7	4	11
Northern Range Total	25	9	34
Non-Northern Range:			
Bechler	8	2	10
Canyon	6	2	8
Cougar Creek	6	5	11
Mollie's	5	-	5
Snake River (no collars)	2	2	4
Yellowstone Delta	11	-	11
Non-Northern Range Total	38	11	49
Total	**63**	**20**	**83**

*Underlined packs denote breeding pairs

and elk have declined 60% since 2007. Wolf packs in the interior also prey on bison, which were still widely available in 2012. 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) than in the interior where density was lower.

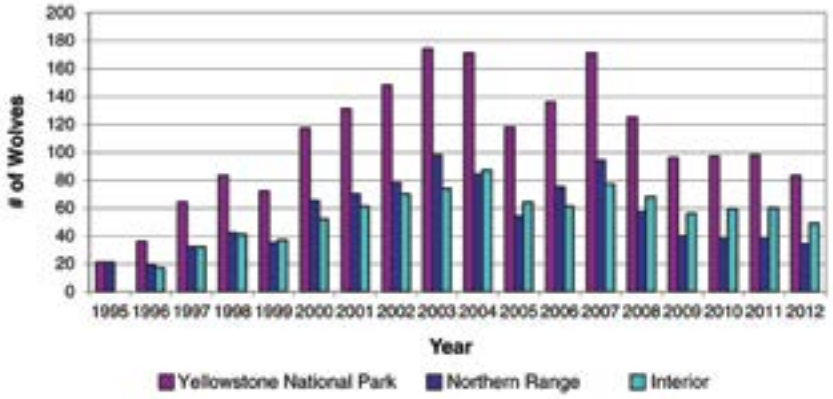

Figure 2. Yellowstone National Park, early winter wolf numbers, 1995–2012.

During 2012, two wolf packs disbanded and one new pack was formed in YNP. The Agate Creek and Mary Mountain packs disbanded when the majority of each pack's members died, dispersed, or disappeared during the year. The Snake River pack previously existed at the south boundary of YNP, but field observations and radio-collar data revealed denning and regular use inside YNP in 2012.

Reproduction

Seven out of eleven packs, along with a lone female originally from the Mollie's pack (who with her pups was adopted by the newly formed Junction Butte pack), produced pups during 2012 (fig. 3). The average number of pups per pack in early winter for only those packs producing pups was 2.5, compared to 4.1 in 2011 and 4.8 in 2010. A total of 20 pups in YNP survived to the end of the year in 2012, slightly more than half those surviving in 2011. Four packs did not produce pups. The alpha females of the Agate Creek and Mary Mountain packs were pregnant, but died near their whelping dates; both packs disbanded soon after. Two other packs did not reproduce despite having at least one (Yellowstone Delta) or as many as nine adult females (Mollie's).

Mortalities

Fifteen radio-collared wolves from packs living primarily in YNP died during 2012 (table 2). Intraspecific aggression was the leading cause of natural mortality (7 deaths). One wolf dispersed from the Yellowstone Delta pack to South Dakota and was hit by a vehicle. Six collared wolves were legally shot during the hunting season (three in Montana, three in Wyoming). One wolf died of unknown natural causes near her den during the whelping season. In addition, wolf project staff recorded eight uncollared wolf deaths; two were natural (one intraspecific and one natural unknown) and six were harvested during the hunting seasons when they moved outside the park into Montana, Idaho, and Wyoming.

Seven of 11 (64%) packs living primarily in YNP had at least one wolf harvested from them: Junction Butte (3 wolves), Blacktail (1 wolf), Mollie's (1 wolf), Lamar Canyon (2 wolves), 8-Mile (2 wolves), Bechler (2 wolves), Snake River (1 wolf). At least three of these harvested wolves were of high social rank (e.g., alpha female or beta male). Effects on reproduction, pack dynamics, and territory are still being monitored, but harvests of

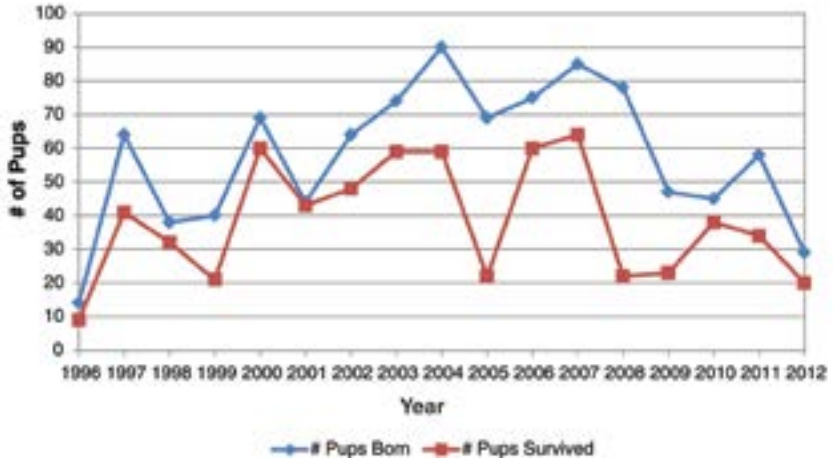

Figure 3. Yellowstone National Park pups born and survived until year end, 1995–2012.

Table 2. Confirmed mortalities of collared Yellowstone National Park wolves, 2012.

Wolf #/Sex	Age Class	Pack	Date of Death	Cause of Death
830F	Adult	Blacktail	3/22/2012	Intraspecific
471F	Old adult	Agate Creek	4/10/2012	Intraspecific
818F	Pup	Mary Mountain	4/11/2012	Intraspecific
819F	Yearling	Mary Mountain	4/13/2012	Intraspecific
827M	Adult	Yellowstone Delta	5/14/2012	Vehicle (in SW South Dakota)
794F	Adult	Mary Mountain	5/22/2012	Natural unknown
838M	Adult	Junction Butte	6/1/2012	Intraspecific
822F	Adult	Mollie's	8/3/2012	Intraspecific
777M	Adult	Junction Butte	8/11/2012	Intraspecific
824M	Yearling	Mollie's	10/30/2012	Harvest
829F	Yearling	Blacktail	11/1/2012	Harvest
754M	Adult	Lamar Canyon	11/11/2012	Harvest
823F	Yearling	Junction Butte	11/13/2012	Harvest
832F	Adult	Lamar Canyon	12/6/2012	Harvest
793M	Adult	Snake River	Early October	Harvest

wolves have potentially affected the function of packs in the park as do natural forms of mortality. Wolves often quickly fill vacant biological and social niches that are a result of wolf losses from any cause.

Pack Summaries

Northern Range Packs

8-Mile Pack *(10 Wolves: 7 Adults, 3 Pups)*

Having settled in the park in 2011, the 8-mile pack established itself as a dominant pack on the northern range in 2012. The pack is believed to be a mix of wolves from the formerly Montana-based pack and the displaced and disbanded Quadrant pack. The pack was led by a large black male and a reddish-gray female. A gray beta female was collared this year as 821F, and the aging large black male SW763M, who was a founder of the pack, continued to contribute to the pack's survival. The pack ranged from the park's northern boundary near the Sepulcher Hills and Stephens Creek to Gardners Hole and Quadrant Mountain. By the end of the year, they expanded their territory onto Mount Everts and parts of Blacktail Plateau as they outnumbered their neighbors. The pack was seen with as many as six pups in the summer, but ended the year with three pups (two blacks, one gray). Two uncollared gray wolves from the pack were legally harvested in Montana outside the park by the end of 2012.

Blacktail Deer Plateau Pack *(4 wolves: 4 adults, 0 pups)*

The Blacktail Deer Plateau pack changed significantly throughout 2012. Although 778M and 693F remained the alpha pair, pack size continuously decreased as a result of dispersal and mortalities. The Blacktail pack began 2012 with 15 wolves, numbered nine by the end of March winter study, with four wolves remaining in the core pack (778M, 693F, and two uncollared females) in December 2012. Four males, including 838M and 777M, dispersed to the Agate Creek pack during breeding season, and went on to form the Junction Butte pack in the summer. Several of Blacktail's yearlings also dispersed during the summer season. Some may have joined the Junction Butte pack, but at the end of 2012 their whereabouts were unknown. A majority of known mortalities resulted from intraspecific conflict: 815M, 830F, 838M, and 777M were killed by the Mollie's pack. The other known mortality was 829F, a yearling female that was harvested during Montana's wolf hunting season outside the park boundary. It is suspected that one of the uncollared females had the only Blacktail litter this year. A couple brief sightings in mid-summer suggest that they had one to two pups that did not survive.

An 8-Mile pack elk kill, Gardner's Hole.

Agate Creek Pack *(0 wolves)*

During the 2012 breeding season, four subordinate males (including 838M and 777M) from the Blacktail pack dispersed and joined the three remaining Agate wolves—female 471F and two uncollared young females. Although two of the males returned to their natal pack by late March, 838M and an uncollared gray seemed poised to revive the Agates, a pack that originally formed in 2001. After several run-ins with the Mollie's pack, alpha female 471F was killed, and the two yearling females disappeared with unknown fates. The two males eventually joined with Mollie's females and formed the Junction Butte pack. At her death, 471F was nearly nine years old and a necropsy revealed she was about two weeks away from whelping seven developing pups. With 471F's death and the disappearance of the other females, the direct line of the Agate Creek pack vanished, and so ended this long-lived pack's presence on the landscape. However, many current packs are derived from former Agates that went on to become successful breeders and leaders (see insert story).

