YELLOWSTONE WOLF PROJECT

ANNUAL REPORT
2010

Yellowstone Wolf Project

Annual Report
2010

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National Park Service
Yellowstone National Park
Yellowstone Center for Resources
Yellowstone National Park, Wyoming

YCR-2011-06

Suggested citation: Smith, D., D. Stahler, E. Albers, R. McIntyre, M. Metz, J. Irving, R. Raymond, C. Anton, K. Cassidy-Quimby, and N. Bowersock, 2011. Yellowstone Wolf Project: Annual Report, 2010. YCR-2011-06. National Park Service, Yellowstone National Park, Yellowstone Center for Resources, Yellowstone National Park, Wyoming.

All photos not otherwise marked are NPS photos.

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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 ended its predator control efforts, there were no gray wolf (*Canis lupus*) packs left in Yellowstone National Park.

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. National Park Service policy calls for restoring, where possible, 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 (GYA) was identified in the recovery plan as one of three areas where the recovery of wolf populations had a good chance of succeeding.

Following an extended period of public planning and input, wolf restoration to the GYA began in 1995, when 14 wolves were brought to the park from Alberta, Canada, held in acclimation pens for 10 weeks, and then released. Initial founder wolves, named for the geographic locales at which they were acclimated, were on Yellowstone's 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 GYA than was originally expected. In 2010, 20% of the approximately 478 wolves in the GYA occupied territories were located primarily within Yellowstone.

The US Fish and Wildlife Service (USFWS) has the primary responsibility for ensuring compliance with the Endangered Species Act and oversees the multi-state wolf recovery program. 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 are protected as an endangered species in all three states again.

Three full-time employees worked for the Yellowstone Wolf Project in 2010: Project Leader Douglas Smith and biological science technicians Erin Albers and Rick McIntyre. Daniel Stahler split time between graduate work at the University of California in Los Angeles and working in the park as a project biologist. Other paid and volunteer staff were Colby Anton, Nate Bowersock, Cheyenne Burnett, Kira Cassidy-Quimby, Kristen Clover, Caitlin Dodge, Allison Greenleaf, Josh Irving, Ryan Kindermann, Ky Koitzsch, Lisa Koitzsch, Matthew Metz, Regina Mossotti, Brendan Oates, Rebecca Raymond, LaRue Seitz, Dave Unger, Rachel Wheat, and Hilary Zaranek. Some of these staff members were paid technicians with funding provided by the Yellowstone Park Foundation.

Wolves reintroduced into Yellowstone were classified by the USFWS as "nonessential experimental" under section 10(j) of the Endangered Species Act and are 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 GYA would be preyed upon. The special rules contained provisions for addressing the possibility of conflicts with livestock.

To facilitate monitoring and research, Yellowstone National Park maintains radio collars in all wolf packs within the park. Wolf Project staff monitor population dispersal, distribution, reproduction, mortality, and predation on ungulates. 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.

2010 Summary

At the end of 2010, at least 97 wolves (11 packs and 6 loners) occupied Yellowstone National Park (YNP). This is nearly the same size population as in 2009 (96 wolves) and represents a stable population. Breeding pairs increased from six in 2009 to eight in 2010. The wolf population declined 43% from 2007 to 2010, primarily because of a smaller elk population, the main food of northern range wolves. The interior wolf population declined less, probably because they augment their diet with bison. The severity of mange declined in 2010 and there was no evidence of distemper being a mortality factor as it was in 1999, 2005, and 2008. Pack size ranged from 3 (Grayling Creek) to 16 (Mollie's) and averaged 8.3, slightly higher than in 2009 (7.1), but lower than the long-term average of 10 wolves per pack. Eight of the 11 packs reproduced (73%). The average number of pups per pack in early winter for packs that had at least one pup was 4.8, compared to the 2009 average of 3.8. A total of 38 pups in YNP survived to year end.

Wolf Project staff detected 268 wolf kills in 2010 (definite, probable, and possible combined), including 211 elk (79%), 25 bison (9%), 7 deer (3%), 4 wolves (1%), 2 moose (<1%), 2 pronghorn (<1%), 2 grizzly bears (< 1%), 4 coyotes (1%), 2 ravens (<1%), and 10 unknown species (4%). The composition of elk kills was 43% cows, 25% calves, 18% bulls, and 15% elk of unknown sex and/or age. Bison kills included 4 calves, 6 cows, 7 bulls, and 8 unknown sex adults. Intensive winter and summer studies of wolf predation continued.

Other research included population 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.

Eighteen wolves from eight packs were captured and collared during 2010. At year end, 28 of the 97 (about 30%) known wolves in the park were collared.

Wolf management activities included den site closures and four incidents of hazing habituated wolves, each of minor significance (yelling, horn blowing, etc.). Staff continued to manage wolf viewing areas in Slough Creek, Lamar Valley, and other places where wolves were frequently sighted. Wolf Project staff made 16,225 visitor contacts and counted about 38,000 people observing wolves; both figures were record highs for the program. Wolf Project public outreach included 248 talks (30% more) and 83 interviews (10% fewer).

Additional information on wolves in Yellowstone is available at www.nps.gov/yell/naturescience/wolves.htm, www.greateryellowstonescience.org, and www.westerngraywolf.fws.gov.

Wolf-provided carcasses benefit the scavenger community and affect the spatial and temporal dispersion of this food source.

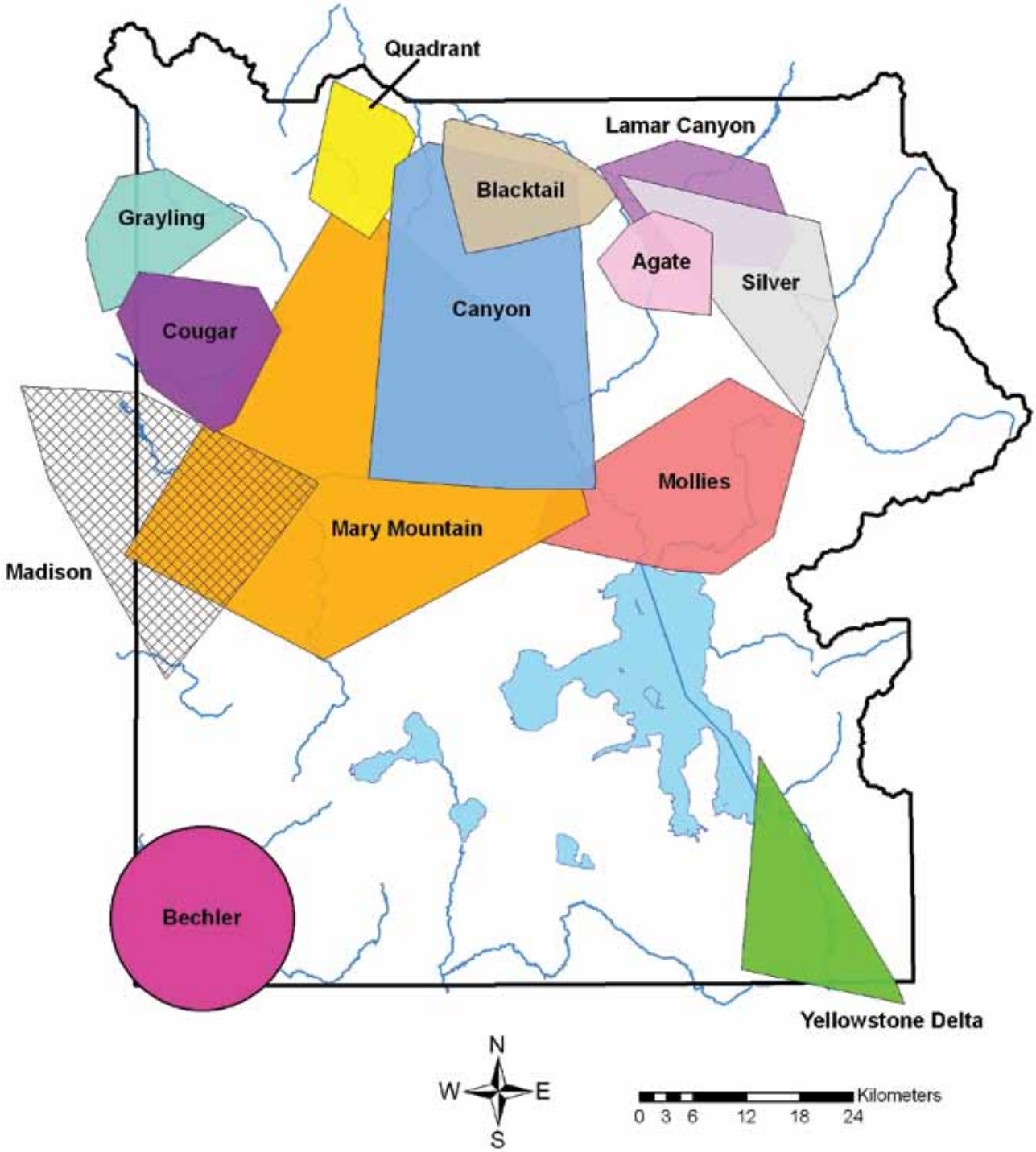

Figure 1. Wolf packs that had some or all of their territory within Yellowstone National Park in 2010.

By late summer, wolf pups, such as these in the Yellowstone Delta pack, can be hard to distinguish from adults.

The Yellowstone Wolf Population

Population and Territory Status

At the end of 2010, at least 97 wolves in 11 packs with 6 loners occupied Yellowstone National Park (YNP; fig. 1, table 1). This is nearly the same size population as in 2009 (96 wolves) and represents a stable population. The number of packs declined from 14 to 11, but breeding pairs increased from six in 2009 to eight in 2010 (table 1). There was no evidence of disease (e.g., distemper) impacting the population in 2010 and the severity of sarcoptic mange declined since peaking in 2008; its population affects are unknown.

The 2010 population consisted of significantly fewer wolves than the parkwide population peak in 2003 at 174 (fig. 2), a decline that was brought about by disease and food stress, and suggests a long-term lower population equilibrium for wolves, especially on the northern range. Northern range wolves have declined 60% since 2007 compared to a 23% decline for interior wolves during the same period. Northern range wolves are much more dependent on elk as a food source, whose population declined 70% since 1994, than are interior wolves that prey on elk and bison, both of which are still widely available in the park interior. Disease impacts have likely played a larger role in the wolf decline on the northern range because of its higher density of canids (wolves, coyotes, and foxes) than in the interior.

There were three fewer packs in 2010 than in 2009; six packs either dissolved or left YNP and two new packs formed (the Madison pack may have been present in

Table 1. Yellowstone National Park wolf population estimates, December 31, 2010

Pack	Adults	Pups	Total
Northern Range			
Agate	4	4	8
Blacktail	8	6	14
Lamar Canyon (formerly 755M Group)	3	4	7
Quadrant Mountain	7	0	7
Loners/Non-pack Wolves (470F and 692F)	2	0	2
Northern range total	24	14	38
Non-northern Range			
Bechler (no working radio collars in pack)	4	7	11
Canyon	3	3	6
Cougar Creek	4	0	4
Grayling	3	0	3
Mary Mountain (formerly 636M Group)	4	2	6
Mollie's	9	7	16
Yellowstone Delta	4	5	9
Loners/Non-pack Wolves	4	0	4
Non-northern range total	35	24	59
Yellowstone National Park total	59	38	97

Note: Underlining denotes official breeding pair packs.

