

An aerial photograph of a wolf pack in a vast, snow-covered landscape. The wolves are scattered across the frame, some standing and others moving, leaving tracks in the snow. Their shadows are cast long and dark on the white surface. The overall scene is bright and clear, suggesting a sunny day.

Yellowstone Wolf Project Annual Report

2016

Summary

There were at least 108 wolves in 11 packs (7 breeding pairs) living primarily in Yellowstone National Park (YNP) through December 2016 (figures 1& 2). Breeding pairs are defined as an adult male and an adult female with two pups that survive through the end of the year. Overall, wolf numbers have fluctuated between 83-108 wolves and 6-9 breeding pairs from 2009 to 2016. Pack size in 2016 ranged from 3 to 18 (table 1), averaging 9.8 in size. Park-wide, 36 pups survived to year end, 16 in northern Yellowstone and 20 in the interior of the park, with an average of 4.0 pups per pack surviving for 9 packs with confirmed reproduction.

Wolf-Prey Relationships

Project staff detected 235 kills that were definitely, probably, or possibly made by wolves in 2016: 161 elk (68.5%), 19 bison (8.1%), five mule deer (2.1%), 14 deer of unknown species (6% probably mule deer), four coyotes (1.7%), three wolves (1.3%), three pronghorn (1.3%), three bighorn sheep (1.3%), two badgers (0.9%), two snowshoe hares (0.9%), one moose (0.4%), one beaver (0.4%), and 17 unidentified animals (7.2%). The composition of elk kills was 36.0% calves, 5.6% yearlings, 21.1% adult females, 26.7% adult males, 2.5% adults of unknown sex, and 8.1% of unknown sex and age. Wolf predation was monitored intensively for five months of the year – one month in early winter (mid-November to mid-December), one month in late winter (March), and three months in spring-summer (May-July). The type of prey killed by wolves varies by time period and consists primarily of elk. However, predation on other prey such as bison may be changing with their increasing abundance (figure 3).

Winter Studies

During March 2016, our “late” winter study period, a total of 22 ungulate carcasses fed on by wolves were discovered by air and ground teams. Thirteen (59%) of these ungulates were killed by wolves, including 11 elk, one bison, and one deer. Four of the elk (36%) were calves, one (9%) was an adult female, and six (55%) were adult males. Wolves also fed

on nine ungulates they did not kill, of which four were elk and five were bison.

During November-December 2016, our “early” winter study period, a total of 22 ungulate carcasses fed on by wolves were discovered by air and ground teams. Twenty (91%) of these ungulates were killed by wolves, which included 11 elk, three bison, two deer, and four unknown species. Four of the elk (36%) were calves, two (18%) were adult females, and five (45%) were adult males. The wolves also fed on two bison that they did not kill. In addition, the wolves also killed one snowshoe hare.

Summer Predation

Wolf predation was also assessed from May through July. This was achieved by hiking to clusters (a location other than a home site where a wolf spent 30 minutes or more) generated from satellite collars (e.g., GPS collars) to search for prey remains. Only some of the wolves in each pack wear GPS collars, and not all GPS collars are used to search for clusters. We found 81 suspected kills or fresh carcasses of ungulate prey, which included 54 (67%) elk, 12 (15%) bison, 9 (11%) deer, two (2%) bighorn sheep, two (2%) pronghorn, one (1%) horse (scavenged after a concessionaire left the animal in the park), and one (1%) unknown species. We also detected two badgers and one snowshoe hare.