Blacktail Deer Plateau wolves.

Junction Butte Pack *(9 wolves: 7 adults, 2 pups)*

The formation of the Junction Butte pack exemplifies the complexity, flexibility, and strife that can stem from wolf social dynamics. After several late winter interactions between the Mollie's and the Agate Creek packs, all three Agate females were either killed or disappeared, and the two Agate males (originally from the Blacktail pack) joined up with two Mollie's females to form the Junction Butte pack. Neither of the new females was believed to be pregnant so the group wandered widely over the spring. The only radio-collared wolf, 838M, was killed by the main Mollie's pack in Antelope Basin in June, but another Blacktail yearling male, 777M, joined the pack soon after. Sometime over July, the pack joined up with a female who denned in Antelope Basin and produced three pups. The female was likely a Mollie's wolf and sister to the Junction Butte females. During August and September the Junction Butte pack encountered the Mollie's pack several times, once resulting in the death of 777M. Following this, three more females, including Mollie's 823F, joined the pack. Wolf 823F, the only collared wolf in the pack, and two others were harvested during the Montana hunting season while one black pup disappeared around the same time. At year's end, there were seven adults and two pups, most of which had slight to moderate mange. With no collars remaining to track the pack, information came from opportunistic observations by staff and park visitors.

Lamar Canyon wolves and bull elk in a standoff.

Wolf 823F (center, wearing collar) of Mollie's pack.

Lamar Canyon Pack
(11 wolves: 7 adults, 4 pups)

The Lamar Canyon pack anchored their territory once again in Lamar Valley. Following the legacy of other packs living in this area of the park, the Lamar wolves quickly became one of the park's most popular and widely viewed packs. Led by alphas 832F and 755M, the pack experienced significant challenges during the year. The first occurred when 832F's pups were less than a week old and the Mollie's pack made a run through the den area, chasing several Lamar Canyon adults. A black male yearling disappeared around this time but the attack did not halt reproductive success as four pups (two gray and two black) were seen in July, bringing the pack size up to 13. A more significant series of events occurred during early winter when the pack traveled approximately 15 miles east out of the park, possibly following migrating elk, where beta male 754M and alpha female 832F were harvested during the Wyoming wolf hunting season. The remaining 11 pack members spent the rest of the year between the Lamar Valley in YNP and the Crandall and Sunlight drainages in Wyoming. With 755M as the father of the other 10 pack members, and therefore unlikely to breed with any of the females, the future of the pack was uncertain at year's end. Continued monitoring will provide insight regarding the implications of this type of pack disruption for wolves living primarily in YNP.

Interior Packs

Mollie's Pack *(5 wolves: 5 adults, 0 pups)*

After ending 2011 as the largest pack living in YNP and one of the longest running pack lineages following reintroduction, the Mollie's pack saw significant changes during 2012. The pack continued their extended use of the northern range for much of the winter and spring, likely due to difficulty finding vulnerable prey in their traditional Pelican Valley territory. Although they began the year with 19 wolves, pack structure may have been less conducive to hunting bison during winter in YNP's interior, as at least 13 pack members were pups or yearlings and the remaining six included four or more older females. Research has shown that prime age adult males are the most successful at killing larger prey due to their larger body size.

The Mollie's pack stayed on the northern range during the denning season, with at least one female localizing near Antelope Creek. By mid-June, the main Mollie's pack returned to Pelican Valley, where elk could be found taking advantage of rich summer forage. Over the next few months, Mollie's wolves only occasionally visited the female(s) with three pups in Antelope Creek , who soon merged with the new Junction Butte pack, also made up of female Mollie's wolves that had dispersed over the spring (see Junction Butte pack summary). Neighboring pack, Mary Mountain, disintegrated over

The Agate Creek Pack

The Agate Creek pack depicted here, and labeled with collar numbers during fall 2008, consisted of many wolves that gained significance in later years.

For more than nine million years wolves have adapted and thrived in an ever-changing environment. They have encountered and persisted through global climate, human population expansion, physical and population changes of their prey, and also their own species' physical and psychological evolution. This flexibility has granted the wolf the most extensive historic range of any land mammal, being found nearly everywhere in the Northern Hemisphere above 20 degrees north latitude.

In Yellowstone National Park, biologists and visitors from around the world are afforded not only intimate views of wild wolves exhibiting natural behavior but also sometimes unique behavior by packs or individuals that does not fit into data forms or scientific publications. During the first 18 years after reintroduction, these extraordinary behaviors seemed to involve the Agate Creek pack more than any other. In observing and recording their behavior, we witnessed some rare cases of social flexibility. Does this mean they are more evolutionarily advanced than their neighbors? Was the change brought about by one unique, influential individual or a combination of personalities? Was this social flexibility the cause of so many Agates becoming the leaders and breeders in other packs? For this story, at least, it is nice to step back from scientific hypotheses and to simply enjoy the not-knowing, the wondering, realizing that we will never know for sure.

This unexplainable social adaptability was evident from the formation of the Agate pack when two gray males arrived in the Lamar Valley, looking to entice females from the Druid pack into starting a new group. One male was huge, gray, and known by his research number: 113M. The other male was smaller, gray in color, and later known as 296M. Years later, genetics revealed that these two males were unrelated. Perhaps they had some inkling that pairing up would not only assist in their chances of survival in a dangerous environment, surrounded by eight already-established packs, but also help to convince females to join them. Perhaps they simply enjoyed each other's company during the lonely dispersal phase—surely a difficult time for such a social creature—and were reluctant to give it up.

Six years later, 113M was injured during a fight with another pack. This presented a unique situation as 113M was unable to breed his long-time alpha female 472F or maintain his alpha status. If an alpha wolf loses its social position (usually when its mate dies) it will often leave the pack. But 113M's son, 383M, an adult male in

the pack, took over as alpha—leading the pack during travel, breeding the alpha female, yet interacting gently with 113M. By the next year 113M was elderly and in his last summer; his role in the pack had changed as he was often seen caring for the newest pups. We watched him sleeping in the warm sun, surrounded by pups and sage, until his quiet death in October.

The Agate pack experienced very stable leadership throughout their tenure, with only four alpha males and four alpha females in the pack's ten and a half years. Two of these had extremely long terms as leaders: 113M was alpha male for six years, and 472F was alpha female for eight years—the longest alpha female reign on record. Born into the Druid pack as a black, 472F slowly turned pewter, then silver, then frost as she reached ten and one-half years old. She also seemed to be able to read social situations with ease. When she was heavily pregnant with her second-to-last litter in 2009, she discovered a kill controlled by the Blacktail pack. She charged down toward the carcass, her body within a day or two of whelping, causing the large Blacktail wolves to scatter to avoid her assertiveness. Maybe she felt she needed one last good meal before giving birth; or maybe she knew the three intruders were males, and brothers to her own alpha male. Whatever the reason, the wolves interacted in a friendly manner for the rest of the day before 472F left on her own to the south, heading straight for her den, her home for the rest of the summer.

Several males born into the Agate Creek pack also showed signs of advanced social adeptness. In 2003, a black male yearling joined the Leopold pack—at the time with 14 members—as a subordinate male, yet breeding with several of the younger females. In 2007, a black male pup spent a few weeks with the Slough Creek pack during the breeding season. He did not breed any of the females yet interacted and played with them before returning to the Agate pack by March. This behavior is not unique on its own but the pup was not of normal breeding age, unlike most such trysts. However, the strategy helped the pup six months later when the Sloughs lost their alpha male and he took over as one of the youngest alphas we have recorded at one year and six months old.

Another Agate-born male, SW147M, left the park for several years but returned in 2009 and met up with the Silver pack. At first he was chased away but eventually fell into favor with the females. The alpha male of Silver, a very old wolf, let the Agate male take over the pack and resigned himself to the beta position. In turn, the Agate male allowed the former alpha to remain with the pack and seemed to treat him amiably, even licking a wound on the old male's ears and sharing some of his new leadership duties.

Although we have records of males joining packs as subordinates, we only know of one instance of a female joining an already-established pack. Agate female 471F, one of only a few white wolves in the park, was born gray but with a coat that lightened over several years. She evoked the look of a small polar bear as she was observed: black nose and golden-brown eyes on dazzling white. She dispersed from the Agate pack at nearly five years old and spent the next three years with various wolves, never successfully raising pups. At eight years old she rejoined the Agate pack, whose current alpha female would be the only wolf she knew from before she left, a sister who was only 10 months old when 471F dispersed and four years younger than her adventurous sibling.

As we watched the Agate wolves exhibit this curiously tolerant and adaptable social behavior, they were not without a fierce territoriality, driving other packs and lone wolves away, even killing them on occasion. This ability to assess a situation and decide the most appropriate behavior may have helped many Agates when they left their home to start their own packs: out of 18 Agate-born wolves collared over nine years, 11 went on to become the leaders of their own packs. Packs that included Swan Lake, Lava Creek, Slough Creek, Hoodoo Creek, Silver, Blacktail Plateau, and Lamar Canyon. Several successors stayed in their natal Agate Creek pack.