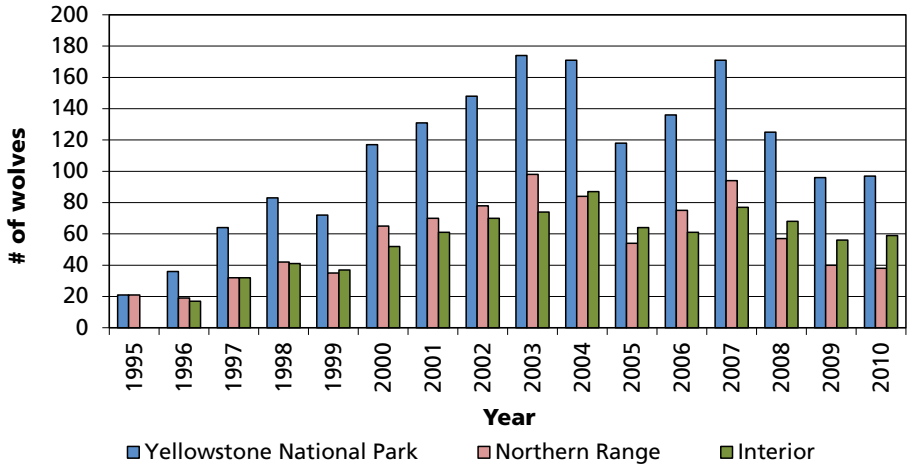

Figure 2. Yellowstone National Park nearly winter wolf population, 1995–2010.

Montana prior to 2010, see "Pack Summaries"). The Gibbon Meadows pack emigrated to the Centennial Mountains in Montana and Idaho and the Madison pack emigrated west of West Yellowstone, Montana. The Cottonwood Creek pack likely persisted north of the park (one known mortality from hunting), but was not monitored because none of the wolves were radio collared. Some sightings reported by Wolf Project staff indicated that they ranged north of YNP. The Druid Peak, Lava Creek, and Everts packs dissolved as a result of mortality or emigration. Two new packs formed in 2010: Lamar Canyon (7 wolves including pups), which settled mostly into the old Druid Peak and Slough Creek territories, and Mary Mountain (6 wolves including pups), which occupied Hayden Valley and the Nez Perce Creek region. Pack size ranged from 3 (Grayling Creek) to 16 (Mollie's) and averaged 8.3, slightly higher than 2009 (7.1), but lower than the long-term average of 10 wolves per pack.

Of the approximately 478 wolves in the greater Yellowstone area (GYA), 20% occupied territories located primarily in YNP.

Northern range. After a steep decline from 2007 to 2009 (57%), the northern range wolf population was stable in 2010. Though the population was stable, there was a high turnover of individuals and packs. Three packs dissolved (Druid Peak, Lava Creek, and Everts) and Cottonwood Creek, which was observed only occasionally by Wolf Project staff, likely moved north out of YNP. The Silver pack which formed in 2010, produced four pups, but they all died because of mange, food stress, and competition with other packs (two known intraspecific strife mortalities). The last pack member to be observed was the uncollared alpha female, in November, and it appears unlikely that she survived to the end of the year.

Four packs remained on the northern range from 2009: Quadrant Mountain, Blacktail, Agate Creek, and Lamar Canyon. Only the Quadrant Mountain pack did not have pups. At least two lone wolves were also present (#470F and #692F) on the northern range. A smaller elk population on the northern range could lead to fewer packs and wolves there in the future.

Interior. Wolf numbers in the park interior have been more stable than on the northern range, declining by 23% since 2007. Two packs emigrated from the park (Gibbon Meadows and Madison) and one pack formed (Mary Mountain). The Gibbon Meadows pack moved to the Centennial Mountains west of the park in April. The Madison pack moved west of West Yellowstone, Montana, in August. They were only sporadically tracked by non-park personnel (e.g., State of Montana staff). The Mary Mountain pack (6 wolves including pups) formed in the Gibbon Meadows territory and produced two surviving pups. One of the wolves that formed this pack, #636M, was radio collared when it was associated

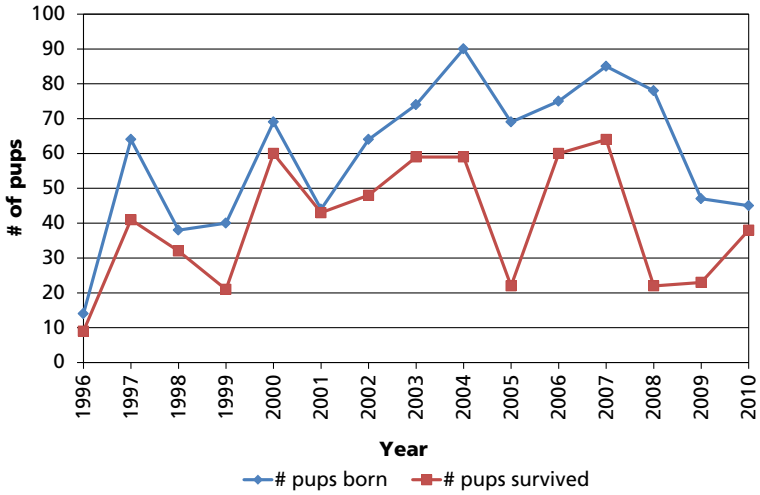

Figure 3. Yellowstone National Park pups born and survived, 1995–2010.

Emergence of bears from dens in late winter adds them to the list of scavengers in Pelican Valley, typically usurping carcasses from Mollie's pack.

with the Cougar Creek pack, making it possible to track this pack's movements. Grayling Creek, Cougar Creek, Canyon, and long-time Mollie's, Bechler, and Yellowstone Delta packs were stable. The Grayling Creek and Cougar Creek packs did not produce pups. The Canyon pack produced three surviving pups, which is low compared to other YNP packs, but higher than in previous years for packs in this territory (Canyon from 2008–present and Hayden from 2004–2007). There were few observations of the uncollared Bechler pack in 2010, but one monitoring flight spotted 4 adults and 12 pups in their territory in July (corroborated by ground observations), indicating that several females had reproduced. No other sightings were made the rest of the year so their December 31 pack size was estimated based on average YNP wolf survival rates. The Yellowstone Delta pack continued to range over a wide area, both in and out of the southeast corner of the park. Mollie's pack, one of the oldest in the interior, still occupied the Pelican Valley area and relied primarily on bison as a food source in winter. In addition to these pack wolves, there were at least four loners.

Reproduction

Eight (73%) of the 11 packs produced litters. Including pups from the Madison pack, 50 pups were born

Table 2. Confirmed mortalities of collared Yellowstone National Park wolves, 2010

Wolf #/Sex	Age Class	Pack	Date of Death	Cause of Death
691F	Adult	Druid Peak	1/23/2010	Intraspecific
756F	Adult	Druid Peak	2/12/2010	Intraspecific
761F	Adult	Druid Peak	2/21/2010	Natural unknown
482M	Old adult	Gibbon Meadows	2/27/2010	Natural unknown
480M	Old adult	Loner, formerly of Druid Peak	3/1/2010	Natural unknown
383M	Adult	Dispersed to Slough from Agate Creek	3/10/2010	Disease/malnutrition
753F	Yearling	Silver	8/6/2010	Interspecific
SW147M*	Adult	Silver	10/31/2010	Intraspecific
472F	Old adult	Agate Creek	12/1/2010	Intraspecific
Total number of deaths of collared wolves			9	

* SW147M was originally collared by the State of Montana north of Yellowstone National Park, hence the southwest Montana nomenclature "SW147M."

A field crew sets out to retrieve the carcass wolf #472, a long-time member of the Agate Creek pack.

in YNP (total for packs that remained in YNP at year end was 45), and 38 (84%) survived through early winter (fig. 3). This was significantly more surviving pups (+39%) than in 2009. Of packs that had pups, the average number of pups per pack at year end was 4.8. The Madison pack's pups that were born in the park are not included in the year-end total because they moved to Idaho where they remained the rest of the year.

Mortalities

Nine collared wolves died during 2010 in YNP. Four wolves died from intraspecific strife (45% of deaths), three from natural or unknown causes (33%), one from interspecific strife (killed by a bison, 11%), and one from disease or malnutrition (11%). The high mortality from wolf–wolf strife continued from 2009 probably indicates food stress among wolves and is corroborated by a steep population decline on the northern range from 94 wolves in 2007 to 38 at the end of 2010. Disease, primarily distemper and possibly mange, has also played a role in the population decline.

Pack Summaries

Northern Range Packs

Agate Creek Pack *(8 wolves: 4 adults, 4 pups)*

Turmoil and turnover marked the breeding season for this northern range pack. At the outset of 2010, the pack consisted of nine-year-old alpha #472F, her daughter #715F, and an uncollared black male. However, dispersers from Mollie's pack (#641M and #586M) arrived in Agate Creek territory during the breeding season to challenge the uncollared black male. Following an intense fight, #641M ousted the uncollared black male (who returned to Blacktail Deer Plateau pack later in the year) and became the new alpha. Together with #586M he revived the Agate Creek pack. During the denning season, both females localized. Four pups of unknown maternity were produced (two black, two gray) and all four survived to year end. Sometime in the fall, an uncollared gray adult joined the pack, most likely a young Mollie's disperser. In early December, long-time alpha female #472F was found dead in the Lamar River near its confluence with Slough Creek. Evidence suggests she was killed by members of the Blacktail Deer Plateau pack, which may have included her daughters #693F and #642F. Originally born in the Druid pack in 2001, #472F was one of the oldest females in the park and leaves behind a significant legacy on the northern range.

Blacktail Deer Plateau Pack
(14 wolves: 8 adults, 6 pups)

With 14 wolves, the Blacktail Deer Plateau pack was the largest pack on the northern range. Led by alphas #693F and #778M (collared in 2011), the Blacktail Deer Plateau pack traveled widely from Specimen Ridge to Crevice Mountain, interacting with each pack on the northern range. Two downloadable GPS collars (on #642F and #752F) were used to understand summer

Close to a cliff and hard to spot, the Agate Creek pack feeds on a dead elk.

Key females (642F, 692F, and 693F) of the Blacktail Deer Plateau pack rally.

and winter foraging patterns of wolves on the northern range. Wolves #693F, #642F, and #692F each denned in separate areas, but all eventually moved to a former Leopold pack den on Blacktail Plateau. They had a total of six surviving pups of unknown maternity. Wolf #692F dispersed in early October, presumably from mounting tension with alpha #693F. An uncollared adult male returned to the pack in early June after his short-term tenure as alpha male in the Agate Creek pack during the breeding season. He was overthrown in a fight with Agate Creek's current alpha, #641M. Some of the Blacktail Deer Plateau wolves that showed signs of mange earlier in year appeared to have recovered while new individuals were infected at the end of 2010.