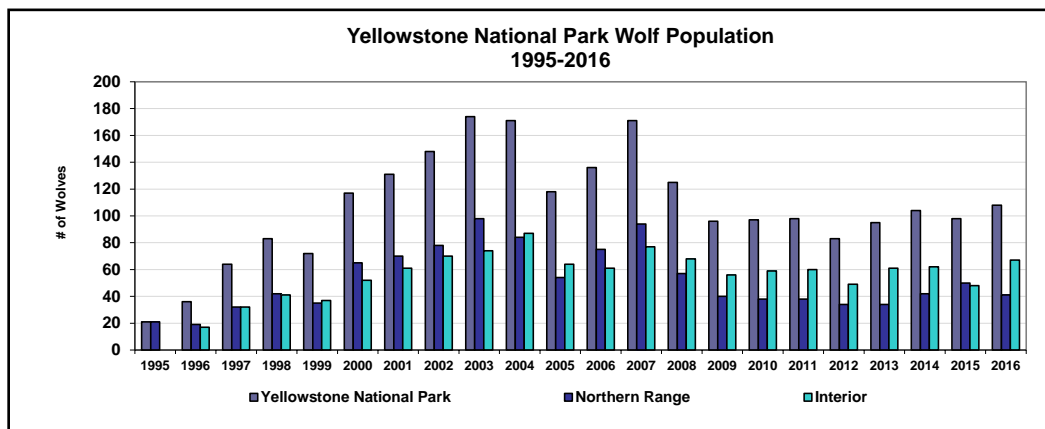


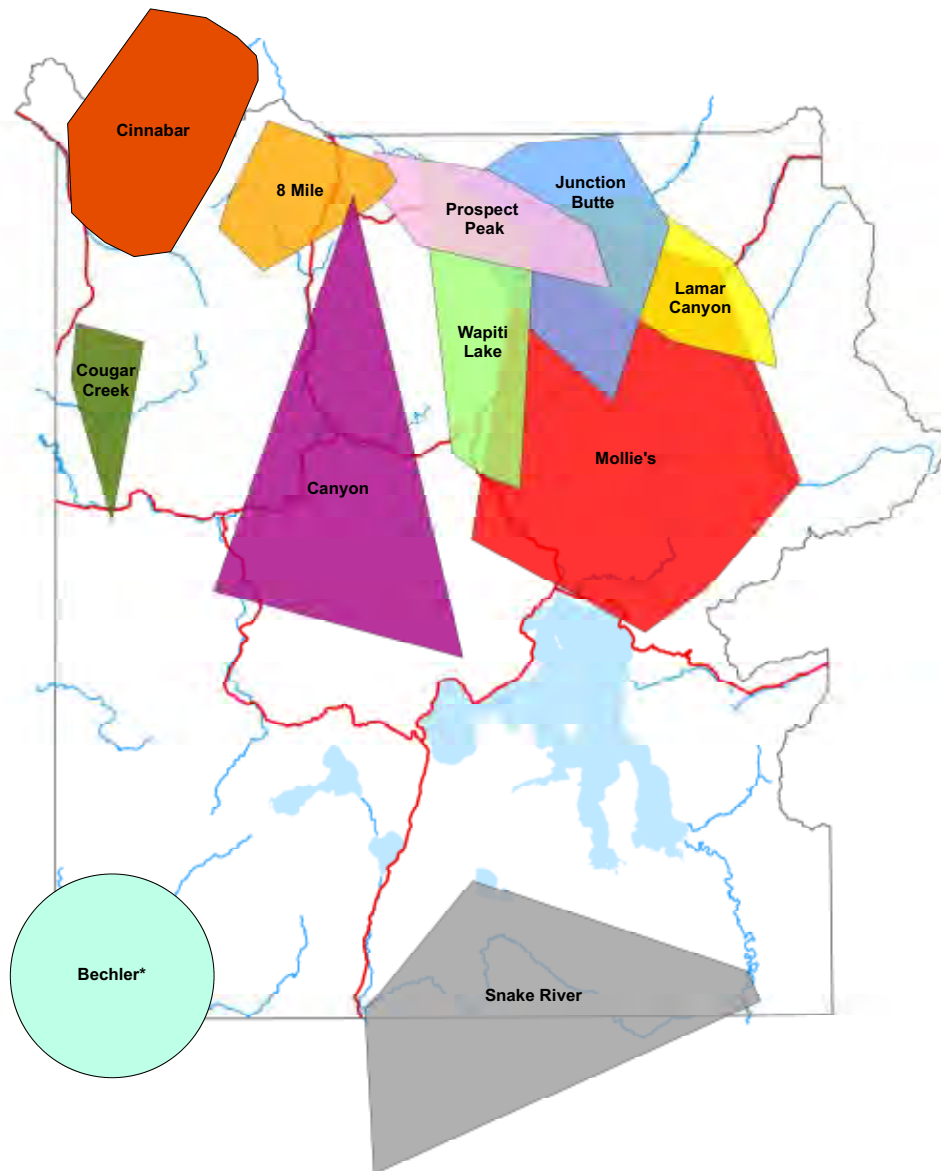
Figure 1. Yellowstone National Park early winter wolf numbers from 1995-2016.