In the wolf-rich landscape of northern YNP, where wolves are so often killed by other wolf packs, the Agate pack seemed to be unique as they lost few wolves to fights with other wolf packs. Although the pack officially disintegrated during April 2012, when all three females died or disappeared within two weeks of each other, today the Agate pack has a lasting legacy in many of the packs throughout the greater Yellowstone ecosystem. Maybe this is the beginning of a new era for wolves. Flexible by nature and adaptable in the extreme, the new pulse of Agates living out there may well propagate, read their surroundings, and find their place in this world as it, and they too, continue to evolve.

the summer and their alpha male 758M rejoined Mollie's, his natal pack. After a trip to the northern range in August, and a run-in with the Lamar Canyon pack resulting in the death of 822F, more Mollie's wolves (including 823F) dispersed to join the Junction Butte pack. During an uncharacteristic move outside the park, yearling male 824M was harvested during the Montana hunting season, and by year's end the Mollie's pack consisted of older female 686F, 779F, 758M, and two uncollared wolves.

Canyon Pack *(8 Wolves: 6 Adults, 2 Pups)*

The Canyon pack, led by the aging black male 712M and the uncollared white alpha female, were some of the most frequently seen wolves by park visitors and staff. This pack continued to roam widely, almost predictably, throughout the seasons. With a home base in Hayden Valley, they ranged west towards Madison Junction and north to Mammoth Hot Springs, often using the road corridor as their main travel route and apparently indifferent to human passersby. Their seasonal movements appear to be driven largely by prey distribution and availability in different areas of the park. They used traditional Hayden home sites for raising two gray pups that were regularly observed by late summer crowds along the valley stretch. The Canyon wolves continue to be a priority for the wolf project's habituation management operations due to their high tolerance and frequent proximity to visitors. Habituated behaviors in this pack have been minimized through close monitoring, public outreach, and occasional hazing events.

Mary Mountain Pack *(0 wolves)*

Unlike the Mollie's pack that ventured north (likely in search of more vulnerable prey) during winter 2011–12, the Mary Mountain pack remained in the park's interior. This decision during a seemingly lean winter may have compromised their ability to stay adequately fed as capture efforts found two pups and a yearling severely underweight. Beginning the year with 10 wolves, the Mary Mountain pack lost four of the five collared pack members by May. Two were killed by other wolves, alpha female 794F died of unknown natural causes near the den, and one collar slipped off. This left alpha male 758M and possibly a few uncollared wolves. Those wolves likely died or dispersed as 758M rejoined his natal pack, the Mollie's, by early July. Why this pack struggled in a territory that had previously supported

Canyon pack negotiating an icy river crossing.

Alpha male 712M of the Canyon pack.

successful packs (e.g., the Nez Perce and Gibbon Meadows packs) is not fully understood, but time may tell by monitoring future occupants to this central part of YNP. By fall, the Canyon pack started spending more time in this territory, indicating the Mary Mountain pack had dissolved and left it vacant.

Yellowstone Delta Pack *(11 Wolves: 11 Adults, 0 Pups)*

During 2012, the Yellowstone Delta pack maintained nearly all members from the previous year, and the pack continued to roam the remote southeast corner of YNP and public wilderness lands adjacent to the park. The upper stretches of the Yellowstone River and the congregating drainages are good habitat for wolves, as indicated by their consistently large pack size and big-bodied wolves. No pups were detected during 2012, even though alpha female 633F was large (121 pounds) and at her reproductive prime at age 5. Alpha male 760M and his brother, beta male 661M, still appeared to be some

Yellowstone Delta pack traveling single file in deep snow.

of the largest wolves in the park, along with 760M's offspring. During capture in February, yearling 827M and pup 828M weighed 145 and 106 pounds, respectively. Wolf 827M demonstrated a remarkable long-range dispersal in late spring that unfortunately ended in May when he was struck by a vehicle and killed near the Pine Ridge Indian Reservation in South Dakota, approximately 500 miles from southeast YNP. The rest of the pack spent the remainder of the year in their remote territory living off elk and the occasional moose, bison, and other prey.

Snake River Pack *(4 Wolves: 2 Adults, 2 Pups)*

Since 2006, the Snake River pack has occupied territory near the south-central boundary of YNP. Without any collars to track until this year, the best knowledge about this pack came from opportunistic observations at a traditional den site where pups were produced each year, along with occasional sightings along the Snake River drainage both inside and outside of YNP. Fortuitously, a wolf previously collared by USFWS outside of YNP, 793M, joined the pack in early 2012 allowing for monitoring throughout the year. However, this radio-collared member of the pack was harvested in the fall south of the park, once again leaving the Snake River wolves difficult to monitor. Early in the season, park staff observed three pups at the den area. Non-invasive scat sampling and individual genotyping through collaboration with University of Montana graduate student Dave Ausband resulted in the detection of at least six adults and three pups present at den and rendezvous sites. Sightings by agencies outside the park late in the year indicated there were four wolves in the pack. However, due to uncertain age and sex composition of the group, the pack did not meet the criteria for counting as a breeding pair for 2012.

Bechler Pack *(10 Wolves: 8 Adults, 2 Pups)*

As in previous years, knowledge of the uncollared Bechler pack was sparse in 2012 and based largely on exploratory aerial reconnaissance and reports from area rangers and park staff. However, as it did with the Snake River pack, non-invasive sampling of adult and pup scats at traditional homesites aided in information about the status of these wolves. Genotypes from scat analyses could identify at least eight adults and five pups present mid-summer. This data supported the only wolf project observation of Bechler wolves, which occurred opportunistically in mid-September during a swan survey. At least 10 wolves were seen, of which 4 were pups. Two pups believed to belong to the Bechler pack were harvested during the Idaho wolf-hunt season. With little information, the best fall estimate was applied to the end of the year count, minus the two harvested pups. The applicability of non-invasive monitoring techniques such as remote cameras and genotyping of scats found in known territory are being explored for difficult-to-collar packs such as the Bechler wolves.

Cougar Creek Pack *(11 wolves: 6 adults, 5 pups)*

The Cougar Creek pack continued to reside in their traditional territory in the northwest portion of the park that always seems to provide these wolves with just enough wintering prey, mostly bull elk. As a result, this pack does not travel widely or interact much with other wolf packs, making them one of the most stable groups of wolves on the landscape. For almost a decade, the Cougar Creek pack generally numbered between four and seven wolves, but with successive years of average pup survival, the pack is now at 11 wolves, which is as large as any of the wolf packs living in YNP. The alpha pair continued to be wolves 478F and 689M. Of note, at nine years of age, alpha female 478F produced a litter of five pups, one of which was the first gray-colored pup born within the Cougar Creek pack in many years. They are one of the few packs that have never had mange, possibly due to the distance of their territory from those of other packs.

Other wolves

Clear Creek
(Estimated 9 wolves: Unknown sex/age)

Although they have no collars and cannot be tracked, this group was once again documented on late summer flights along the east side of Yellowstone Lake. At least nine individuals, possibly with pups, were documented from aerial photos. While they appear to spend time in YNP during the summer, it is unknown where the pack ranges or dens. Presumably, they move outside the park following elk migrations to the east during the winter months. Non-invasive sampling techniques are slated for future monitoring of this poorly understand pack. There may be some connection between these wolves and the Pahaska pack in Wyoming to the east of YNP.

Wolf Capture and Collaring

Nineteen wolves from nine packs were captured and radio-collared in 2012: 1 old adult, 7 adults, 2 yearlings, and 9 pups of which 14 were females and 5 were males (table 3). Both VHF and downloadable GPS collars were deployed. As of the end of 2012, 18% of the wolves primarily living in YNP were collared.

Processing Mary Mountain wolves 818F and 819F.

Wolf Predation

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 2012 during which wolves were intensively radio-tracked and observed for 30-day periods in March and from mid-November to mid-December. The Blacktail, Agate Creek, and Lamar Canyon packs were the main study packs monitored by three-person ground teams and aircraft during the March session, with the Junction Butte pack replacing the Agate Creek pack for November–December session. Additionally, other park packs (Canyon, Cougar Creek, Mary Mountain, Mollie's, Quadrant, 8-mile) were monitored from only aircraft. The 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, Blacktail, Lamar Canyon, and Junction Butte packs during winter studies and also during a spring–summer (May–July) monitoring period. During these established predation studies, and opportunistically throughout the

Table 3. Yellowstone Wolf Project collaring operations, 2012.

Capture Date	Wolf #/ Sex	Age	Color	Pack
2/3/2012	818F	Pup	Gray	Mary Mountain
	819F	Yearling	Gray	Mary Mountain
2/4/2012	820F	Pup	Gray	Lamar Canyon
	832F	Adult	Gray	Lamar Canyon
	821F	Adult	Gray	8-Mile
	822F	Adult	Black	Mollie's
	823F	Pup	Gray	Mollie's
	824M	Pup	Gray	Mollie's
2/5/2012	825F	Pup	Black	Cougar Creek
	826F	Pup	Gray	Mary Mountain
	633F	Adult	Black	Yellowstone Delta
	827M	Yearling	Gray	Yellowstone Delta
	828M	Pup	Gray	Yellowstone Delta
2/6/2012	829F	Pup	Black	Blacktail
	830F	Adult	Black	Blacktail
2/7/2012	712M	Adult	Black	Canyon
	831F	Pup	Black	Canyon
2/21/2012	471F	Old adult	Gray	Agate Creek
	838M	Adult	Black	Agate Creek

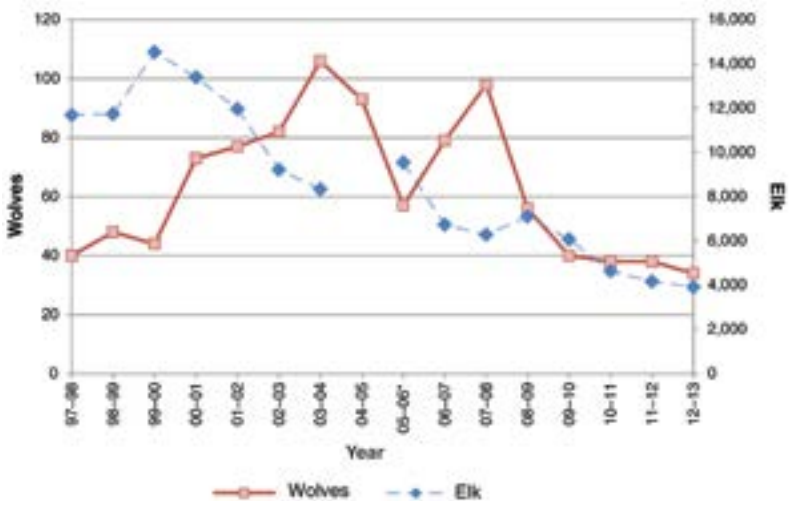

Figure 4. Yellowstone National Park northern range elk and wolf counts, 1995–2012.