Druid Peak Pack *(0 wolves)*

The Druid Peak pack collapsed in late 2009 and early 2010, possibly due to the loss of long-time alpha female #569F and an infestation of mange affecting all pack members. In early 2010, the pack split into several groups and survived largely through scavenging from kills by other packs. Three-year-old #691F was attacked by the Silver pack and died under one of the Lamar Buffalo Ranch Yellowstone Association Institute cabins, while the two-year-old, "Thin Female," was fatally wounded while scavenging a Blacktail Deer Plateau pack carcass. Three-year-old "White Line" (761F) fought with the Lamar Canyon alpha female at a kill site and was later killed in the same area, possibly by wolves or a mountain lion. Several other Druid Peak wolves disappeared during this time, including #571F and two yearling males. The last collared Druid Peak member, yearling #690F, dispersed to Butte, Montana, where she was legally shot and killed near livestock. The last known sighting of a Druid Peak pack member ("Dull Bar", female) occurred in the Hellroaring drainage in late winter with a group of wolves suspected to be from a pack north of the park. Alpha #480M dispersed from the others in late 2009, and his decomposed body was found near the Hellroaring drainage (unknown cause). The Druid Peak pack had exceptional longevity and their legacy lives on in many of today's packs.

Lamar Canyon Pack *(7 wolves: 3 adults, 4 pups)*

The Lamar Canyon pack was formed after the dissolution of the Druid Peak pack in February 2010 and quickly occupied the northeast corner of the park. Led by an uncollared gray female, "06 Female," this pack flourished immediately. Brothers #755M (alpha) and #754M were the only other adults. The pack's territory encompassed the Slough Creek drainage and the northern section of the Lamar Valley from late January to late fall. However, they quickly moved into territory previously occupied by the Silver pack in early winter and ranged throughout the Lamar Valley and east to Silver Gate, Montana. The pack used a former Slough Creek pack den site and produced four gray pups, the first litter by 06 Female. By the end of the year, the pack was primarily observed in the Lamar Valley and interacted several times with the neighboring Agate Creek pack, including one incident when all seven Lamar Canyon pack members attacked and injured Agate Creek beta male #586M. All three Lamar Canyon adults were observed with varying degrees of mange at the end of 2010.

SUE WARE

Wolf #204M, a Swan Lake Pack disperser, was killed by other wolves. There is a bite wound on the right frontal bone of the skull and the muzzle area is porous with infectious lesions resulting from this injury.

Stories from the Bones

by Sue Ware

Since their reintroduction to Yellowstone National Park in 1995, gray wolves (*Canis lupus*) have been carefully documented by scientists, staff, volunteers, visiting researchers, and recreational wolf watchers. The wealth of data collected from these studies, including the skeletal remains of wolves, are curated at the Yellowstone National Park Heritage and Research Center in Gardiner, Montana. Using these skeletal remains, I study the impact of pathology (any deviation from a healthy, normal, or efficient condition) on the life and behavior of individual wolves and pack dynamics. Each set of remains tells a story about the wolf's life and death; the pathology of the bones allows us to observe how disease and injury impact each individual. With investigation, the remains can reveal the cause and circumstances of a wolf's death, and insights to its behavior and health during its life.

Pathology can contribute to our understanding of behavior, pack dynamics, predator–prey relationships, and the species' struggle for survival. By studying a skeleton's pathology, I can determine the degree of impact that trauma and disease had on an individual. To reveal each wolf's story, I examine its remains (84 sets, so far) for evidence of disease or injuries sustained during life and develop a pathology of the skeleton. During my examination of individual bones, I take photographs and measurements and enter the data into a database for comparison with other wolf populations in the United States. I couple this data with information from visual field observations, photographs, and videos collected by the Wolf Project to investigate the injuries a wolf may have sustained during its lifetime. The observations of injuries that I make while constructing the pathology often cannot be made while an individual is alive.

The pathological changes in a skeleton let us take a retrospective look at some of the major life events for a wolf. Early in my study, my examination of the skulls and other bones revealed that there is a wide range of medical conditions among the Yellowstone wolf population, ranging from mild to severe cases of damaged bones (e.g., metatarsals, ribs, and teeth). These conditions provide clues about the overall health of an individual wolf. I can confirm a wolf's age by examining the stages of tooth eruption and wear, the suture closures in the skull (fibrous joints found in the skull—the squiggly lines running down the top of the skull), and the fusion of the long bones (bones that are longer than they are wide—leg bones for wolves). Other aspects of a wolf's life can be observed by looking for clues on the skull. This includes bite marks which can tell us about altercations with other wolves or other species such as cougars or bears. Fractures and infections are often observed on the bones in the form of large holes, the presence of extra bone, bone spurs, or changes in a bone's appearance. Dental abscess-

es, periodontal disease, broken teeth, and teeth that are rotated in the upper and lower jaw indicate changes and damage to the skull and jaws, often as the result of interactions with its prey species. Through my research, I have observed that one of the most life-threatening conditions is re-injury.

The pathological changes I have observed in the Yellowstone wolf skeletal remains demonstrate that disease, injuries, and stress are all part of making a living as Yellowstone's top predator and each takes its toll on wolves. Damage to a wolf's face and mouth can make its life more difficult, especially when teeth are broken, damaged, or missing. Wolves use their teeth to bring down prey, travel long distances, and fight for territory against other wolves, missing and damaged teeth can greatly alter or impair a wolf's ability to perform these daily tasks. When a wolf cannot perform its daily tasks, its status and position in the pack is threatened and the wolf may be ostracized or killed.

During the pathology I conducted for wolf #8M, alpha male of the Rose Creek Pack and seven-years-old when he died of natural causes, I observed that his skull showed the effects of aging, including tooth loss and damage to his remaining teeth. His canine teeth are loose and blunted and the muzzle area of his skull is soft, porous, and shows the effects of advanced osteomyelitis, a bone infection. An infection of this magnitude is systemic and causes cardiac disease, tooth loss, internal organ damage, and severe pain. I coupled this data with the Wolf Project's visual observations and learned that while enduring these conditions, #8M led his pack as the alpha male (no other males had challenged his status) in the successful pursuit of elk (not as an observer, but as an active participant) the week before he died. A field observer noted that he was severely kicked by the elk during the pursuit.

Wolf #8M was riddled with infection, had damaged and loose teeth, suffered a kick by an elk, and was most likely in severe pain, but still led his pack through successful hunts.

I also constructed a pathology for wolf #21M, a popular Druid Peak pack alpha male. This study revealed he had sustained a serious injury to the top of his skull at one time. He was also affected by his age (9 years old at death), as his teeth were worn and cracked. Although his skull and teeth were damaged, he appeared to survive quite well and perform as the alpha male until his death.

Wolf #483F in the Leopold and Geode Creek packs sustained severe damage to the top of her skull. The pathology revealed that she sustained attacks by two different species, a wolf and, likely, a cougar (bite measurements are consistent with a female cougar). The wounds show a degree of healing, indicating she survived these two attacks; however, this wolf died most likely from a brain infection resulting from these encounters.

These are only a few of the "bone stories" from the Yellowstone wolves. As I study these animals, I am aware that although many of the wolves I have studied were well-known by field observers during their life, each has another interesting story to tell after death. The bones help augment our understanding about the wolves during their lifetimes, telling the dramatic story about this keystone predator in Yellowstone.

Sue Ware *is a paleopathologist (scholar of ancient diseases) and osteologist (scholar of bones) with the Denver Museum of Nature and Science. She has been a visiting scholar with the Wolf Project since 2008.*

SUE WARE

Wolf #42F, an alpha from Druid Peak pack, was killed by other wolves. The injuries she sustained are concentrated in the soft tissues and bones of her body, not her skull, which only showed the effects of aging such as worn, broken, and missing teeth.

A typical summer scene in Yellowstone: a grizzly bear is in control, ravens steal tidbits, and wolves are off to the side after making the kill.

Lava Creek Pack *(0 wolves)*

The three members of the short-lived Lava Creek pack went their separate ways during the 2010 breeding season. Alpha male SW#147M, originally from Montana's 8-Mile pack, took over the alpha position of the Silver pack, while the uncollared gray female ("06 Female") joined two black males to form the Lamar Canyon pack. The dominant Lava Creek female and former Agate Creek wolf, #471F, was observed occasionally with former Everts pack alpha male #685M, as well as with males from the Canyon pack. However, #471F has not been located since June—her collar was over five years old and the battery may have run out.

Quadrant Mountain Pack *(7 adult wolves)*

The Quadrant Mountain pack was stable in both pack size and territory use this year, consisting of 4 adults and 3 yearling females. Based on field observations, Wolf Project staff concluded there was a shift in female leadership, with the black uncollared adult female becoming dominant over former alpha #469F. Both females localized at different den sites, but pups were never observed and it is unclear why the pack failed to reproduce. High snowpack during early winter in the Quadrant Mountain pack's core territory drove ungulate species to lower elevations earlier than in previous winters. Consequently, territory use shifted slightly from Gardner's Hole and the surrounding drainages, with the pack spending more time in the lower elevations east of Sepulcher Mountain, Reese Creek, and the Gardiner Basin. The Quadrant Mountain pack continued to appear healthy and no members of the pack showed signs of mange.

Silver Pack *(Unknown)*

For several years prior to 2010, a group of uncollared wolves were occasionally observed in the Pebble Creek area. They were known as the Silver pack, due to the distinct silver color of the alpha female, suspected to have originated from a northern range pack. In the fall of 2009, a group of four wolves was observed regularly in the Lamar Valley and as far west as Hellroaring Slope. As the Druid Peak pack declined and disappeared, the Silver

A bull elk kill in early winter made by the Quadrant Mountain pack.

The old gray female (#469) in the Quadrant pack.

A lone Gibbon wolf gives up.

wolves quickly took over this recently vacated territory and became the principal pack of this historically productive region. In early 2010, SW#147M left the Lava Creek pack and inserted himself as the alpha male in the Silver pack, where he was seen mating with both the alpha and beta females. SW#147M allowed the former alpha male, a large uncollared gray, to stay with the pack—a behavior rarely observed in the wild. The pack denned in the Lamar Valley and had four pups, all of whom disappeared in late summer and likely died due in part to mange. In August, yearling #753F died, probably from a fatal encounter with a bison. Two months later SW#147M was found dead from intraspecific mortality. The alpha female was last seen alone in early November with severe mange, and the status of the other adults is unknown.

Non-northern Range Packs

Bechler Pack *(Estimated 11 wolves: 4 adults, 7 pups)*

The information about this pack is derived from exploratory aerial searches and reports from park staff working in the Bechler region because the pack does not have functioning radio collars. A mid-summer flight over the pack's traditional den area yielded a count of 12 pups with several adults, suggesting that multiple females gave birth. We suspect a collared black female observed with the pups is #545F and likely one of the breeders. Wolf #545F was first collared with the pack as a pup in 2006 and was last located in 2007. We now believe she has lived with the pack since her last location, unnoticed and with a malfunctioning collar. Throughout the last several months of the year, little information was available on the Bechler pack and counts represent best estimates of pup survival. Sightings and reports of howling, wolf kills, and other sign throughout their traditional territory confirmed that the Bechler pack persists in this unique area of the park.

Canyon Pack *(6 wolves: 3 adults, 3 pups)*

The Canyon pack finally had its first productive year by raising three pups to year end. The pack spent the first part of the winter hunting elk in the Mammoth Hot Springs area, and acted as if they would den in the area. However, park management removed multiple carcass and hazed the pack out of developed areas, and the pack moved to Canyon where they settled near the old Hayden pack's den. For the remainder of the summer

Blood on the face of this Canyon pack wolf means a fresh kill.

Mollie's pack in Pelican Valley faces a seemingly insurmountable challenge.

Yellowstone Delta pups hop for a regurgitation.

and fall, the pack was observed routinely near the pack's rendezvous site in Hayden Valley, offering great viewing for park visitors. At year end, the pack became nomadic again and moved back north into the Mammoth Hot Springs area to hunt elk. Despite the pack's occasional use of road corridors and developed areas, they never showed signs of actively approaching people.