Table 1. Yellowstone wolf population estimate as of 12/31/16.

Yellowstone Wolf Population Estimate as of 12/31/2016	Adults	Pups	Total
Northern Range			
<u>8 Mile</u>	8	10	18
Junction Butte	3	4	7
Lamar Canyon	5	2	5
<u>Prospect Peak</u>	9	2	11
Northern Range Totals	25	16	41
Non-Northern Range			
Bechler (no collars)	5	4	9
Canyon	5	1	6
Cinnabar	3		3
<u>Cougar Creek</u>	6	2	8
<u>Mollie's</u>	14	4	18
<u>Snake River</u>	9	5	14
<u>Wapiti Lake</u>	5	4	9
Non-Northern Range Totals	47	20	67
YNP Total	72	36	108

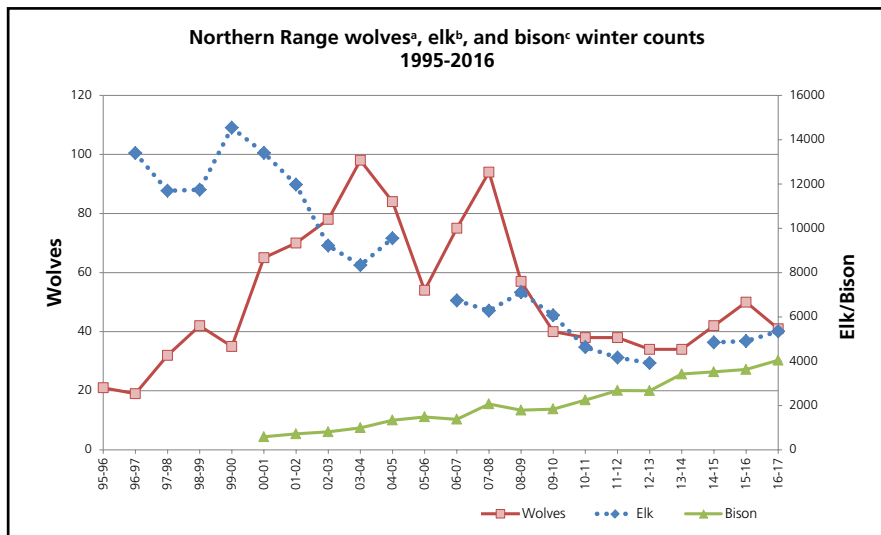
Note: underlined packs count as breeding pair

2016 Wolf Pack Territories



* No radio collars present, unable to estimate territory size.

Figure 2. Territories of wolf packs that primarily used Yellowstone National Park in 2016. Territories only reflect NPS monitoring. The circular areas indicate that this pack had no radio collars.



^aWolf counts include wolves from packs both inside and outside the park on the Northern Range.
^bOfficial elk counts were not generated in winters of '95-'96, '05-'06, and '13-'14.
^cBison numbers reflect the maximum number of bison counted during July-August of the previous summer.

Figure 3. Counts of wolves, elk, and bison in northern Yellowstone National Park from 1995-2016. Gaps in data represent years where no data was collected.

Table 2. Confirmed collared wolf mortalities in Yellowstone National Park in 2016.

Wolf #/Sex	Age Class	Pack	Date of Death	Cause of Death
1012M	pup	Prospect Peak	3/14/2016	Intraspecific
995F	yearling	dispersed from Junction Butte	3/22/2016	Control Action
970F	old adult	Junction Butte	4/30/2016	Natural Unknown
993M	adult	Lamar Canyon	6/26/2016	Interspecific
911M	old adult	Junction Butte	9/15/2016	Intraspecific

Mortalities

Five radio-collared wolves died in 2016 (table 2): two were killed by other wolves, one kicked and killed by an ungulate, one died of unknown natural causes (necropsy was delayed by river levels and exact cause of death could not be determined), and one was legally shot outside the park boundary. Ages of wolf mortalities varied, with two old adults (>6-years-old), one adult (2-5-years-old), one yearling, and one pup. In addition, staff recorded seven uncollared wolf deaths; one was natural (intraspecific), and six were harvested during the wolf hunting season in Montana.