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 255 kills (definite, probable, and possible combined) made by wolves in 2012, including 159 elk (62%), 32 bison (13%), 13 mule deer (5%), 4 pronghorn (2%), 2 whitetail deer (1%), 5 deer unknown species (2%), 2 moose (1%), 2 Canada geese (1%), 9 wolves (4%), 1 bighorn sheep (<1%), 1 otter (<1%), 1 grizzly bear cub (<1%), 1 coyote (<1%), and 23 unknown prey (9%). The composition of elk kills was 40% cows, 28% calves, 21% bulls, 4% yearlings, 4% adults of unknown sex, and 3% of unknown sex and age. Bison kills included 17 calves, 8 cows, 1 yearling, 1 bull, 2 adults of unknown sex, and 3 of unknown sex and age.

Given the controversy surrounding wolf impacts on ungulate populations, wolf and elk interactions continue to be a primary focus of predation studies in YNP. The northern Yellowstone elk population has declined since wolf reintroduction (fig. 4). In addition to wolves, factors affecting elk population dynamics include other predators, management of elk outside the park, and weather patterns (e.g. drought, weather severity). Weather patterns influence forage quality and availability, ultimately impacting elk nutritional condition. Consequently, changes in prey selection and kill rates through time result from complex interactions among these factors.

Winter Studies

March. During the 2012 March winter study (30 days), study packs were observed for a total of 356 hours from the ground. Because of poor weather conditions, wolf packs were only located from the air on 7 days. We did not attempt to locate the Delta pack. The number of days other wolf packs were located ranged from 6 (8-Mile) to 7 (Agate, Blacktail, Canyon, Cougar, Lamar Canyon, Mary Mountain, and Mollie's).

A total of 32 ungulate carcasses fed upon by wolves were discovered by air and ground teams. Additionally, 1 goose was killed by wolves. Among ungulates fed upon by wolves, 28 (88%) were killed by wolves, which included 19 elk, 4 bison, 3 deer, 1 bighorn sheep, and 1 moose. Among elk, 1 (5%) was a calf, 7 (37%) were cows, and 11 (58%) were bulls. Wolves also fed upon 3 bison and 1 deer that they did not kill. Of these, at least 2 of the bison had drowned and the deer had been killed by a cougar. Kill rate was low compared to most late winters, which was likely the result of the relatively mild winter of 2011–2012.

November–December. The 2012 November-December winter study (30 days) was unique as it was the first time a pack (Junction Butte) with no radio-collared wolves was among the study packs monitored from the ground. During this winter study, study packs were observed for a total of 169 hours from the ground. Because of poor weather conditions, wolf packs were only located from the air on 5 days, and the number of days radio-collared wolf packs were successfully located ranged from 2 (Delta) to 5 (Blacktail and Mollie's).

A total of 22 ungulate carcasses fed upon by wolves were discovered by air and ground teams. Additionally, 1 otter was killed by wolves. Among ungulates fed upon by wolves, 18 (82%) were killed by wolves, which included 13 elk, 1 bison, 3 deer, and 1 unknown ungulate. Among elk, 5 (38%) were cows, 4 (31%) were calves, 2 (15%) were yearlings, and 2 (15%) were bulls. The wolves also fed upon 2 bison, 1 bull elk, and 1 unknown ungulate that they did not kill. In comparison to other early winter study periods, kill rates were low, as was the percentage of calves in the wolves' diet.

Blacktail wolves 693F and 777M, with two other wolves, hunting a bull elk.

GPS Collars and Winter Predation. During March, we searched clusters of GPS radio locations from wolves 832F of the Lamar Canyon pack and 829F of the Blacktail pack. We also searched GPS clusters for wolf 777M, who was a member of the Blacktail pack for the first couple weeks of March before dispersing and joining the Agate Creek pack. For the Lamar Canyon pack, all carcasses were detected by GPS clusters; conversely, traditional monitoring methods (i.e., air and ground crews) only found 67% of all carcasses. However, for the Blacktail pack, only 75% of carcasses were detected through GPS clusters, and traditional monitoring methods found approximately 70% of all carcasses. For the last 10 days of the winter study, when 777M was present with the Agate Creek pack, about 90% of carcasses were detected though GPS clusters and 50% were detected by air or ground crews.

By November–December, 832F of the Lamar Canyon pack was the only GPS-collared wolf present among the wolves living primarily in YNP. We searched the GPS clusters for 832F for the first few weeks of winter study until she died in early December. Prior to this, seven ungulate carcasses killed by or fed on by the Lamar Canyon pack were detected. Among these, GPS clusters and traditional methods each detected about 70% of the carcasses.

As in previous years, carcasses not detected by GPS clusters were primarily due to less pack cohesion (i.e., the GPS collared wolf was not present at a carcass fed upon by members of its pack). In comparison, carcasses not detected by traditional monitoring methods were primarily the result of kills being made in areas not observable by ground crews on days during which a flight did not occur.

Blacktail Deer Plateau wolves.

Lamar Canyon bull elk carcass.

Summer Predation

In 2012, the Yellowstone Wolf Project continued to assess the predation patterns of wolves from May through July by searching the GPS clusters of wolves 777M and 829F. Wolf 829F was a member of the Blacktail pack for the entire study period and 777M was also a member of the Blacktail pack when the study period began. However, 777M dispersed in late May and joined the Junction Butte pack as it formed during early June. Wolf 777M then remained with this new pack for the duration of the summer 2012 study period. Through our monitoring efforts, we found 67 suspected kills or fresh carcasses of ungulate prey, which included 46 elk, 13 bison, 3 deer, and 5 unknown species. Of note, bison made up a larger percentage of carcasses that GPS-collared wolves fed upon than in any previous year for which we searched wolf GPS clusters during summer. As a result of wolves' increased predation of bison, only about 70% of the ungulates detected through GPS clusters from May 1 to July 31 were elk. Among elk, 54% were neonate calves, 34% were cows, 4% were 11- to 14-month-old elk, 2% were 23- to 26-month-old elk, and 4% were bulls.

Genetics

Collaborative efforts between the Yellowstone Wolf Project and the University of California, Los Angeles (UCLA) continued in 2012 working with genetic samples from wolves living in YNP. 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. Separately, Smith and Stahler continued collaboration as 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 genetic data on wolves living in YNP with ecological, demographic, and life history datasets. Work is ongoing with both studies.

The wolf project also continued to collaborate with UCLA on the wolf genome sequencing project which involves wolves from around the world, including the well-studied 302M from YNP. DNA from 302M is being used for whole genome sequencing that will create the entire genetic map of wild wolves, allowing us to better understand how genes may impact wolf behavior, health, life history, and canid evolution.

Additionally, the wolf project collaborated with doctoral student Dave Ausband from University of Montana on scat collection at den and rendezvous sites, for genotyping unique individuals to improve knowledge of pack composition of lesser-known wolf packs living in YNP.

Caitlin Ruhl takes a break to figure things out.

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 in northern YNP during 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. In 2012, seven out of eleven monitored packs were infected and within these, prevalence ranged between 5 and 100%. Uninfected packs tended to be those living in the interior of YNP. Although *S. scabiei* has been isolated from wolves living in YNP in the past, we recently attempted additional skin scrapings without success in isolating the mite. Those efforts will continue. Despite our difficulty in isolating the mite, the hair-loss patterns are highly consistent with sarcoptic mange as opposed to other parasites that result in hair loss.

In 2008, the Yellowstone Wolf Project began a partnership with the US Geological Survey to rigorously address questions about how mange is affecting individual wolves and their overall population in the Yellowstone region. This collaboration continued to include Paul Cross, Catherine Haase, and Olivier Putzeys of the US

Geological Survey, Nate Bowersock of the wolf project, Emily Almberg and Peter Hudson of Penn State University, and Andy Dobson of Princeton University. This team's manuscript was published in *Philosophical Transactions of the Royal Society B* (Issue 367) and described the invasion of mange into the park and documented 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 a project that is using thermal imagery cameras to measure the heat loss associated with mange-induced hair loss. Trail and thermal cameras were deployed in the field throughout the winter months of 2012, and analyses of these photos are ongoing. Ultimately, these measurements will allow us to estimate the caloric costs of infection and ask questions about how infection with mange alters the energy balance that wolves must maintain for survival.