Cougar Creek Pack *(4 wolves: 4 adults, 0 pups)*

Rarely straying from their traditional territory in the northwest corner of YNP, the Cougar Creek pack existed as a nuclear family in 2010 comprised of alphas #478F and #689M and their two yearling offspring born in 2009. Regular aerial observations of this small pack found them continuing to use bull elk as a food source throughout their territory. We observed a complete hunting sequence during summer that demonstrated all four wolves were well-versed in hunting bulls, including seven-year-old #478F, who made the final neck lunge despite her age. No pups were observed following a short localization at a traditional den site. While the cause of failed reproduction is unknown, female age, small pack size, and disease may be possible factors.

Gibbon Meadows Pack *(Unknown)*

After being one of the largest packs in the park for several years, the Gibbon Meadows pack left YNP in April for Montana's Centennial Valley, west of the park. This dispersal may have been triggered by the loss of key older wolves, including the deaths of alpha female #537F in late 2009 and of nine-year-old #482M in February. Genetic analysis revealed that the long-term breeder and possible alpha in Gibbon Meadows was not #482M, but his older brother, #258M (uncollared since 2002 when it slipped off). Both males were born in the Cougar Creek pack and believed to be original founders of the Gibbon Meadows pack. Once the pack left the park, tracking the three collared wolves (two-year-old #688M and newly collared 2009 pups #768F and #769M) became difficult and very little was known about pack size, presence of breeding pair, or territory use for the rest of the year. We suspect that some pack members remained in the park to form the Mary Mountain pack, while evidence from State of Montana biologists monitoring wolves outside of YNP suggests the pack did not remain a cohesive group.

Grayling Creek Pack *(3 wolves: 3 adults, 0 pups)*

In their second year of existence, the small Grayling Creek pack traveled the northwest corner of the park, frequently visiting the Grayling Creek drainage and the heavily timbered drainages west of Highway 191 along the park boundary. For 2010, the pack consisted of three wolves: alpha male #647M and two unknown uncollared black wolves. Due to the burned and unburned forest habitat of their territory, this pack was difficult to collar via helicopter darting and regularly observe with aerial monitoring. Consequently, we do not know who the other two pack members are and whether either was a female with whom #647M could have mated in 2010.

Madison Pack *(13 wolves: 8 adults, 5 pups)*

Although Montana State University researchers suspect this pack formed years ago, the Madison pack was much more visible in 2010, enabling us to collar two

of them in March. They were then tracked to a den site where they produced five pups. They ranged mostly between West Yellowstone, Montana, and Madison Junction. In August, the pack abruptly left the park and settled in Idaho west of West Yellowstone, where we were able to locate them much less frequently, but they still resided there at the end of 2010. Although present in the beginning of 2009 in YNP, they were not counted as one of the packs in the park.

Table 3. Yellowstone Wolf Project collaring operations, 2010

Date of capture/ Death	Wolf #/Sex	Age class	Pelt color	Pack
2/20/2010	478F	Adult	Black	Cougar Creek
2/3/2010	642F	Adult	Black	Blacktail
2/21/2010	661M	Adult	Black	Yellowstone Delta
2/3/2010	692F	Adult	Black	Blacktail
2/3/2010	693F	Adult	Gray	Blacktail
2/3/2010	752F	Pup	Black	Blacktail
2/3/2010	753F	Pup	Gray	Silver
2/4/2010	754M	Yearling	Black	755M Group
2/4/2010	755M	Yearling	Black	755M Group
2/20/2010	757F	Pup	Black	Cougar Creek
2/20/2010	758M	Pup	Black	Mollie's
2/20/2010	759F	Pup	Gray	Mollie's
2/21/2010	760M	Adult	Gray	Yellowstone Delta
3/8/2010	762M	Adult	Black	Madison
3/8/2010	763F	Yearling	Gray	Madison
3/24/2010	768F	Pup	Gray	Gibbon Meadows
3/24/2010	769M	Yearling	Gray	Gibbon Meadows
2/3/2010	SW147M	Adult	Black	Silver

Mary Mountain Pack *(6 wolves: 4 adults, 2 pups)*

During the breeding season, a dispersing Cougar Creek male #636M ventured into the Gibbon Meadows pack's territory in the Firehole–Madison region and joined up with several wolves suspected of being young Gibbon Meadows females. Following the spring departure of the remaining Gibbon Meadows wolves to areas west of the park, #636M's group settled into this territory and became the Mary Mountain pack. Only one wolf was collared and observation attempts throughout the summer were unsuccessful at identifying the breeding female, locating a den, or obtaining a high count of pups. However, by September we had observed up to six adults and two pups ranging from Hayden Valley to Sentinel Meadows, confirming the presence of a new breeding pair and pack resulting from the mixing of Cougar Creek and Gibbon Meadows bloodlines.

Mollie's Pack *(16 wolves: 9 adults, 7 pups)*

Mollie's pack was the largest pack in 2010 with 16 members at year end. After localizing at a traditional den site in Pelican Valley, #486F produced a litter of seven pups who all survived to year end. Pack movements for the year were centered in Pelican Valley but radiated outward into Hayden Valley and, occasionally, portions of the northern range. Bison groups that remain in Pelican Valley during winter were, once again, a vital food resource for this pack as high snowpack pushed elk out of the pack's core territory. No Mollie's wolves showed signs of mange in 2010, a tremendous recovery as they were badly infected two years earlier. Wolf–bison–grizzly interaction studies in Pelican Valley continued for the 13th year.

Yellowstone Delta Pack *(9 wolves: 4 adults, 5 pups)*

Although difficult to monitor due to the remoteness of their territory, the Yellowstone Delta Pack still thrives in the Thorofare region. Two new adult males (#661M and #760M) were captured near the Trident in late winter. Wolf #661M was originally collared as a yearling in Wyoming's South Fork pack east of the park in 2008, eventually dispersing into the park with his brother #760M and joining the two known remaining Delta females, #633F and likely #575F (suspected but not confirmed due to a non-functioning collar). The pack produced five pups which all survived to year end, but with several showing signs of mange (the first observation of mange for this pack). Given that the litter was all gray and our knowledge of coat color inheritance, we suspect the breeders of the pack to be #760M and #575F, both of which are gray.

Wolf Capture and Collaring

In 2010, 18 wolves in six packs were captured and collared. At year end, 28 of the 97 (29%) known wolves in the park were collared (table 3), including 8 adults (none of them old), 4 yearlings, and 6 pups; 8 males and 10 female. Both VHF and downloadable GPS collars were deployed. Which collars were placed on which wolves depended on monitoring objectives, but VHF collars were still the most commonly used.

Blacktail Deer Plateau pack consumes a freshly killed bull elk.

Wolf Predation

Wolf–Prey Relationships

Wolf–prey relationships were documented by observing wolf predation directly and by recording the characteristics of wolf prey at kill sites. Wolf packs were monitored for two winter-study sessions in 2010 during which wolves were intensively radio-tracked and observed for 30-day periods in March and from mid-November to mid-December. The Agate Creek (November–December), Blacktail Deer Plateau (March and November–December), Lamar Canyon (March and November–December), Quadrant Mountain (March), and Silver (March) packs were the main packs monitored by three-person ground teams. In both winter studies, crews monitoring the Quadrant Mountain pack switched to monitoring the Lamar Canyon (March) and Agate (November–December) packs due to difficult monitoring logistics. All packs were monitored from aircraft. The Canyon, Cougar Creek, Grayling Creek, Madison River, Mary Mountain, Mollie's, and Gibbon Meadows packs were monitored from aircraft only. The Yellowstone Delta and Bechler packs were rarely located due in part to their absence from the park, poor conditions for aerial monitoring, and lack of radio collars (Bechler).

The summer predation study used data from downloadable GPS collars on wolves from the Blacktail Deer Plateau pack (see "Summer Predation") to understand summer predation patterns. During these established predation studies as well as opportunistically throughout the year, project staff recorded behavioral interactions between wolves and prey, predation 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.

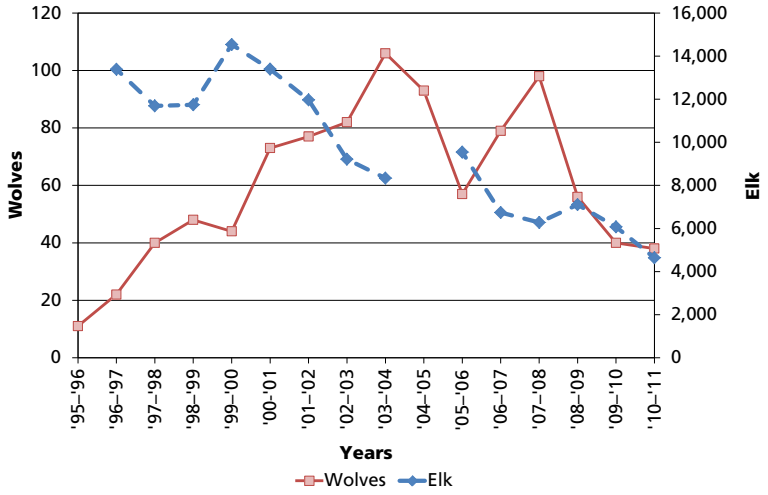

Figure 4. Yellowstone National Park northern range elk–wolf population, 1995–2010.

Composition of Wolf Kills

Project staff detected 268 kills (definite, probable, and possible combined) made by wolves in 2010, including 211 elk (79%), 25 bison (9%), 7 deer (3%), 4 coyotes (1%), 4 wolves (1%), 2 moose (<1%), 2 pronghorn (<1%), 2 grizzly bears (<1%), 2 ravens (<1%), and 10 unknown prey (4%). The composition of elk kills was 25% calves, 43% cows, 18% bulls, and 15% elk of unknown sex and/or age. Bison kills included seven bulls, six cows, four calves, and eight adults of unknown sex.

Given the ecological significance and controversy surrounding wolf impacts on ungulate populations, wolf and elk interac-

Deep in the heart of Yellowstone, Wolf Project staff take notes about Delta wolf 760M.

You need to be tough—winter study November 2010.

tions continue to be a primary focus of predation studies in YNP. Since wolf reintroduction, the northern range elk population has declined approximately 50% with wolves being one of the factors. Other factors include other predators, management of elk outside YNP, and weather patterns (e.g., drought, weather severity) that influence forage quality and availability, ultimately impacting elk condition. Consequently, changes in prey selection and kill rates through time result from complex interactions between these factors, particularly the link between wolf and ungulate population dynamics and seasonal weather patterns. For example, wolves selected primarily elk calves during the November–December predation study and bull elk in March, likely because of their relative availability and condition during those seasons. In contrast to recent non-drought years, we propose that winter and summer precipitation in 2010 contributed to the greater availability of elk calf and fewer vulnerable bull elk in early winter due to forage quality. Collaborative research with Dr. Chris Wilmers at University of California, Santa Cruz, will evaluate this hypothesized link between climate, forage quality, and predator–prey dynamics. When examined, however, not as number of elk killed per wolf but as biomass consumption (kg/wolf/day), kill rates have remained relatively stable since 1995.