Disease

There was no evidence of any major disease mortality. The Lamar Canyon pack began the year with varying levels of mange infection among individuals (some mild and some severe); but by the fall, the one male and two remaining females had recovered.

Pup Survival

Each year staff attempt to establish early pup counts at dens by either observing from the ground through spotting scopes or, more often, taking photos of the den area during track-

ing flights. Since wolf pups normally stay underground for their first three to five weeks, the earliest counts are often of two- to three-months-old pups. For some packs whose den sites are unknown or hidden, we do not get pup counts until the pups are moved to a rendezvous site in the early fall. This year we were able to get exceptionally early counts from the Junction Butte pack (first pup sighting was May 4 of a pup only ~15 days old) and tracked their survival throughout the entire year (figure 4).

Wolf Capture

Seven wolves in three packs were captured and collared in 2016 (table 3). In addition to marking them, a number of measurements and biological samples were taken. Two

Table 3. Wolves captured and handled on January 26, 2016.

Wolf #/Sex	Age	Color	Pack
1005F	Pup	Black	8 Mile
1012M	Pup	Gray	Prospect Peak
1013M	Pup	Gray	Mollie's
1014M	Adult	Black	Mollie's
1015M	Yearling	Black	Mollie's
821F	Adult	Gray	Prospect Peak
910M	Adult	Black	8 Mile

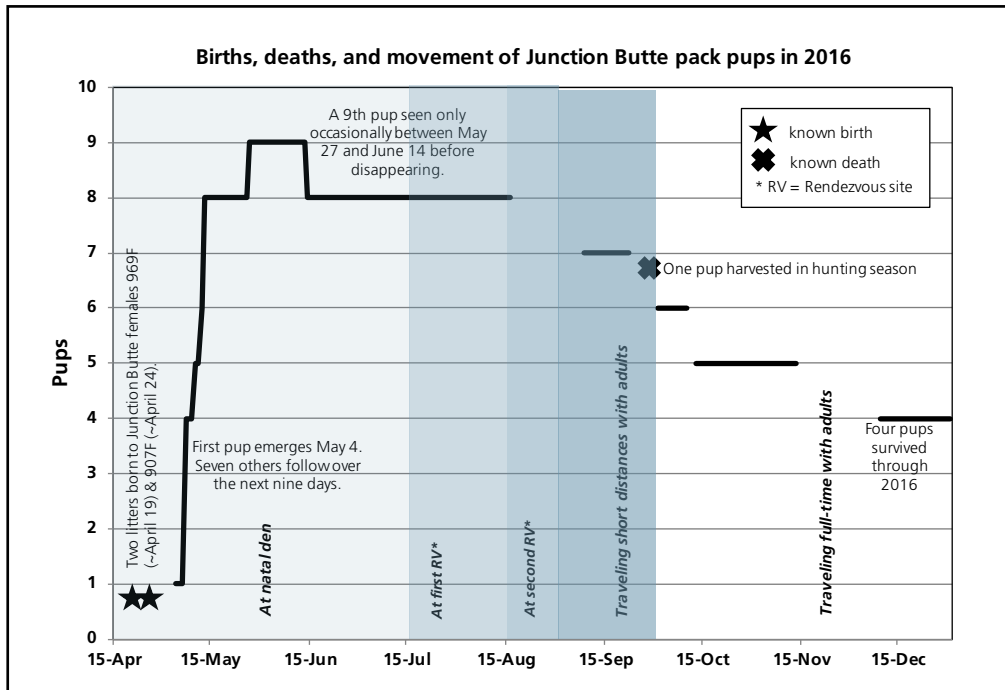


Figure 4. Survival of pups in the Junction Butte pack with approximate dates of mortality. Solid lines represent periods of confirmed sightings. Gaps indicate periods of no visual observations of the pups.



NIPS Photo - E. STAHLER

A grizzly bear covers a bison carcass as the Mollie's pack lingers nearby. Bull bison that die after the rut provide a large food source at a time of year when the elk are generally healthy.