Ongoing disease surveillance suggested that canine distemper virus did not circulate within YNP in 2011. We are awaiting the analysis of the samples that reflect pathogen exposure in 2012. Exposure to canine parvovirus and canine adenovirus type-1 in 2011 was nearly universal and similar to what we have seen in other years.

Spotting scopes are essential to wolf watching in Yellowstone National Park.

Wolves are still a big attraction in YNP and visitors need to be at least 100 yards away to view them.

Wolf Management

Area Closures

To prevent human disturbance of denning wolves during the sensitive period of pup rearing, visitor entry was closed to areas surrounding the dens and rendezvous areas of the Canyon and Lamar Canyon packs for various times during summer 2012. Den sites for the Blacktail Deer Plateau and Junction Butte packs were protected from disturbance coincidental to area closures for bear management in the park. Other packs' den sites were not closed because low visitor use made it unlikely these dens would be disturbed.

Wolf Road Management Project

Since wolves were reintroduced in YNP in 1995, the Lamar Valley has become the premier location worldwide to observe free-ranging wolves. From 1996 to 2009 the main pack of interest was the Druid Peak pack, which denned in or near Lamar Valley most years. Since the dissolution of the Druid pack, the focus has been on the Lamar Canyon pack, which denned at the same sites historically used by Druid in both 2011 and 2012.

Staff in YNP established the Wolf Road Management Project 13 years ago to better deal with the opportunities and problems that accompany increasing visitor numbers. The objectives for this program are to support: 1) human safety; 2) wolf safety; 3) visitor enjoyment; and 4) wolf monitoring and research. A record number of visitor contacts were made by staff in the 2012 season

(17,978 people) and the summer season was characterized by numerous wolf-viewing opportunities.

Habituated Wolves

There were fewer cases of habituated wolves in 2012. The Canyon and Lamar Canyon packs exhibited the most habituated behavior, with most of the behavior occurring during the spring and summer. Both packs den relatively close to park roads and must maneuver around park visitors and vehicles more often than packs in the backcountry. An uncollared yearling in the Lamar Canyon pack may have been tossed food by a visitor when the wolf was traveling near the roadway. The next time the wolf showed habituated behavior, she was hazed with cracker shells and afterward did not show signs of further habituation.

Wolf Management Outside Yellowstone

Information on wolf management and recovery status in the greater Yellowstone recovery area in 2012 is available at *www.fws.gov/mountain-prairie/species/mammals/wolf/*.

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

Title: Wolf habitat selection at the territory level: seasonal and interannual variation and influence on reproductive success
Graduate Student: Alessia Uboni, completed PhD in Forestry
Committee Chair and University: Dr. John A. Vucetich, School of Forest Resources and Environmental Science, Michigan Technological University

Title: Elucidating evolutionary processes in North American gray wolves: demographic history, coat color-ation, and ecotype-specific selection.
Graduate Student: Rena M Schweizer, PhD Candidate
Committee Chair and University: Dr. Robert K Wayne, Department of Ecology and Evolutionary Biology, University of California, Los Angeles

Title: Modeling the effects of environmental change on wolf population dynamics
Graduate Student: Dr. Sarah Cubaynes, Post-doctoral research associate
Committee Chair and University: Dr. Tim Coulson, Department of Zoology, University of Oxford

Title: Survival of Northern Rocky Mountain wolves: Phase II
Graduate Student: Jack Massey, PhD student
Committee Chair and University: Dr. Tim Coulson, Department of Zoology, University of Oxford

Title: Groups and mortality: their effects on cooperative behavior and population growth in a social carnivore
Graduate student: David Ausband, PhD student
Committee Chair and University: Dr. Michael S. Mitchell, Advisor, University of Montana, Wildlife Biology Program

Title: Influence of top-down and bottom-up forces on movement and habitat use of northern Yellowstone elk
Graduate Student: Michel T. Kohl, PhD student
Committee Chair and University: Dr. Daniel R. MacNulty, Department of Wildland Resources, Utah State University

Ryan Kindermann, dressed for anything, tallies another one for the books.

Title: Assessing the impact of wolf predation on the demography and age structure of northern Yellowstone elk
Graduate Student: Ryan Kindermann, PhD student
Committee Chair and University: Dr. Daniel R. MacNulty, Department of Wildland Resources, Utah State University

Title: Dynamics of predator–prey space use in a wolf–bison system.
Graduate Student: Aimee Tallian, PhD student
Committee Chair and University: Dr. Daniel R. MacNulty, Department of Wildland Resources, Utah State University

Title: Group composition effects on interpack aggressive interactions in Yellowstone wolves
Graduate Student: Kira Quimby, MS student
Committee Chair and University: Dr. L.D. Mech, Department of Natural Resources, Science, and Management, University of Minnesota

Title: The dynamics and impacts of sarcoptic mange in wolves in YNP
Graduate Student: Emily Almberg, PhD candidate
Committee Chair and University: Dr. Peter Hudson, Department of Biology, Penn State University

Yellowstone Wolf Project Ongoing Research

Predator–Prey. Wolf–prey relationships are a major area of focus for wolf research in YNP. Biannual 30-day winter studies (November 15–December 14 and March 1–30) ongoing for 15 years are designed to record early and late winter predation patterns. More recently, summer predation patterns are studied using downloadable GPS collar data (May through July), along with scat collection for diet analysis. In addition, GPS collars are now being used during winter studies. During these established predation studies, and opportunistically throughout the year, project staff records behavioral interactions between wolves and prey, predation rates, total time wolves feed on carcasses, percent consumption of kills by scavengers, characteristics of wolf prey (e.g., sex, species, nutritional condition), and characteristics of kill sites.

Elk Research. A Long Term Research in Environmental Biology grant from the National Science Foundation, was awarded to the Yellowstone Wolf Project in 2012, continues to fund a long-term study of wolf impacts on the northern Yellowstone elk population. This work has developed into a large-scale project consisting of two objectives: 1) to determine the influence of wolf predation on the survival, recruitment, and age structure of northern Yellowstone elk population, and 2) determine the relative influence of top-down and bottom-up factors on the movement of elk in northern YNP, and evaluate the influence of these movement patterns on elk survival and reproduction. We are now tracking 71 elk instrumented with 30 GPS and 51 VHF radio-collars. Collared elk are monitored for survival and calf recruitment throughout the year.

Hunting Behavior. This aspect of wolf-prey relationships has been a research focus in YNP largely through the efforts of long-term collaborator Dr. Dan MacNulty (Utah State University). 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 the 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

Researchers have looked at scavenger–wolf interactions and found significant amounts of carcasses are consumed by scavengers.

habitat use; and 3) assess the importance of wolf-killed ungulates for grizzly bears emerging in early spring.

Demographics. Using data from radio-marked wolves, year-round research focuses on understanding the major components of wolf demographics (births, deaths, immigration, and emigration) in YNP. Monitoring efforts through ground and aerial tracking and observations provide annual counts, 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 are an important research focus for wolf biologists in YNP. Using radio-collar 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 populations.

Breeding Behavior. During January and February each year, project staff monitor wolf packs living in YNP 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 individual attempts to breed and their relative fitness consequences.

Ravens and wolves essentially compete at the carcass and sometimes wolves are intolerant of raven presence.

Canyon pups.

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, approximately 10–20 wolves are helicopter-darted and radio-collared. Handling of individuals provides data on morphometrics (e.g., body size and shape), 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 YNP's wolf research program.

Disease. Research on the disease ecology of wolves living in YNP 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 parkwide 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.

Genetics. Annual genetic sampling (blood, tissue,

and scat) from live and dead wolves is used to study genetic diversity, age and sex 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 wolves inhabiting YNP. Examples of current research questions include regional population genetic structure, evolutionary history and selection for coat color, evolution of life history traits, effects of kinship on breeding strategies, territoriality, and strife. Additionally, whole genome sequencing on wolves in YNP 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 carnivores in YNP. 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 involve habitat use (using Resource Selection Functions), travel and territory size, summer versus winter, and night versus day, as well as comparisons between GPS and VHF collars.

Wolf Symposium

In October 2012, individuals who played a key role in the 1995 reintroduction of wolves to Yellowstone gathered to share their personal experiences and perspectives during an Oral History Symposium at Mammoth Hot Springs, Wyoming. Attended by managers, attorneys, biologists, historians, and government wildlife trappers, the symposium documented the behind-the-scenes work of a significant conservation effort. For many participants, it was their first contact with each other since the reintroduction 15 years before.

A keynote address was given by Ed Bangs, who served as the US Fish and Wildlife Service Wolf Recovery Coordinator. Other presenters included current Yellowstone Wolf Project leader Douglas Smith, former Yellowstone Superintendent Bob Barbee, and Mike Phillips, Executive Director of the Turner Endangered Species Fund.

Filmmaker Bob Landis presented film footage that was narrated extemporaneously by symposium participants. Included was rare film of the collaring and trapping efforts in Canada, the feeding and handling of wolves in the pens, and the initial releases. A copy of the

Looking for wolves.

Participants in the 1995 reintroduction of wolves gathered for an oral history symposium in October 2012.

Bob Barbee, park superintendent during wolf recovery in 1995, presented the keynote address.

narrated film is available in the park library.

An early morning wolf watching expedition allowed the group to see the reintroduction goals realized. For Douglas Smith, standing in the Lamar Valley with this pioneering group was an unforgettable experience. "We tend to focus on biology and forget the human side of big events in Yellowstone. The Wolf Oral History Symposium was about the people, and reconvening this crowd was memorable (and at times hilarious). There were many lessons learned and instructional reflections. It was well worth the time."