Winter Studies

March. During the 30-day March study, wolves were observed for 307 hours from the ground. The number of days wolf packs were located from the air ranged from 4 (Yellowstone Delta) to 19 (Agate Creek, Blacktail Deer Plateau, Canyon, Lamar Canyon, Mollie's, and Silver). Air and ground teams located a total of 36 carcasses that wolves had fed on (25 elk, 7 bison, 1 moose, and 3 unknown species). Among the elk, 12 (48%) were bulls, 7 (28%) were cows, 5 (20%) were calves, and 1 (4 %) was of unknown sex and age. In addition, two bison and two unidentifiable ungulates were killed by wolves. Most of the carcasses were wolf kills; seven were winter-killed ungulates (5 bison, 1 elk, and 1 moose). Documenting the consumption of biomass from ungulates not killed by wolves is important in explaining variation in kill rates through time. Lower than expected kill rates, particularly for larger wolf packs, can sometimes be explained by increased scavenging of winter-killed ungulates in the spring.

November–December. The 2010 study was characterized by extreme weather conditions during much of the study, including heavy snowfall, cold temperatures, and high winds. Data collection by field crews, and

Colby Anton on early morning duty.

It takes all kinds.

particularly the air crew, was challenging, and only four flights (a record low) could be made during the 30-day study, locating the Agate Creek, Blacktail Deer Plateau, Cougar Creek, Grayling Creek, Mollie's and Mary Mountain packs. However, wolves were observed for 207 hours from the ground, and a total of 26 ungulate carcasses used by wolves were discovered by air and ground teams. These carcasses, which were mostly wolf kills, with some other natural and human-caused mortalities that wolves scavenged on, included 22 elk, 2 bison, 1 mule deer, and 1 big horn sheep. Of the 19 wolf-killed elk, there were 8 calves (42%), 8 cows (42%), 1 bull (5%), and 2 (11 %) of unknown sex and age. Wolves also scavenged four ungulates (2 elk, 2 bison) that died from non-predation natural causes and one road-killed elk.

GPS Collars and Winter Predation. The Wolf Project began to incorporate GPS clustering methodology during the November–December 2009 study to better understand if ungulates killed by wolves are missed via our traditional monitoring methods (aerial and ground). If so, we seek to understand what factors (e.g., prey size, time of day kill is made) are most likely to lead to not detecting a kill via ground or aerial observation and why kills may not be detected by GPS clusters. Ultimately, combining GPS clustering methodology with our traditional methods of detecting kills may allow for the most complete assessment of prey composition and kill rate.

During both the March and November–December study periods of 2010, we continued to search clusters of GPS locations. During March, project staff searched clusters created by Blacktail Deer Plateau wolves #642F and #752F. Most kills during March were found by both GPS clusters and our traditional methods. The few kills that were missed by our traditional methods were typically made on days when the ground crew was unable to obtain a visual observation of the Blacktail Deer Plateau pack and the fixed-wing airplane could not fly. By November, we were only able to download the GPS locations from #642F (although #752F was still present, her GPS collar malfunctioned). We were unable to adequately search #642F's GPS clusters from the first 10 days of winter study because extremely large amounts of snowfall covered any wolf sign or potential carcasses. However, we were able to search the clusters created during the final 20 days of winter study. Through these searches, we determined that both our traditional methods and GPS clusters missed a few kills. This November–December winter study represents the first period where kills were occasionally missed through GPS clustering methodology. A possible explanation for this is that the Blacktail Deer Plateau pack consisted of 14 wolves during the November–December winter study, and larger packs tend to spend less time feeding from a carcass. In order to further investigate the value of GPS clustering methodology, the Wolf Project plans to continue this aspect of winter study in 2011.

Summer Predation

Beginning in 2004, the Wolf Project began using GPS clustering methodology to assess the predation patterns of wolves during summer (May 1 to July 31). In 2010, we searched GPS clusters of Blacktail Deer Plateau wolves #642F and #752F to further understand how and why the predation patterns of northern range wolves differ among seasons. Through these searches, we found 54 suspected kills or fresh carcasses (48 elk, 2 deer, 2 bison, 1 pronghorn, and 1 unknown species). Accordingly, 89% of the ungulates fed upon by wolves from May 1 to July 31 were elk, which is similar to previous years. Among elk, 48% were neonate calves and 38% were cows. The remaining 14% of elk carcasses were bulls and 11- to 13-month-old elk. As was observed in 2009, the Blacktail Deer Plateau pack used less bull elk than the Leopold pack (which resided in this area until it dissolved in

Mangy wolves taking time out to scratch.

2009). It is unknown why these packs have had such different patterns of prey composition while residing in the same general territory during the summer.

Population Genetics

Collaborative efforts between the Wolf Project and the University of California, Los Angeles (UCLA), continued in 2010. Dan Stahler attended UCLA for his last graduate quarter in the spring, and continued collecting data in the YNP population throughout 2010 for his dissertation. In May, Stahler and Smith became collaborators on a National Science Foundation grant awarded to co-principal investigators Dr. Robert Wayne and Dr. John Novembre at UCLA that aims to further understand the evolutionary and ecological dynamics of coat color in wolves. Previous work has shown that black wolves get their dark coat color from a genetic mutation that first occurred in dogs, and was likely introduced and selected in wild wolf populations following successful mating with dogs that came into North America with humans thousands of years ago. Given that the frequency of both gray and black wolves in YNP is roughly equal, it has been hypothesized that there are fitness trade-offs associated with the gene responsible for coat color. Current research aims to evaluate fitness and health differences relative to coat color, and how this contributes to the maintenance of this polymorphism.

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

Disease

Research on disease in the YNP wolf population is ongoing. Our most active area of disease research in 2010 was on sarcoptic mange (or "scabies"), an infection caused by a mite (*Sarcoptes scabiei*), which reached epidemic proportions on the northern range in 2009. The mite is primarily transmitted through direct contact and burrows into its host's skin where it feeds and lays its eggs. This process can initiate an extreme allergic reaction in the host, causing the host to scratch infected areas resulting in hair loss, crusted skin, and open sores, which can lead to systemic infection and risk of hypothermia due to exposure. The Druid Peak, Everts, and Leopold packs' demise was associated with mange.

In 2008, the 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 now includes Paul Cross and Mike Ebinger of the US Geological Survey, Colby Anton of the Wolf Project, Emily Almberg and Peter Hudson of Pennsylvania State University, and Andy Dobson of Princeton University. With the data collected so far, in 2010 this team began to analyze the impacts of mange on wolf survival, reproduction, and behavior in Yellowstone. We also started a project that will use thermal imagery cameras to measure the heat loss associated with infection-induced hair loss, enabling us to estimate the caloric costs of infection and

The modern day challenges of being a wolf in a national park include traffic.

The Wolf Project conducts many carcass surveys. Somebody has to do it.

address questions about how infection alters the energy balance that wolves must maintain for survival. We hope the information about the costs of infection will increase our understanding of the relationships between mange infection, energy needs, hunting behavior and ability, and ultimately, pack stability and longevity.

Future research may study the role of coyotes and foxes in the spread of mange as well the mechanisms behind individual variations in infection: Why is it that some wolves suffer from severe mange infections while others only contract mild infections and quickly recover? Are there differences in immune function related to genetics or to stress?

Wolf Management

Area Closures

To prevent human disturbance of denning wolves during the sensitive period of pup rearing, visitor access was closed to some areas of the park surrounding dens. Land surrounding the Canyon and Lamar Canyon packs' den and rendezvous areas were closed for various lengths of time this summer. Thousands of visitors were still able to observe adults and pups in both packs from a safe distance, providing both protection to the pack and enjoyment to visitors. The Lamar Canyon pack den area was closed until June 30, while trails and areas near the Canyon pack's den and rendezvous sites in Hayden Valley were temporarily closed throughout the summer. Den sites for the Leopold, Mollie's, and Agate Creek packs were protected from disturbance because they were located near areas closed for bear management. The areas around the other packs' den sites were not closed because they have historically received low visitor use.

Wolf Road Management Project

After wolf reintroduction began in Yellowstone, the Lamar Valley became the premier location worldwide to observe free-ranging wolves. The main pack of interest was traditionally the Druid Peak pack, which denned in or near the Lamar Valley from 1997 through 2009, but this year there were two new packs in the area: the Lamar Canyon and Silver packs. The National Park Service established the Wolf Road Management Project to better deal with the opportunities and problems that accompany increasing visitor numbers. The objectives for this program are: (1) human safety, (2) wolf safety, (3) visitor enjoyment, and (4) wolf monitoring and research. A record number of visitor contacts were made by staff in the 2010 season (16,225 people) and the summer season was characterized by high wolf viewing opportunities (table 4).

The 2010 road management season was staffed primarily by two Wolf Project employees, Rick McIntyre and Colby Anton, for 126 days (May 11 to September 11). The Lamar Canyon pack, which denned at a former Slough Creek pack site, was the most visible this season. There was one litter of four gray pups produced by the uncollared four-year-old alpha female. Most sightings of the pack occurred around their den site and observation points were easily accessible for most visitors. Except for several weeks, the pack remained in fairly visible areas in

the Slough Creek drainage until the end of the road management season.

The Silver pack denned at an old Druid den site on the south side of Lamar Valley in a heavily forested area, but the adult wolves were often seen coming and going from the timber surrounding the site. Four gray pups emerged from the forest edge in early June and were visible from this rendezvous site for about a month. During this time, most pack members, including the pups, were displaying varying degrees of mange. After July 19, the pack moved the pups to a rendezvous site in Flint Creek and was seen only sporadically from the ground through the end of the road management season.

Italian exchange students Lorenza Grotelli and Davide Paugliaroli.

Habituated Wolves

There were fewer instances of wolves showing habituated behavior in 2010. None of the cases involved food-conditioned wolves. On four occasions wolves were hazed, three of which were very low level (e.g., hand clapping, yelling, honking) and the other involved cracker shells. Three of the four hazing events involved the Canyon pack, which exhibited habituated behaviors in that they frequently traveled on roads and through developed areas, and the other was lone wolf #587M near Old Faithful. All events were considered successful with the wolves responding to the stimulus and moving away from the area.

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

Year	Visitor contacts	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	283.2	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	126/126 (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%)

Wolf Management Outside Yellowstone

Information on wolf management and recovery status in the greater Yellowstone recovery area in 2010 is available at www.westerngraywolf.fws.gov.

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

Four graduate students worked in collaboration with the Wolf Project in 2010: Matt Metz, Kira Cassidy-Quimby, Daniel Stahler, and Alessia Uboni. Metz and Cassidy-Quimby are long-time employees on the project that have moved on to work in a new capacity and are partially supported by project funding. Stahler maintained his role as Project Biologist while fulfilling degree requirements and data analysis. Uboni became a collaborator after working as a GIS technician in Yellowstone Center for Resources.

Title: Behavioral, ecological, and genetic influences on life-history strategies and social dynamics of gray wolves

Graduate Student: Daniel Stahler, PhD candidate

Committee Chair: Dr. Robert Wayne, University of California, Los Angeles

Project Summary: The evolution of complex societies, such as seen in wolves, is greatly influenced by how ecological and social constraints impact population structure and mating systems. In combination with the underlying genetic structure of wolf packs, aspects of wolf ecology such as reproduction, dispersal, pack formation, and territoriality are predicted to vary with the abundance and distribution of resources. This research will investigate the link between socioecological conditions and these aspects of wolf ecology in Yellowstone. This project will take advantage of long-term datasets following the 1995 reintroduction: (1) a complete population pedigree of marked individuals resulting from the integration of molecular and field-based behavioral data and (2) predator-prey and wolf population dynamics. By combining field and laboratory-based data, this study will address questions concerning life history patterns, territoriality, and pack interactions and how they are associated with kinship and ecological condition. By combining long-term ecological, behavioral, and molecular datasets, this study will enhance our understanding of the evolution of complex, kin-structured societies, as well as provide a better understanding of how social and ecological conditions are related to wolf population dynamics and conservation.