NPS Photo - D. STAHLER

The 8-Mile pack had 12 pups in 2016 from probably three different mothers - 909F and her two daughters.

females and five males were captured; two were old adults (>6-years-old), one was an adult (2-5-years-old), one was a yearling, and three were pups (<12 months). Unfortunately, 62% of the new collars malfunctioned due to a manufacturing

issue. We lost track of two packs because of this; thus, wolves with non-working radio collars are targeted for recollaring in 2017.

Wolf Management

Wolf management activities included den site closures. For the first time in several years, there were no reported hazing events on habituated wolves. Staff continued to manage wolf viewing areas in Slough Creek, Lamar Valley, Hayden Valley, and other areas where wolves were frequently observed. There was no wolf hunt in Wyoming because wolves were still protected under the Endangered Species Act. Idaho and Montana conducted wolf hunts. Six wolves from two packs (three Junction Butte and three 8 Mile) with territories primarily in YNP were legally harvested in Montana while outside the park boundary.

Wolf Pack Summaries (figure 2)

8 Mile (18 wolves; 8 adults, 10 pups)

At least two, and possibly three, litters were born to the 8 Mile pack in 2016 for a total of 12 pups. The pack continued to use their traditional territory, but in November they traveled outside the park and three pack members (one adult male and two pups) were shot during the Montana wolf hunting

season. The remaining 18 pack members stayed together, led by long-time alpha female 909F, who turned 7-years-old in 2016.

Prospect Peak (11 wolves; 9 adults, 2 pups)

During the 2016 breeding season, a younger male (likely dispersed into the pack from 8 Mile in late 2014) started to dominate 10-year-old 763M, who remained with the pack as a subordinate until his disappearance in November. Alpha female 821F (turned 7-years-old) had a litter of four pups; two were still alive by the end of the year. Several subordinate wolves formed a splinter group during the fall and winter, but by December were mostly with the main group again. Observers recorded the Prospect Peak pack successfully hunting a female and calf bison in late November, a behavior rarely recorded on the Northern Range.

Junction Butte (7 wolves; 3 adults, 4 pups)

Alpha female 970F died of unknown natural causes only two weeks after her estimated whelp date, but two subordinate



A rare visual of the Cougar Creek pack late in the year provided the Wolf Project with some interesting insight into their social structure.



females denned in the Slough Creek area. They produced a total of nine pups, and the pack was the center of wolf watching activity this year. During the fall, three pack members (a yearling male, yearling female, and one pup) were shot outside the park, alpha male 911M was killed by the Prospect Peak pack, beta male 890M dispersed to the Mollie's pack, and several yearlings and pups disappeared. From a summer high of 19 wolves, the pack ended the year with two adult females, one yearling female, and four pups.

Lamar Canyon (5 wolves; 5 adults, 0 pups)

Mange affected most members of the Lamar Canyon pack, likely playing a role in the deaths or disappearances of all three of 2015's pups and one yearling by late February. Alpha female 926F may have localized near a den, but we never observed any pups; and within several weeks the pack did not return to the area. Three adult males (992M, 993M, and uncollared "Mottled") died or disappeared, leaving only 965M and two females. In October, three males from the Beartooth pack in Wyoming traveled to Lamar Valley, and the two Lamar Canyon females stayed with them, causing 965M to disperse.

Mollie's (18 wolves; 14 adults, 4 pups)

The Mollie's pack began 2016 with no apparent alpha male, although alpha female 779F produced a litter of four pups. Three males dispersed to the Wapiti Lake pack over the summer. Perhaps with fewer adult males in the pack, Junction Butte beta male 890M was able to join the Mollie's pack in late July. The Mollie's pack spent late 2016 in their interior territory, perhaps taking advantage of winter-weakened bison.

Wapiti Lake (9 wolves; 5 adults, 4 pups)

The Wapiti Lake female produced a litter of four pups, and the pack was viewed nearly daily in Hayden Valley over the summer. In July, three males from the Mollie's pack began to interact with the females and pups, leading 755M to avoid the area. Although he delivered food to his pups for several weeks during the transition, eventually 755M left and dispersed while the new pack of nine traveled together.

Canyon (6 wolves; 5 adults, 1 pup)

Tracking this pack relied on chance sightings and remote cameras. Still led by 10-year-old 712M and the 11-year-old white alpha female, the pack was seen with one gray pup in late summer. It is unknown if a younger female is the mother of the pup. The pack traveled in the Mammoth Hot Springs area near the end of the year, following elk movements to low elevation.