The individual oral histories of symposium participants will be collected throughout the coming year. Their histories will be archived with conference video, transcripts of formal presentations, moderated discussions, and group interviews. For more information, contact Charissa_Reid@nps.gov.

Outreach

Yellowstone Wolf Project staff gave 280 formal talks and 89 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 27,500 people view wolves, making 17,978 visitor contacts, and giving hundreds of informal talks in the field (table 4).

Table 4.Visitor contacts while working on the road management project during summer.

Year	Visitor contacts	Informal talks	# of people at talks	Total contacts	# of people seeing wolves	Time wolves visible (hours)	Days wolves visible
2000	6,760	83	1,833	8,593	8,145	283	77/82 (94%)
2001	9,375	288	1,552	10,927	11,210	368	125/125 (100%)
2002	9,450	244	1,952	11,402	12,414	460	126/126 (100%)
2003	9,375	258	2,064	11,439	9,827	415	124/124 (100%)
2004	9,450	226	2,260	11,710	8,721	395	126/126 (100%)
2005	6,200	125	1,250	7,450	11,695	790	124/124 (100%)
2006	6,500	200	2,000	8,500	13,640	620	124/124 (100%)
2007	8,775	230	2,300	11,075	32,600	750	117/117 (100%)
2008	8.660	358	3,925	12,585	35,000	830	124/124 (100%)
2009	10,040	602	5,245	15,285	31,000	750	124/124 (100%)
2010	9,975	561	6,250	16,225	38,000	850	126/126 (100%)
2011	10,420	664	7,215	17,635	25,000	600	126/126 (100%)
2012	12,420	542	6,286	17,978	27,500	550	126/126 (100%)

Back row (left to right): Hans Martin, Peter Mumford, Jack Massey, Douglas Smith, Michael Roesch, Steve Ruff, Joel Ruprecht, Nate Bowersock. Front row (left to right): Sarah Cubaynes, Caitlin Ruhl, Tanya Wolf, Cayley Faurot-Daniels, Matt Metz, Erin Stahler, Daniel Stahler, Kira Quimby.

Staff and Volunteers

Four full-time NPS employees worked for the Yellowstone Wolf Project in 2012: 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, Aidan Beers, Nate Bowersock, Sarah Cubaynes, Cayley Faurot-Daniels, Jared Green, Josh Irving, Ryan Kindermann, Hans Martin, Jack Massey, Molly McDevitt, Matthew Metz, Nathan Muhn, Peter Mumford, Rebecca Raymond, Steve Ruff, Michael Roesch, Joel Ruprecht, Caitlin Ruhl, Kira Quimby, Aimee Tallian, Julie Tasch, Jamie Walton, Tanya Wolf, and Travis Wyman. Some of these staff members were paid technicians with funding provided by the Yellowstone Park Foundation.

The wolf capture helicopter allows good range over the vast Yellowstone landscape as well as safe operation in the high-elevation, thin-air conditions.

Acknowledgments

We continue to be impressed by and thank the many interested people who come forward every year to work with wolves. First and foremost are the Yellowstone Wolf Project staff, including volunteers, without whom we would accomplish much less. The wolf-watching community in YNP has always helped when they can and 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. Learn more at *www.ypf.org*.

Continued support from Canon U.S.A, Inc., an anonymous donor, the Tapeats Fund, the Twin Spruce Foundation, the Perkin-Prothro Foundation, participants in the wolf collar sponsorship program, and the National Science Foundation grants DEB-0613730 and DEB-1245373 are also critical to our success and we thank them.

We also appreciate safe piloting from Roger Stradley of Gallatin Flying Service, Steve Ard of Tracker Aviation, and Bob Hawkins of Sky Aviation. Without all of the above support we would know less about wolves living in YNP.

Agate pack wolves.

Appendices

Appendix I. Wolf Project Volunteer Roster, 2012

Table I-1

Name	Period of Involvement	Hours Worked
Aidan Beers	2/27–4/7/2012 and 4/9–8/3/2012	1,192
Sarah Cubaynes	11/11–2/18/2012	304
Cayley Faurot-Daniels	11/11–12/18/2012	304
Jared Green	2/27–4/7/2012	336
Hans Martin	2/27–4/7/2012	336
Jack Massey	11/11–12/18/2012	304
Molly McDevitt	6/20–12/18/2012	1,128
Nate Muhn	11/11–12/18/2012	304
Peter Mumford	11/11–12/18/2012	304
Steve Ruff	2/27–4/7/2012 and 11/11–12/18/2012	640
Michael Roesch	11/11–12/18/2012	304
Joel Ruprecht	11/11–12/18/2012	304
Julie Tasch	1/1–4/27/2012	776
Tanya Wolf	11/11–12/18/2012	304
Total Volunteer Hours*		**6,840**

*Based on the standard biological field technician GS-5 hourly rate.

Appendix II. Publications in 2012

Almberg, E.S., P.C. Cross, A.P. Dobson, D.W. Smith, and P.J. Hudson. 2012. Parasite invasion following host reintroduction: a case study of Yellowstone's wolves. *Philosophical Transactions of the Royal Society B,* 367(1604):2840–2851.

MacNulty, D.R., D.W. Smith, L.D. Mech, J.A. Vucetich, and C. Packer. 2012. Nonlinear effects of group size on the success of wolves hunting elk. *Behavioral Ecology,* 23:75–82.

Metz, M.C., D.W. Smith, J.A. Vucetich, D.R. Stahler, and R.O. Peterson. 2012. Seasonal patterns of predation for gray wolves in the multi-prey system of Yellowstone National Park. *Journal of Animal Ecology,* 81:553–563.

Smith, D.W. and G. Ferguson. 2012. *Decade of the wolf, revised and updated edition: Returning the wild to Yellowstone*. Lyons Press.

Stahler, D.R., D.R. MacNulty, R.K. Wayne, B. vonHoldt, and D.W. Smith. 2012. The adaptive value of morphological, behavioural and life-history traits in reproductive female wolves. *Journal of Animal Ecology,* 82:222–234.

Appendix III. Grants in 2012

Smith and Stahler, along with co-principal investigators Dr. Dan MacNulty (Utah State University), Dr. John Vucetich (Michigan Tech University), and Dr. Tim Coulson (Oxford University), were awarded a Long-Term Research in Environmental Biology grant from the National Science Foundation. The grant is funding a project titled *Yellowstone wolves: their ecology and community consequences*. The overall project goal is to determine how and why wolves in YNP affect, and are affected by, their environment. The long-term goals are to determine: 1) the demographic impact of wolves on their main prey, elk; 2) the evolutionary response of wolves and elk following wolf reintroduction; and 3) the influence of wolves on community interactions. The primary study area is northern YNP. Progress toward these long-term goals during the initial 5-year award has generated more than 30 peer-reviewed publications that have been cited more than 300 times.

Appendix IV. Interviews Given by Wolf Project Staff, 2012

Date	Interviewer
Doug Smith:	
January	Anisa Peters, *National Geographic*
	Matt Brown, Associated Press
	Teton Science School
	Mary Ellen Hannibal, book author
	Yellowstone Journal
February	Jay Kohn, KTVQ Billings TV
	David Wilson, Michigan Tech and University of Nevada, Reno, *Alumni Magazine*
	Lily Schultz, California high school student
	Keith Crowley, Lodge Trail Media
March	Brett French, *Billings Gazette*
	Matt Brown, Associated Press
	Carly Flondry, *Bozeman Daily Chronicle*
	Lisa Reuters, journalist
April	Josephine Macoff, *Minneapolis Tribune*
May	Christina Lysacek, KBZK Bozeman
	Keith Crowley, Lodge Trail Media
	Slate Magazine
	Allison Brown Olgilvie, Washington, DC
	David Wilson, freelance journalist
	Sara McPherson, *Science World*
	Elizabeth Miller, *Boulder Weekly*
	Emily Blanchard, Community Partnership
	Matt Pomilia, Anatolian Leopard Foundation
	David Banker, Monter Television, England
	Mingo Morgan
June	Rockholm Media Group, Idaho
	Steve Camelio, Yellowstone Association
July	University School
	Lisa Reuter, Yellowstone Association
August	Carlos De Angelo, Argentina
	Iberra Reserue, DOI Jaguar Restoration Assistant to Ken Salazar
	Mary Porter, *The Pueblo Chieftain*
	Men's Journal
September	Jay Kohn, Billings KTVQ TV
	Kenta Okumura, Media One Co., Tokyo, Japan
	Cristina Eisenberg, writer
	Tim Newnan, *Sunday Night,* Australia