Project Activity in 2010: Completed teaching requirements at UCLA, field data collection and management, analyzed genetic samples, coauthored several YNP wolf genetic related papers, completed one manuscript for submission early 2011.

Anticipated Completion Date: June 2011

Rebecca Raymond prepares to process a Gibbon Meadows pack wolf (768F) in Hayden Valley.

Title: Individual participation in intraspecific encounters and the benefits of aggression in gray wolves of Yellowstone National Park

Graduate Student: Kira Cassidy-Quimby, MS candidate

Committee Chair: Dr. L. David Mech, University of Minnesota, St. Paul

Pilot Roger Stradley (or call number 93-alpha) circles Mount Everts.

Pelican Crew: Where are the wolves?

Project Summary: Recently, social mammals throughout the world have been the subjects of studies on aggression and intergroup fighting. Due to the gray wolf's elusiveness and historically low population, an important gap in knowledge exists concerning the details of their aggressive interactions and the possible benefits of such behavior. This project will use long-term data and observations of wolf intergroup interactions after the 1995 reintroduction to (1) determine which individuals in a pack initiate and participate in interactions, (2) examine behavior pre-interaction to determine circumstances where wolves engage or avoid another group, (3) examine the possible adaptive advantages of aggression, and (4) determine the relationship between the rate of direct aggression and wolf and prey densities.
Project Activity in 2010: Coursework, development of research questions, and data collection.
Anticipated completion date: May 2012

Title: Seasonal patterns in foraging and predation of gray wolves in Yellowstone National Park
Graduate Student: Matt Metz, MS
Committee Chair: Dr. John Vucetich, Michigan Technological University
Project Summary: In temperate climates, knowledge regarding the predation patterns of large, terrestrial predators, including wolves, has been primarily limited to winter because kills are more easily detected on the snow-covered landscape. However, carcasses are now more easily detected during snow-free periods of the year through the use of GPS collars. GPS collars have been used to assess summer predation patterns for wolves on Yellowstone's northern range since 2004. Also using data collected since 1995 for winter, this study assessed how foraging behavior and predation patterns differ among seasons for northern range wolves. The social foraging behavior of wolves differed greatly among seasons, as individual wolves were estimated to attend 95% of their pack's kills during winter, but only 59% during summer. Further, individuals were significantly more likely to attend large ungulate carcasses (e.g., adult elk) than small ungulate carcasses (e.g., deer, neonate calves) during summer. Because wolves tend to not feed from every carcass during summer, summer kill rates were estimated using principles of the double-count method. These estimates for summer kill rates were compared to those from winter, and found that wolves acquire much less biomass per wolf per day during summer. However, because wolves often prey upon very small, neonate elk during early summer, the number of prey killed per wolf per day peaks during elk calving in June. Finally, the study also determined that the prey composition of wolf kills varies among season, as wolf predation of deer increases during the summer, coinciding with their return to the portion of the northern range in YNP.
Project Activity in 2010: Successfully defended thesis.
Completion Date: April 2010

Title: Wolf spatial analysis: Habitat use and territorial patterns
Graduate Student: Alessia Uboni, PhD candidate

Committee Chair: Dr. John Vucetich, Michigan Technological University

Project Summary: This project focuses primarily on spatial analysis of wolf movements using radio telemetry. Territory mapping and determining wolf habitat use via Resource Selection Function (RSF) will be a major part of this project. Relating habitat use to variables like elk distribution and abundance, pack size, kill rate, intraspecific strife, winter vs. summer, day vs. night will be the major emphasis of this project which will use data from 1995 to the present and data derived from both GPS and VHF collars.

Project Activity in 2010: Attended school at Michigan Technological University, taking classes and working on data analyses.

Anticipated Completion Date: May 2013

Caitlin Dodge slices through a bone for a sample.

Visiting Scholars

The Wolf Project Visiting Scholars Program is an annual program that enables a scientist or manager from another agency or university to visit and work with Wolf Project personnel. Tim Coulson from Imperial College London visited in late November 2010 to assist with field work and help analyze data on environmental effects on the wolf population. Dr. Coulson innovatively analyzed wolf project data extending our knowledge of YNP wolves and at year end had a manuscript almost completed. Further, Dr. Coulson is interested in participating in studies on wolf survival in Idaho, Montana, and Wyoming from 2005–2010, the period after the earlier survival study (1982–2004) ended.

Sue Ware, a paleopathologist and osteologist from the Denver Museum of Nature and Science and visiting scholar since 2008, continued to clean YNP wolf skulls with the museum's dermestid beetle colony and analyze them for pathologies that could have led to mortality. She also gathered post-cranial material for her own research on wolf skeletal morphology. Dr. Ware has had access to skull collections across North America, enabling her to compare YNP wolves to other wolves, leading to greater insights into the evolution and pathology of canids.

Life has its rewards.

Yellowstone Wolf Project Research

Predator–Prey. A major objective for YNP wolf research is wolf–prey relationships. Biannual 30-day winter studies (November 15–December 14 and March 1–30), ongoing for 16 years, are designed to record early and late winter predation patterns. More recently, summer predation patterns are studied using downloadable GPS data (May through July) along with scat collection for diet analysis. In addition, GPS collars are now being used at the same time winter studies occur. During these established predation studies and opportunistically throughout the year, project staff record 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. Graduate Matt Metz conducted research associated with this topic.

Hunting Behavior. This aspect of wolf–prey relationships has been a research focus in YNP largely through the efforts of long-term graduate and post-

A Gibbon pack wolf investigates a camera near the Mary Mountain trail used to monitor bison migration.

doctoral researcher Dan MacNulty. With the availability of longitudinal data from repeated observations of individually known wolves hunting prey, behavioral, ecological, and evolutionary dynamics of predation have been uniquely studied. Recent published research has focused on predatory performance of wolves with respect to age, body, and group size, and their relationship to ecological and evolutionary dynamics.

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

Erin Albers and Rebecca Raymond team up to put the collar on this Yellowstone Delta wolf (661M).

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

Dispersal. The ecological, demographic, and genetic implications of dispersal are important research focuses for YNP wolf biologists. 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 regional wolf populations. Graduate work by Dan Stahler at UCLA and Kira Cassidy-Quimby at the University of Minnesota is associated with the topic.

Breeding Behavior. During January and February each year, project staff monitor packs 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 individuals' attempts to breed and their relative fitness consequences. Aspects of breeding behavior are included in Dan Stahler's graduate research.

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 25–30 wolves are helicopter darted and radio-collared. Handling of individuals provides data on morphometrics, disease, genetic sampling, age, sex, breeding status, and condition. Both VHF and GPS collars are deployed, and provide the basis for nearly all other aspects of YNP's wolf research program.

Disease. Research on the disease ecology of wolves 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 population-wide sarcoptic mange monitoring effort has begun using an individual-based monthly documentation of mange occurrence, severity, and recovery in all packs through the use of direct observations, handling, aerial photographs, and thermal imagery.

Population Genetics. Annual genetic sampling (blood, tissue, and scats) from live and dead wolves is used to study genetic diversity, population structure, parentage and kinship, gene flow, and selection of fitness related traits. In combination with ecological and behavioral datasets, genetic data supports research on both evolutionary and ecological dynamics in the population in YNP. Examples of current research questions include evolutionary history and selection for coat color, evolution of life history traits, effect of kinship on breeding strategies, territoriality and strife. Additionally, genome sequencing on YNP wolf samples has begun 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 YNP's carnivores. Data is collected on all observed wolf–bear, wolf–cougar, and wolf–coyote interactions.

Doug Smith and Rick McIntyre team up for one of their many talks – this time for the Yellowstone National Park interpretative staff training.

Additionally, data on scavenger species diversity, abundance, and carcass utilization at wolf kills are collected to understand how these interactions influence structure and function of the ecosystem.

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

Staff and Public Involvement

Staff and Volunteers

Three full-time employees worked for the Yellowstone Wolf Project in 2010: Project Leader Douglas Smith and Biological Science technicians Erin Albers and Rick McIntyre. Daniel Stahler split time between graduate work at University of California in Los Angeles and working in the park as the project biologist. Other

The 2010 early Winter Study crew (back row left to right): Josh Irving, Daniel Stahler, Rachel Wheat, Douglas Smith, Cheyenne Burnett, Nate Bowersock, Brendan Oates, and Colby Anton; (front row, left to right): Caitlin Dodge, Kira Quimby, Rebecca Raymond, Erin Albers, Allison Greenleaf, Matt Metz, and Ryan Kindermann.

Colby Anton talks to a group in Mammoth Hot Springs.

paid and volunteer staff were Colby Anton, Nate Bowersock, Cheyenne Burnett, Kira Cassidy-Quimby, Kristen Clover, Caitlin Dodge, Allison Greenleaf, Josh Irving, Ryan Kindermann, Ky Koitzsch, Lisa Koitzsch, Matthew Metz, Regina Mossotti, Brendan Oates, Rebecca Raymond, LaRue Seitz, Dave Unger, Rachel Wheat, and Hilary Zaranek.

Outreach

Yellowstone Wolf Project staff gave 239 formal talks and 81 interviews (see Appendices III and IV). Talks were at both scientific conferences and to general audiences. Interviews were to all forms of media. Staff assisted visitors in the field helping 38,000 people view wolves, making 16,225 visitor contacts and giving 561 informal talks in the field.

Acknowledgements

We continue to be impressed by and thank the many interested people who come forward every year to work with and help YNP wolves. First and foremost are the Wolf Project staff including volunteers, without whom we would accomplish much less. The Yellowstone wolf-watching community over the years has always helped when they can and to them we are appreciative. We also thank the many generous individuals, foundations, and organizations that have provided over $4 million in grants through the Yellowstone Park Foundation to the Wolf Project since 1996. Continued support from Canon U.S.A., Inc., an anonymous donor, The Tapeats Fund, the Twin Spruce Foundation, the Perkin-Prothro Foundation, the participants in the wolf collar sponsorship program, and the National Science Foundation grant DEB-0613730 is also critical to our success and we thank all of those mentioned above.

Generous contributions to the Yellowstone Park Foundation provide more than 60% of the Wolf Project's annual budget and enable important studies on disease transmission, genetics, predation habits, the social dynamics of Yellowstone's wolf packs and their role in the ecosystem. This valuable support also ensures that programs to educate visitors and help them see wolves in Yellowstone continue to meet the park's growing number of visitors. Learn more at www.ypf.org/wolf.

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 and be less able to protect the wolves of Yellowstone.