Cougar Creek (8 wolves; 6 adults, 2 pups)

Much of Cougar Creek pack territory was included in the massive, yet fragmented, Maple Creek fire during summer 2016. By fall we recorded at least two pups present. A later flight confirmed the pack has at least eight members.

Cinnabar (3 wolves; 3 adults)

In July, seven year-old subordinate male 910M from the 8 Mile pack joined other wolves, including sw5023F from the Cinnabar pack. They traveled partly in old Cinnabar pack territory and were given that pack name as a result.

Snake River (14 wolves; 9 adults, 5 pups)

The Snake River pack used their traditional den site and produced at least six pups, with five still alive in the fall. One radio-collar reached the end of battery life and dropped off in the spring; the other stopped working by the end of the year.

Bechler (9 wolves; 4 adults, 5 pups)

For the first time in Bechler territory, staff deployed two remote cameras on a game trail during the fall months. Cameras successfully captured images and videos of five adults (one a white wolf) with four pups. It is unknown where the Bechler pack travels during the winter, but this was the first reliable count in years.

Outreach

Public outreach included giving 278 formal talks, participating in 82 interviews, helping 12,810 people view wolves, making 41,682 visitor contacts, and giving 772 informal talks in the field. Volunteers (table 4) worked over 13,000 hours in 2016. In April 2016, Wolf Project Research Associate Kira Cassidy gave a TEDx talk in Bozeman, MT, on the value of the oldest group members of social species, including wolves and humans. The talk titled “Aging in the wild: lessons from animals on the value of growing old” is on YouTube (<https://www.youtube.com/watch?v=Y5M7e0PWFtk&t=10s>).



NPS Photo - E. STAHLER

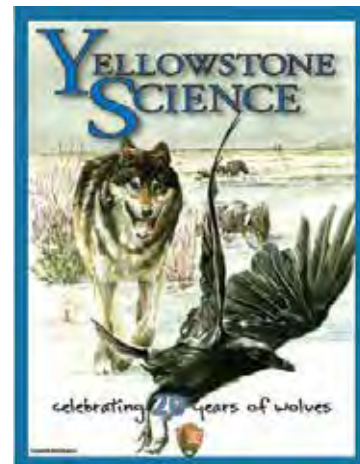
Kira Cassidy takes notes on the remains of the Junction Butte alpha female (970F) who died in Slough Creek two weeks after giving birth. (See Junction Butte pack summary for details).

Volunteers

Table 4. Wolf Project Volunteers, 2016

Name	Hours
Mallory Abel	560
Erika Anderson	560
Lizzy Baxter	296
Wesley Binder	576
Joshua Blouin	296
Ellen Brandell	192
Alison Cebula	296
Nels Christensen	280
Jane Dentinger	280
Melissa DiNino	280
Adam Fahnestock	296
Grace Glynn	304
Ky Koitzsch	704
Lisa Koitzsch	704
Lisa Lochner	280
Kenneth Loonam	296
Connor Meyer	976
Shana Olson	296
Kate Orlofsky	296
Anna Peterson	272
Collin Peterson	456
Kira Powell	576
Roberta Ryan	280
Ellie Schmidt	280
Nikki Tatton	680
Becca Thomas-Kuzilik	1,624
Rory Trimbo	576
Chad Wildermith	576
TOTAL	13,088

To download a copy of *Yellowstone Science: Celebrating 20 Years of Wolves*, visit nps.gov/yellowstonescience





The Hard Life of a Yellowstone Wolf

Wolf 911M, the alpha male of the Junction Butte pack, appeared healthy in early 2016. Although he bred with the pack's alpha female, she died during the spring with their pups. The pack still had offspring, however, when two of 911M's daughters gave birth to nine pups near Slough Creek. He traveled with the pack, hunted elk, and protected his grand-pups from an invasion by the Mollie's pack in April. At some point during the spring—between the time of the last snow melt and the park's flash of green—911M was injured, likely kicked by an ungulate, and his left mandible was shattered. We didn't know about the injury then but by late summer it was clear something was wrong, 911M had lost weight and was limping worse than ever. On September 15th 911M was seen alone in Lamar Valley and hunting a cow elk that had been injured by the Prospect Peak pack. It was a tough battle but eventually 911M took the elk down and fed. His own ribs, pelvis and

spine even more obvious due to his wet fur. Later that day the Prospect Peak pack returned and, instead of running away, 911M stood his ground. The rival pack killed him, as wolf packs work hard to eliminate any competition.