Date	Interviewer
Doug Smith (cont.):	
	Emily Rust, *The Scroll*, Rexburg, ID
	Bertholot Brannstrom, journalist
	Stephanie Dolrerr/Leela Hazzoh, Lion Guardians
October	Media One Co., Tokyo, Japan
	Media One Co., Tokyo, Japan
	PBS
	Emma Duncan, *The Economist*
	Ilona Popper
	Kevin Ranker, Washington State Senator
	Alia Mulder, University of Montana
	Rachel Teel, PBS
	Emma Caruso, Montana State University
	Andrew Sessa, *Departures* Magazine
	Allan Lucy, filmmaker
November	Susan Cosier, Audubon meeting
	Nicholas Shinaberry, student
	David Skange, Montana State University
	Mike Wolterbeek, University of Nevada, Reno
	Kurt Repanshek, *National Parks Traveler*
	Shruti Ravindran, Columbia University
	Laura Zuckerman, *Rockies News*
	Virginia Morrel, *Science News*
	Conrad Wilson, Minnesota Public Radio
December	Rachel Oliver, Webster University
	Michal Hugerty, Nevada Public Radio
	CBS News, KTVN, Reno, Nevada
	Nate Schweber, *The New York Times*
	CBC, "As It Happens"
	NPR, *To the Point*
	Frank Hinchy, Ohio Outdoor News
Dan Stahler:	
September	Faye Flam, *Philadelphia News*
October	The Asahi Shimbun, Japanese newspaper
	Kevin Ranker, Washington State Senator
	Gibb Mathers, *The Powell Tribune*
	Brett French, *Billings Gazette*
	Philadelphia Tribune
	UCLA Newsroom
	Utah State University
December	Robin Young, *Here and Now*, NPR
	Nate Schweber, *The New York Times*
	Matt Brown, AP reporter
	Jim Wickens, The Ecologist, Link TV, UK

Date	Interviewer
Dan Stahler (cont.):	
	Matt Williams, Guardian UK
Kira Cassidy-Quimby:	
December	*Audubon Magazine*
Rick McIntyre:	
March	*Yellowstone Journal*
May	Christine Weinheimer, Yellowstone Park Foundation (YPF)

Date	Interviewer
Rick McIntyre (cont.):	
	Alexandra Geneste, *Geo* Magazine (French edition)
August	Kathy Kasic, film project
September	Cristina Eisenberg, author, The Carnivore Way
	KUED, PBS, Salt Lake City, UT
November	Megan Regnearus, YPF newsletter

Appendix V. Talks Given by Wolf Project Staff, 2012

Date	Group	Location
Doug Smith:		
January	High school group	Darby, MT
	USGS talk	Bozeman, MT
March	University of Minnesota wildlife class	YNP
	CSU Wildlife Society Club	YNP
May	Interpretive ranger training	YNP
	Oregon State University	Corvallis, OR
	Xanterra guides	YNP
June	Hawthorne Elementary	Bozeman, MT
	USFS Carnivore class	YNP
	Flagstaff science teacher K-12	Flagstaff, AZ
July	University of Montana school group	Missoula, MT
	School groups	Thompson Fall, MT
August	Buffalo Bill Historical Center	Cody, WY
	Peter Weizicki, Minnesota high school group	YNP
	Wolf Park 40th Anniversary	Battle Ground, IN
	Free field trip	YNP
September	YPF Board	YNP
	Gonzaga University wildlife biology class	YNP
	YPF Board	YNP
	Pueblo Zoo	Pueblo, CO
October	Biennial Conference, Yellowstone Center for Resources	YNP
	Wolf Oral History	YNP
	Wolf Oral History	YNP
	Montana Chapter SCB	Bozeman, MT
November	Winter Study training	YNP
December	University of Nevada, Reno	Reno, NV
	Interpretive ranger training	YNP
	J.N. Ding Darling National Wildlife Refuge	Sanibel, FL
	J.N. Ding Darling National Wildlife Refuge	Sanibel, FL
	Retirement home talk	Fort Meyers, FL
Dan Stahler:		
April	Gregory Siekaniec, Deputy Director of USFWS	YNP
	Rachel Jacobson, Acting Assistant Secretary of the Interior	YNP
May	NPS Archives Workshop	YNP
	Scott Talbot, Director Wyoming Game and Fish	Lakewood, CO

Date	Group	Location
Dan Stahler (cont.):		
June	The Wild Side Tours and Treks	Gardiner, MT
September	UCLA, Robert Wayne lab	YNP
October	Biennial Conference, Yellowstone Center for Resources	YNP
	The Wild Side Tours and Treks	Gardiner, MT
Rick McIntyre:		
January	Yellowstone Association Institute (YAI) class: Winter Wolf Discovery	YNP
	Crazy Mountain Ranch Yellowstone Tour	YNP
	Tauck Winter in Yellowstone Tour	YNP
	Tauck Winter in Yellowstone Tour	YNP
	St. Monica High School (CA) Yellowstone field trip	YNP
	St. Monica High School (CA) Yellowstone field trip	YNP
	YAI class: Living History of Yellowstone Wolves	YNP
	Crazy Mountain Ranch Yellowstone Tour	YNP
	YAI class: Wolf Forensics	YNP
	The Wild Side Wildlife tours	YNP
February	University of Montana Western Roads Scholar: Yellowstone field trip	YNP
	YPF Board of Directors field trip	YNP
	University of Montana field trip	YNP
	Xanterra wildlife tour	YNP
	The Wild Side Wildlife Tours	YNP
	American Museum of Natural History Yellowstone Tour	YNP
	YAI class: The Wolves of Yellowstone	YNP
	Xanterra/YAI: Tour for Travel Writers	YNP
	Greater Yellowstone Coalition, wildlife watching trip	YNP
	Cody (WY) High School environmental science class	YNP
	The Wild Side Wildlife Tours	YNP
	Northwest Academy (Naples, ID) Yellowstone field trip	YNP
March	YAI class: Coyotes and Ravens	YNP
	Montana State University Graduate Studies field trip	YNP
	The Wild Side Wildlife Tours	YNP
	YAI class: Wolf Week	YNP
	Franklin and Marshall College (PA) wildlife conservation class	YNP
	Colorado State University student chapter of the Wildlife Society	YNP
	University of Iowa field studies in non-profit marketing class	YNP
	Franklin and Marshall College (PA) wildlife conservation class	YNP
	YAI class: Wolf Week	YNP
	Billings (MT) West High School Ecology Club	YNP
	University of Washington wilderness in the Pacific Northwest class	YNP
	Expedition Yellowstone class: Trevor Day School (New York City, NY)	YNP
	YAI class: Wolf Week	YNP
	Expedition Yellowstone class: Lame Deer (MT) Middle School	YNP
	Colorado State University student chapter of the Society of Conservation Biology	YNP
April	*Expedition Yellowstone* class: Saco Elementary School (MT)	YNP
	YA Naturalist Guide Certificate Program	YNP
	West Yellowstone (MT) Elementary School	YNP
	YA staff field trip	YNP
	YA staff field trip	YNP

Date	Group	Location
Rick McIntyre (cont.):		
	YA Naturalist Guide Certificate Program	YNP
	Expedition Yellowstone class: DeSmet (Missoula, MT) Middle School	YNP
	Expedition Yellowstone class: DeSmet (Missoula, MT) Middle School	YNP
	Billings (MT) Central Catholic High School: AP biology class	YNP
	College of Southern Idaho: Science and Literature of the Environment	YNP
May	North Summit and South Summit middle schools: Camus and Colville, UT	YNP
	Washington and Lee University (Lexington, VA) ecology class	YNP
	Longfellow (Bozeman, MT) Elementary School	YNP
	The Wild Side Wildlife Tours	YNP
	Rocky Mountain Academy (Denver, CO)	YNP
	YA new naturalist training	YNP
	Cody (WY) High School environmental sciences class	YNP
	Teton Science School graduate students field trip	YNP
	Rocky Mountain Experiential School (Denver, CO)	YNP
	YAI naturalist training group	YNP
	Natural Resources Defense Council Yellowstone field trip	YNP
	Expedition Yellowstone Class: Wyoming Indian School	YNP
	YAI class: Wolves of Yellowstone	YNP
	Greybull (WY) Elementary School	YNP
	Teton Science School graduate students field trip	YNP
	Greater Yellowstone Coalition Yellowstone field trip	YNP
	YAI: Spring wolves and bears tour	YNP
	Greater Yellowstone Coalition Yellowstone field trip	YNP
	YAI class: The Ecology of Fear: Wolves, Elk, and Trophic Cascades	YNP
	Xanterra naturalist training trip	YNP
	Houston (TX) Zoo, Yellowstone field trip	YNP
	YAI tour group	YNP
	YAI class: Behind the Scenes of Wolf Management and Ecology	YNP
	Whitman College (WA) class: Geology and Environmental Studies	YNP
	YAI class: Behind the Scenes of Wolf Management and Ecology	YNP
	Field tour for Emily Blanchard: graduate student at Duke University	YNP
	Wood River High School (Sun Valley, ID) AP biology class	YNP
	YAI class: Spring Babies	YNP
	YAI class: Wildlife Watching	YNP
	Field tour for employees of Yellowstone Wilderness Outfitters	YNP
June	California State at Channel Islands class: Science and Public Policy in YNP	YNP
	The Wild Side Wildlife Tours	YNP
	Casper (WY) College class: The Yellowstone Experience	YNP
	Ecology Project International staff training	YNP
	Field trip for US Fish and Wildlife Service biologist	YNP
	Casper (WY) College class: The Yellowstone Experience	YNP
	Wymore (NB) Southern High School	YNP
	US Forest Service Carnivore Management Conference	YNP
	Afton (WY) Middle School	YNP
	Gardiner (MT) School District field trip for elementary students	YNP
	Tower Fall store employees	YNP