Appendices

Appendix I. Wolf Project Volunteer Roster, 2010

Table I-1. Wolf Project volunteer roster, 2010

Name	Period of Involvement	Hours Worked
Colby Anton	1/1–4/24/10	712
Nate Bowersock	1/1–4/24/10, 8/1–8/20/10, and 11/8–12/17/10	1,144
Cheyenne Burnett	11/12–12/17/10	288
Kristen Clover	6/20–7/9/10	120
Caitlin Dodge	2/24–4/2/10, 5/1–5/30/10, and 11/12–12/15/10	736
Allison Greenleaf	2/24–4/2/10 and 11/12–12/17/10	592
Ryan Kindermann	11/12–12/17/10	288
Ky Koitzsch	2/24–4/2/10	304
Lisa Koitzsch	2/24–4/2/10	304
Regina Mossotti	2/24–4/2/10	304
Brendan Oates	11/12–12/17/10	288
Larue Seitz	2/24–4/2/10	304
Dave Unger	2/24–3/12/10 and 6/21–7/2/10	232
Rachel Wheat	11/12–12/17/10	288
Total Volunteer Hours*		5,904

*Based on the standard biological field technician GS-5 hourly rate (currently $15.00/hour), volunteer hours are worth $88,560.

Appendix II. Publications, 2010

Almberg, E., P. Cross, D. Smith. 2010. Persistence of canine distemper virus in the Greater Yellowstone Ecosystem's carnivore community. *Ecological Applications* 20(7):2058–2074

Barnowe-Meyer, K., P.J. White, T.L. Davis, D.W. Smith, R.L. Crabtree, and J.A. Byers. 2010. Influences of wolves and high-elevation dispersion on reproductive success of pronghorn (*Antilocarpa americana*). *Journal of Mammalogy* 91:712-721.

Mitchell, M.S., J.A. Gude, D.E. Ausband, C.A. Sime, E.E. Bangs, M.D. Jimenez, C.M. Mack, T.J. Meier, S. Nadeau, and D.W. Smith. 2010. Temporal validation of an estimator for successful breeding pairs of wolves *Canis lupus* in the US northern Rocky Mountains. *Wildlife Biology* 16:101–106.

Murray, D.L., D.W. Smith, E.E. Bangs, C. Mack, J.K. Oakleaf, J. Fontaine, D. Boyd, M. Jiminez, C. Niemeyer, T.J. Meier, D.R. Stahler, J. Holyan, and V. Asher. 2010. Death from anthropogenic causes is partially compensatory in recovering wolf populations. *Biological Conservation* 143(11):2514–2524.

Smith, D.W., E.E. Bangs, J.K. Oakleaf, C. Mack, J. Fontaine, D. Boyd, M. Jimenez, D.H. Pletscher, C.C. Niemeyer, T.J. Meier, D.R. Stahler, J. Holyan, V.J. Asher, D. Murray. 2010. Survival of colonizing wolves in the northern Rocky Mountains of the United States, 1982–2004. *Journal of Wildlife Management* 74:620–634.

vonHoldt, B.M., D.R. Stahler, E.E. Bangs, D.W. Smith, M.D. Jimenez, C.M. Mack, C.C. Niemeyer, J.P. Pollinger, R.K. Wayne. 2010. A novel assessment of population structure and gene flow in grey wolf populations of the Northern Rocky Mountains of the United States. *Molecular Ecology* 19(20): 4412–4427

Rick McIntyre (top) on one of his many searches for the best view. Bottom: Chest waders required.

Appendix III. Interviews Given by Wolf Project Staff, 2010

Table III-1. Interviews given by Wolf Project staff, 2010

Staff Member	Date	Interviewer
Douglas Smith	January	Megan Ventura, *National Geographic*
		Janice Lloyd, *USA Today*
		Jayne Clark, *USA Today*
		Iain Scott, director of World Wildlife Trust
		Beth Pratt, Examiner.com
		Michelle Nijhuis, *High Country News*
		Kurt Repanshek, *National Parks Traveler*
		Jordan Smith, *Discover Magazine*
		Crosby LeVeen, Loaded Dory Films
		Karina Hamalainen, *Super Science Magazine*
		Hal Herring, *High Country News*
	February	Kurt Repanshek, *National Parks Traveler*
		Mike Gibeau, Banff National Park
		Nick Ellingsworth, *Dog Whisperer*, National Geographic TV
		Jared Anderson, KOTA TV, Sheridan, WY/ Rapid City, SD
		Patrick Burke, journalist
	March	Mike Gibney, *Bozeman Chronicle*
		Ed O'Brian, Montana Public Radio, Missoula, MT
		Michelle Norris, National Public Radio, *All Things Considered*
		John O'Keefe, Assistant to Congressman Phil Gingrey, GA-11
		Mike Mestus, KTVM TV/NBC
		Oregon State University, Conservation Biology class with Christina Eisenburg
		Chrissina Burke, University of Nevada-Reno
		Sharon Levy, *New Scientist*
		Josh Dean, *Outside Magazine*
		Jeremy Pelzer, *Casper Tribune*
		Christine Weinheimer, *Yellowstone Park Foundation Newsletter*
		Emily Lipman, Georgia State University
	April	Nils Eklund, *Swedish National News*
		Susanna Baltscheffsky, *Swedish Daily Newspaper*
	May	Brett French, *Billings Gazette*
		James Manfull, National Geographic Television
		Jake Nichols, *Jackson Hole Weekly*
	June	*Christian Science Monitor*
		Jenna Bush, *Today Show*
		Erin Reuss, National Geographic Television
		Susan Milius, *Science News*
		John Marker, *Idaho Post*
	August	Toyota, Yellowstone Park Foundation Special
		National Geographic, United Kingdom
		Lisa Reuler, Yellowstone Association
	September	Charles Hodgkins, author of *Guide Book*
		Riley Blanton, *Outside Magazine*
		Kaspar Luder, University of Zurich
		Riley Blanton, *Outside Magazine*
		Rachel Marty, Colorado State University
	October	Mike Gurnett, Montana Fish, Wildlife and Parks
		Susanna Baltschetfsky, *Svenska Dagbladet Magazine*, Sweden
		Ginne Glowacki, French Public Television, Paris
	November	BBC interview (day 1)
		BBC Interview (day 2)
		Melissa Gaskill, *Wildflower Magazine*
	December	Aaron Lake Smith, *The Thread Magazine*
		Bob Landis, filmmaker

Staff Member	Date	Interviewer
D. Smith, cont'd.		Laura Peterson, *Land Letter Magazine*
		Brett French, *Billings Gazette*
		Melissa Gaskill, *Atlantic Monthly*
Dan Stahler	August	National Geographic Television
		National Parks Magazine
Rick McIntyre	January	Todd Wilkinson, *Jackson Hole News*
		Douglas McCann and Crosby LeVeen, Loaded Dory Films
	February	Ben Pierce, *Bozeman Chronicle*
		PBS, *Christmas in the National Parks*
		Nick Ellingsworth, *The Dog Whisperer*, National Geographic Television
		Josh Dean, *Outside Magazine*
		Brett French, *Billings Gazette*
	March	Michael Gibney, *Bozeman Chronicle*
	April	Amy Linn, *Headwall Magazine*
	June	Jenna Bush, NBC *Today Show*
		Corinne Garcia, *Christian Science Monitor*
	July	Joe Romain, Harvard Press (1st interview)
		Joe Romain, Harvard Press (2nd interview)
		Todd Georgelas, National Geographic (1st interview)
		Todd Georgelas, National Geographic (2nd interview)
	August	Poul Husted, *Politiken Newspaper* (Denmark)
	September	Montana Tourism/Xanterra tour for travel writers
		Max Harstarn, GoNomad.com
		Josh Dean, *Outside Magazine*
		Krista Gonzales (Texas A&M at Kingsville) student phone interview
Colby Anton	February	PBS, *Christmas in the Parks*
	September	Yellowstone Association Roosevelt Rendezvous
	October	Susanna Baltscheffsky, *Swedish Daily News*
	November	BBC film crew

Appendix IV. Talks Given by Wolf Project Staff 2010

Table IV-1. Talks given by Wolf Project staff, 2010

Staff Member	Date	Group	Location
Douglas Smith	January	The Wild Side Tours & Treks	YNP
	February	Defenders of Wildlife	YNP
		Meredith Taylor tour group	YNP
		Greater Yellowstone Coalition	YNP
		Panel discussion	Livingston, MT
	March	Wild Side	Gardiner, MT
		Yellowstone Association Conference	YNP
		University of Washington, Wildlife Biology class	YNP
		Yasuo Kuwahara	YNP
	April	Swedish Wolf Symposium, Vålådalen	Sweden
		National Park Service Deputy Director/Department of the Interior solicitor	YNP
		College of Southern Idaho, John Simpkin	YNP
		Rancher's workshop: B Bar Large Carnivore–Livestock interviews	MT
	May	Greater Yellowstone Coalition, MacNeil Lyons	YNP
		Yellowstone Park Foundation board meeting	YNP
		National Wildlife Federation board meeting	YNP
	June	US Forest Service Yellowstone carnivore class	YNP
		American Society of Mammalogists, (day 1)	YNP
		American Society of Mammalogists, (day 2)	YNP
		American Society of Mammalogists meeting	Laramie, WY
		Defenders of Wildlife Board	YNP
		World Wildlife Fund Board	YNP
		Museum of Idaho	Idaho Falls, ID

Staff Member	Date	Group	Location
D. Smith, cont'd.	July	Conservation Biology Conference	Edmonton, Alberta, Canada
		YAI class	YNP
		Crow Indian Tribe ROTC	YNP
	August	Montana Wildlife Services annual meeting	Red Lodge, MT
		Murie Center	Jackson, WY
		Yellowstone Association event	Big Sky, MT
	September	Canon Expo	New York, NY
	October	Biennial Scientific Conference on the Greater Yellowstone Ecosystem	YNP
		Museum of the Rockies	Bozeman, MT
	November	YAI class	YNP
		YAI class	YNP
		Winter study training	YNP
	December	Interpretive winter training	YNP
		Outfitter and guide training	YNP
Dan Stahler	February	The Wild Side Tours & Treks	Gardiner, MT
	August	American Associations State Colleges	YNP
		YAI	YNP
		USDA Foreign Agricultural Attaché Tour	YNP
	September	Bruce Museum	Greenwich, CT
		USDA Foreign Agricultural Attaché Tour	YNP
	October	Canon U.S.A., Inc. talk	YNP
	November	YAI	YNP
		Yellowstone Wolf Project winter study training talk	YNP
	December	Xanterra snowcoach driver orientation training	YNP
Rick McIntyre	January	North Carolina State University field trip	YNP
		University of Wisconsin at Whitewater field trip	YNP
		YAI Class: Winter Wildlife Watching	YNP
		Yellowstone Association/Xanterra winter press trip	YNP
		YAI: Winter Wildlife Expedition	YNP
		Bozeman (MT) High School, Wildlife Ecology and Management class	YNP
		Star Lane Center School (Casper, WY) field trip	YNP
		YAI class: Winter Wildlife Tour	YNP
		YAI class: Exciting Horizons for Wolves	YNP
		National Geographic Expeditions trip	YNP
		YAI class: The Wolves of Yellowstone	YNP
		YAI class: Winter In Wonderland and Winter Wildlife Expedition	YNP
		Private Yellowstone Association tour	YNP
	February	British Columbia Institute of Technology field trip	YNP
		Smithsonian Adventures Yellowstone trip	YNP
		YAI class: Tom Murphy Photography Seminar	YNP
		Talk to park visitors on the death of the thin female (Slough Creek)	YNP
		YAI class: Wolves in the 21st Century	YNP
		National Geographic Expeditions trip	YNP
		Greater Yellowstone Coalition Members, trip at YAI	YNP
		Smithsonian Adventures, Yellowstone field trip	YNP
		YAI class: Winter Wolf Discovery	YNP
	March=	YAI class: Winter Wolf Discovery	YNP
		Nathan Varley's wolf tour	YNP
		Northwest Academy (Naples, ID) field trip	YNP
		Mike Nelson's Wolf Group	YNP
		Colorado Rocky Mountain College field trip	YNP
		Lawrence Academy (Groton, MA) field tip	YNP
		YAI: The Living History of Yellowstone's Wolves	YNP
		Yellowstone Association, Legacy Meeting	YNP
		International Wolf Center field trip (Dave Mech)	YNP
		Expedition: Yellowstone! class: Trever Day School (New York, NY)	YNP
		YAI Class: Coyote and Raven	YNP
		Victor Emmanuel Nature Tours, tour	YNP