Upon examination, 911M only weighed 67 pounds—2/3rds his normal weight. His cleaned jaw (see below) told the rest of the story. The severe injury was several months old with extensive calcification, the body's long-term attempt to heal trauma to the bone. But the jaw of a wolf is constantly moving and it could never heal correctly; instead forming a gap all the way through the mandible with bone shards scattered throughout. A deeply painful injury that would have any human in intensive care and consuming fluids for months, this wolf was still living and hunting and traveling miles in the Yellowstone backcountry, until the very last day.



Photo © C. WHITMAN

Wolf 911M's shattered left mandible was a long-term injury he likely endured for months. In an attempt to heal, the mandible formed new bone tissue near the break but the jaw never stabilized into one piece due to constant movement while eating or drinking.

Publications in 2016

- Ausband, D.E., M.S. Mitchell, S.B. Bassing, A. Morehouse, D.W. Smith, D.R. Stahler, and J. Struthers. 2016. Individual, group, and environmental influences on helping behavior in a social carnivore. *Ethology* 122:963-972.
- Ausband, D.E., M.S. Mitchell, S.B. Bassing, M. Nordhagen, D.W. Smith, and D.R. Stahler. 2016. Dog days of summer: influences on decision of wolves to move pups. *Journal of Mammalogy* 97:1282-1287.
- Borg, B.L., S.M. Arthur, N.A. Broman, K.A. Cassidy, R. McIntyre, D.W. Smith, and L.R. Prugh. 2016. Implications of harvest on the boundaries of protected areas for large carnivore viewing opportunities. *PLoS ONE* 11:e0153808.
- Cassidy, K.A. 2016. Wolves in Yellowstone. Yellowstone to Yukon Conservation Initiative. February 5, 2016. <https://y2y.net/news/updates-from-the-field/wolves-in-yellowstone>.
- Cassidy, K.A. 2016. Gray wolves support each other in times of danger. *Yellowstone Quarterly*. July 28, 2016. Yellowstone Association. <https://www.yellowstoneassociation.org/article/gray-wolves-support-each-other-times-danger?a=news-item>.
- Cassidy, K.A. 2016. For gray wolves and hunter-gatherers, family is all that matters. *Earth Archives*. December 15, 2016. <http://www.eartharchives.org/articles/for-gray-wolves-and-hunter-gatherers-family-is-all-that-matters/>.
- Cassidy, K.A., and R.T. McIntyre. 2016. Do gray wolves (*Canis lupus*) support pack mates during aggressive inter-pack interactions? *Animal Cognition* 19:1-9.
- Celebrating 20 years of Wolves. 2016. Special Issue of *Yellowstone Science* 24(1).
- Charruau, P., R. A. Johnston, D. R. Stahler, A. Lea, N. Snyder-Mackler, D. W. Smith, S. W. Cole, J. Tung, and R. K. Wayne. 2016. Pervasive effects of aging on gene expression in wild wolves. *Molecular Biology and Evolution* 33:1967-1978.
- Cross, P.C., E.S. Almberg, C.G. Haase, P.J. Hudson, S.K. Maloney, M.C. Metz, A.J. Munn, P. Nugent, O. Putzeys, D.R. Stahler, A.C. Stewart, and D.W. Smith. 2016. Energetic costs of range in wolves estimated from infrared thermography. *Ecology* 97:1938-1948.
- Harrison, Q.B. Fall 2016. A very personal encounter. *International Wolf*. p. 26-27.
- Hedrick, P.W., D.W. Smith, and D.R. Stahler. 2016. Negative-assortative mating for color in wolves. *Evolution* 70:757-766.
- Smith, D.W., P.J. White, D.R. Stahler, A. Wydeven, and D.E. Hallac. 2016. Managing wolves in the Yellowstone area: balancing goals across jurisdictional boundaries. *Wildlife Society Bulletin* 40:436-445.