Date	Group	Location
Rick McIntyre (cont.):		
	Rhodes College (TN) class	YNP
	Austin Lehman Tours training for new guides	YNP
	Rhodes College (TN) class	YNP
	North Carolina Museum of Natural History field trip for science teachers	YNP
	Project Yellowstone field trip for high school students, Statesville (NC)	YNP
	Introduction of Wolf Management, Ed Bangs at Silver Gate (MT)	YNP
	Ecology Project International (Wolf Point, MT)	YNP
	TBI Yellowstone tour group	YNP
	Youth Conservation Corp crew	YNP
	Austin Lehman tour group	YNP
	Project Yellowstone field trip for high school students, Statesville (NC)	YNP
	Eastern Washington University class: Research and Writing in the Field in Yellowstone	YNP
	Bend (OR) Science Station field trip	YNP
	Eastern Washington University class: Research and Writing in the Field in Yellowstone	YNP
	YAI: Spring Wildlife and Hiking Class/Woman's Wilderness Institute (Boulder, CO)	YNP
	Teton Science School graduate student	YNP
	Women's Wilderness Institute (Boulder, CO)	YNP
	Wild Rockies Field Institute	YNP
	Austin-Lehman tour group	YNP
	Plattsburgh (NY) Oak Street Elementary School Science Club	YNP
	Hallifax (MA) Girl Scout Troop	YNP
	Gannon University (PA) Ecology of Yellowstone class	YNP
	Ecology Project International (high school students: Oakland, CA)	YNP
	Tour for NPS Employee in the Teacher/Ranger/Teacher Program	YNP

Date	Group	Location
Rick McIntyre (cont.):		
July	California State University at Monterey Bay class: Wildland Studies	YNP
	YAI trip for Lima (OH) YMCA group	YNP
	Flying Pig tour group	YNP
	Ecology Project International (high school students, MT/ID)	YNP
	Summer Journey Yellowstone trip: Junior high school students (Grand Rapids, MI)	YNP
	Beckett (MA) YMCA Yellowstone tour	YNP
	Summer Journey Yellowstone trip: Grand Rapids, MI	YNP
	National Geographic Student Expeditions	YNP
	Teton Science School: high school field ecology	YNP
	Montana State University: Master of Science and Science Education students	YNP
	Maryland Audubon Naturalist Society	YNP
	Teton Science School: high school field trip	YNP
	University High School, Cleveland (OH)	YNP
	Ecology Project International (high school students: ID/WY)	YNP
	Arvada (CO) Girl Scout troop	YNP
	Woodlin High School (Walsenburg, CO) Summer Science field trip	YNP
	Austin-Lehman tour group	YNP
	Project Exploration (Chicago, IL, high school group)	YNP
	Houston Children's Hospital Cancer Survivor Group	YNP
	Erie (PA) Playhouse Yellowstone tour	YNP
	Ecology Project International (high school students)	YNP
	Dokkyo High School (Tokyo, Japan)	YNP
	Austin-Lehman tour group	YNP
	YNP visitors at Soda Butte Cone	YNP
	Wildlife Wonders Yellowstone trip (Girl Scout troop)	YNP
	Ecology Project International: Moses Brown High School (Providence, RI)	YNP
	State University of New York at Buffalo class: Ecology of Unique Environments	YNP
	State University of New York at Buffalo class: Ecology of Unique Environments	YNP
August	Wild kids Yellowstone trip	YNP
	YNP visitors: Death of wolf 822F	YNP
	Ecology Project International (College Students from China)	YNP
	National Geographic Expeditions	YNP
	Tour for wildlife biologist from Argentina	YNP
	Tour for new physician at Mammoth Clinic	YNP
	YNP visitors: Death of wolf 777M	YNP
	YAI: Defenders of Wildlife meeting	YNP
	Ecology Project International (high school students: ID/MT)	YNP
	Austin-Lehman tours	YNP
	Elderhostel Road Scholar tour	YNP
	Ecology Project International (high school students: Idaho/Montana)	YNP
	University of Wisconsin: Whitewater Yellowstone Studies class	YNP
	YAI: Wildlife watching private tour	YNP
September	YAI class: Forces of Nature: Wolves and Fire	YNP
	YNP visitors at Hitching Post lot	YNP

Date	Group	Location
Rick McIntyre (cont.):		
	YAI class: Fall Wolves and Elk	YNP
	Austin-Lehman Tour for Delegation (Nimbia, Africa)	YNP
	Tour for Two, USFWS biologist	YNP
	YNP visitors in Soda Butte Valley	YNP
	Brigham Young University (UT) class: Forest Management and Ecology	YNP
	Lethbridge College (Canada) class: Parks and Protected Areas Management	YNP
	Houston (TX) Zoo, Yellowstone field trip	YNP
	Tour for UCLA researchers and park visitors of a wolf acclimation pens	YNP
	University of Montana West Ecology class	YNP
	Upper Valley (Piqua, OH) Technical High School Yellowstone trip	YNP
	YAI class: Wolves of Yellowstone	YNP
	College of Idaho (Colville, ID): Ecological Economics class	YNP
October	YAI class: Fall Wolf and Elk	YNP
	Rocky Mountain School for Expeditionary Ecology (Denver, CO)	YNP
	Expedition Yellowstone class: Dubois (WY) Elementary School	YNP
	Star Lane School Yellowstone Association Tour (Casper, WY)	YNP
	University of Montana class: Field Techniques in Recreation Management	YNP
	YAI class: Fall Wolf and Elk	YNP
	Tour for Two NPS researchers from Grand Teton National Park	YNP
	Tour for Two NPS employees from Rocky Mountain National Park	YNP
	Panel discussion: "Wolf Watching and Habituated Wolves," Wolf Symposium	YNP
	Field trip for Wolf Symposium	YNP
	Montana Outdoor Science School Master Naturalist class	YNP
	North Dakota State University at Valley City class: Explorations of the Greater Yellowstone Ecosystem	YNP
	Expedition Yellowstone class: Cokeville (WY) Elementary School	YNP
	Society for Conservation Biology: Colorado State University Chapter	YNP
	Society for Conservation Biology: Colorado State University Chapter	YNP
	National Wolf Watcher Coalition Yellowstone field trip	YNP
	Wendt Advertising Yellowstone trip (website designers for YA)	YNP
November	Montana State University class: Yellowstone: A Scientific Laboratory	YNP
	YAI class: Writing in the Wild	YNP
	YAI class: Looking at Wildlife with a Scientist's Eye	YNP
December	Big Sky Youth Empowerment Yellowstone Trip (Belgrade, MT)	YNP
	YAI class: Wolf Week	YNP
	Wildlife Conservation Society Yellowstone Exchange Program for Chinese Natural Reserve managers	YNP
	Columbia University Ecotourism Yellowstone trip for Tibetan Leaders	YNP
	Field trip for National Park Service Long Range Planning Team	YNP
	International Nature and Outdoor Activities College: Yellowstone trip (visiting group, Japan)	YNP
	YAI class: Winter Wolf Discovery Tour	YNP
	Bushbuck tour group	YNP
	National Parks and Conservation Association	YNP
	YAI class: New Year's Wildlife Watching	YNP
	YAI class: Winter Wildlife Expedition	YNP
	Austin-Lehman tour group	YNP

Hans Martin working in winter conditions.

Date	Group	Location
Kira Quimby:		
May	Yellowstone Park Foundation board members	YNP
	Bozeman High School	Bozeman, MT
June	Junior Curators/Museum Education Instructors, Museum of Natural History	Bozeman, MT
July	YAI class: "Exploring Knowledge of Wolves"	YNP
August	University of Buffalo class: "Unique Environments"	YNP
September	YAI class: Roosevelt Rendezvous Session 1	YNP
	YAI class: Roosevelt Rendezvous Session 3	YNP
October	GYE Conference poster presentation	YNP
	Wolf Symposium talk/field trip	YNP
Matt Metz:		
May	Xanterra employees	YNP
	Xanterra employees	YNP
	Yellowstone Park Foundation board field trip	YNP
July	YAI class	YNP
	Youth Conservation Corps summer employees	YNP
August	NPS (Bert Frost and Elaine Leslie) field trip	YNP
October	Biennial Conference, Yellowstone Center for Resources	YNP
	The Wildlife Society Annual Conference	Portland, OR
December	YAI Instructors	YNP
Colby Anton:		
January	North Carolina Museum of Natural Sciences	YNP
February	University of Montana	YNP
	Yellowstone Park Foundation	YNP
	British Columbia Institute of Technology	YNP
March	YAI class: Wolf Week	YNP
	YAI class: Wolf Week	YNP
April	Association of Fish and Wildlife Agencies	YNP

Date	Group	Location
Caitlin Ruhl:		
September	Chinese Delegation	YNP
October	NPS (Ramona and Lee Bass) field trip	YNP
November	Bozeman High School shadow	YNP
Molly McDevitt:		
October	NPS (Ramona and Lee Bass) field trip	YNP
	North Dakota State University Yellowstone class	YNP
November	Bozeman High School shadow	YNP
Rebecca Raymond:		
March	Franklin and Marshall College	Lancaster, PA
	Marslov group	YNP
	School group	YNP
Hans Martin:		
July	University of Wisconsin–Whitewater students	YNP
September	YAI class: Roosevelt Rendezvous	YNP
December	YAI class: Wolf Week	YNP
	YAI class: Wolf Week	YNP
Josh Irving:		
February	British Columbia Institute of Technology	YNP
	New Mexico Wilderness Alliance	YNP
March	YAI class: Wolf Week	YNP

For further information regarding Yellowstone National Park's cultural and natural resources consider subscribing to our publication, *Yellowstone Science*, or visit *www.nps.gov/yellowstonescience*.