Staff Member	Date	Group	Location
R.McIntyre, cont'd.	April	Expedition: Yellowstone! class: Pocatello (ID) Charter School,	YNP
		Expedition: Yellowstone! class: Spokane (WA) Pioneer School	YNP
		Tour for Bridget Fahey and Sarena Selbo, US Fish and Wildlife Service (Denver, CO)	YNP
		Aspen (CO) High School field trip	YNP
		Expedition: Yellowstone! class: Thermopolis (WY) Elementary School	YNP
		Suffield (CT) High School trip	YNP
		College of Southern Idaho, Science, Literature, and the Environment class	YNP
		Billings (MT) Central Catholic High School Advanced Placement Biology class	YNP
		Expedition Yellowstone Class-Fort Casper Elementary School (Casper, WY)	YNP
	May	Teton Science School Graduate School student field trip	YNP
		Expedition: Yellowstone! class: Thermopolis (WY) Elementary School	YNP
		Teton Science School Graduate School students field trip	YNP
		Greater Yellowstone Coalition field trip	YNP
		Burke Catholic High School (Goshen, NY) trip	YNP
		Clemson University (SC) Rocky Mountain Field ecology class	YNP
		Project Wet, Yellowstone field trip for Latin American educators	YNP
		Yellowstone Park Foundation Board of Directors field trip	YNP
		WGBH National Parks World Tour	YNP
		National Wildlife Federation tour	YNP
		Gill-St. Bernard High School (Gladestone, NY)	YNP
		Wolf Conservation Center (South Salem, NY)	YNP
		Bozeman (MT) High School, Wildlife Ecology and Management class	YNP
		YAI class: Wolf Ecology and Management	YNP
		Tour for Susan Jacobsen, Endangered Species Director Southwest Region of US Fish and Wildlife Service, and family	YNP
		YAI Class: Wolves	YNP
	June	Xanterra tour bus drivers orientation field trip	YNP
		Yellowstone Park Foundation Members field trip	YNP
		Ecology Project International staff orientation trip	YNP
		Spring Wolf and Bear class (Nathan Varley/Linda Thruston)	YNP
		University of Colorado Science Discovery Trip	YNP
		Boy Scouts Troop 83 (Mercer, PA)	YNP
		Ecology Project International (Montana high school students)	YNP
		Tower Fall Store employees	YNP
		Rhodes College (Memphis, TN) Yellowstone field trip	YNP
		YAI Tour for Castleton College (VT)	YNP
		Wild Rockies field institute (University of Montana) Yellowstone trip	YNP
		Tour for Yadvendradev Jhala (Wildlife Institute of India)	YNP
		Gannon University trip	YNP
		University of Pittsburgh Yellowstone ecology class	YNP
		World Wildlife Fund Board of Directors trip	YNP
		Ecology Project International (Bishop O'Dowd High School-Oakland, CA)	YNP
		Indiana State University (American Democracy Project)	YNP
		Racine (WS) Unified School District trip	YNP
		California State at Monterey Bay, Wildland Studies class	YNP
	July	Wolf Conservation Center (South Salem, NY) field trip	YNP
		California State at Monterey Bay, Wildland Studies Class	YNP
		Yellowstone Youth Conservation Corp crew	YNP
		American Youth Outreach Unlimited trip (Versailles, IN)	YNP
		YAI class: Emerging Knowledge About Wolves	YNP
		Eire Playhouse (PA) trip	YNP
		Ecology Project International (high school students from MT and WY)	YNP
		Teton Science School high school field ecology class	YNP
		Xanterra wildlife tour	YNP
		Xanterra tour for teen Village Ranch Camp (Elbert, CO)	YNP
		Xanterra Wildlife tour	YNP

Staff Member	Date	Group	Location
R. McIntyre, cont'd.		Teton Science School, high school natural history class	YNP
		Ecology Project International (Montana high school students)	YNP
	August	University of Buffalo Class, Ecology of Unique Environments	YNP
		Ecology Project International (WA and CA high school students)	YNP
		Defenders of Wildlife Tour	YNP
		Roslyn (NY) Middle School trip	YNP
		Beckett/Chimney Corners (MA) YMCA Camp trip	YNP
		Beckett/Chimney Corners (MA) YMCA Camp trip	YNP
		Boys and Girls Clubs of Tacoma (WA) My Yellowstone Adventure Class, YAI	YNP
		Ecology Project International (students from Galapagos Islands)	YNP
		Xanterra Employee (Lake/Canyon/Roosevelt) field trip	YNP
	September	Xanterra Field Trip for Travel Reporters	YNP
		YAI class: Wolves and Fire	YNP
		Tour for Annie Graham and party	YNP
		Xanterra employees recreational trip	YNP
		University of Washington, Ecosystems Management class	YNP
		Washington (DC) Audubon Naturalist Society trip	YNP
		Cody (WY) Elementary School fifth graders trip	YNP
		Expedition: Yellowstone!: class, Pinedale (WY) Middle School	YNP
		Speyside (UK)Wildlife Tour	YNP
		YAI: Fall Elk and Wolf Discovery class	YNP
		Xanterra employee hike to Rose Creek pen	YNP
		Paradise Valley (MT) Middle School trip	YNP
		Expedition: Yellowstone! class: St. Lawrence School (Laramie, WY)	YNP
	October	Vintage Chevy Club/Big Sky Region Yellowstone tour	YNP
		Talk for park visitors	YNP
		Expedition: Yellowstone! class: Kennewick (WA) School District	YNP
		Colorado State University Society for Conservation Biology	YNP
		Bozeman (MT) High School, Wildlife Ecology and Management Class I	YNP
		Expedition: Yellowstone! class: Geraldine (MT) Elementary School	YNP
		Bozeman (MT) High School, Wildlife Ecology and Management Class II	YNP
		University of Montana Nature Based Tourism class trip	YNP
		Expedition: Yellowstone! class: Gardiner (MT) Elementary School, Grade 5	YNP
		North Dakota State University Environmental Science field trip	YNP
		YAI: Class, The Wolves of Yellowstone	YNP
		Expedition: Yellowstone! class: Kemmerer (WY) Elementary School	YNP
		Expedition: Yellowstone! class: Jefferson County (CO) Open School	YNP
		Cody (WY) High School Advanced Placement biology class field trip	YNP
		Cooke City (MT) Elementary School	YNP
		Expedition: Yellowstone! class: Grace Lutheran School, Pocatello (ID)	YNP
		Yellowstone County Guardians Youth Wilderness Leadership Program (Mike Leech)	YNP
		Kalispell (MT) High School Yellowstone trip	YNP
		Expedition: Yellowstone! class: Grace Lutheran Scholl-Pocatello (ID)	YNP
	November	Montana State University class: Yellowstone: A Science Laboratory	YNP
		Capital High School (Helena, MT), science seminar field trip	YNP
		Greater Yellowstone Coalition Meeting at YAI	YNP
		YAI: Food for the Masses Class I	YNP
		Expedition: Yellowstone! class: Holy Spirit Catholic School (Pocatello, ID)	YNP
		YAI: Food for the Masses Class II	YNP
	December	Museum of the Rockies (Bozeman, MT), volunteers Yellowstone trip	YNP
		YAI class: Painting Yellowstone in Winter	YNP
		Yellowstone Association naturalist training trip	YNP
		National Park Service Winter naturalists training trip	YNP
		Nathan Varley's photography workshop	YNP
		Tour for Sarah and Laurie Williamson (Joliet, MT)	YNP
		YAI: Wolf Week class	YNP
		Expedition: Yellowstone! class: City Middle School (Spokane, WA)	YNP
		YAI: class-Snowshoeing the History of Yellowstone	YNP

Staff Member	Date	Group	Location
R. McIntyre, cont'd.		Yellowstone Safari tour group	YNP
		My Yellowstone Adventure Group (students from Dallas, TX)	YNP
		YAI: Wolf Week class	YNP
		National Geographic Expeditions tour group	YNP
		My Yellowstone Adventure Group (students from Dallas, TX)	YNP
		YAI: Winter Wildlife tour	YNP
		YAI class: Holiday Wolf Watching	YNP
		National Geographic Expeditions tour group	YNP
	February	University of Montana	Gardiner, MT
Matt Metz		Graduate student research symposium	Houghton, MI
	April	Michigan Technological University	Houghton, MI
	May	University of Wyoming	Laramie, WY
		National Park Service interpretation training	YNP
	June	American Society of Mammalogists annual meeting	Laramie, WY
	July	Yellowstone Center for Resources	YNP
Kira Cassidy-Quimby	November	Backcountry rangers	YNP
Josh Irving	April	US Forest Service group	YNP
		Gardiner School field trip	YNP
	May	Park employees	YNP
		Yellowstone Park Foundation	YNP
		Xanterra bus guides	YNP
		Park employees	YNP
	June	Park employees	YNP
	August	Colorado State University group	YNP
	September	Crowe Horwath, LLP	YNP
		Roosevelt Rendezvous	YNP
		Lovell (WY) Elementary School	Northwest College Field Station, WY
		Lethbridge College, Alberta, Canada	YNP
	November	Winter study training	YNP
	December	Absorkee (MT) High School group	YNP
		YAI class: Lamar Wolf Week	YNP
Rebecca Raymond	January	Montana Fish, Wildlife and Parks and US Forest service	Gardiner, MT
	February	University of Montana class	YNP
	May	National Wildlife Federation, president and trustees	YNP
		University of Wisconsin, Lacrosse	YNP
	June	Yadvendradev Jhala, Wildlife Institute of India	YNP
		Youth Conservation Corps	YNP
Colby Anton	February	British Columbia Institute of Technology field trip	YNP
		University of Montana field trip	YNP
	May	Xanterra Employees (Old Faithful)	YNP
		Northwestern Iowa University field trip	YNP
	June	Xanterra employees (Grant Village)	YNP
		California State University, Monterrey Wildland Studies Program	YNP
	July	Youth Conservation Corps summer employees (day 1)	YNP
		Youth Conservation Corps summer employees (day 2)	YNP
		Youth Conservation Corps summer employees (day 3)	YNP
		Siemens Foundation & Discovery Education	YNP
	September	Yellowstone Association Roosevelt Rendezvous	YNP
		Powell (WY) High School	YNP
		Upper Valley Joint Vocational School (Piqua, OH)	YNP
	October	Xanterra media trip	YNP
		Jefferson County Vocational School field trip	YNP
	December	YAI class: Lamar Wolf Week	YNP
Nate Bowersock	February	Elderhostel group	YNP
	March	Colorado Middle School group	YNP

Note: YNP = Yellowstone National Park; YAI = Yellowstone Association Institute