

Yellowstone National Park  
Yellowstone Wolf Project 2018  
Wyoming, Montana, Idaho

Yellowstone Center for Resources  
National Park Service  
Department of the Interior

An aerial photograph of a mountain slope covered in patches of snow and brown vegetation. A river flows through the bottom of the slope, and a bison is visible in the water. The text "Yellowstone Wolf Project Annual Report" is overlaid on the image.

# Yellowstone Wolf Project Annual Report

2018

## Summary

There were at least 80 wolves in 9 packs (7 breeding pairs) living primarily in Yellowstone National Park (YNP) at the end of December 2018. Overall, wolf numbers fluctuated little from 2009 to 2017 (83-108 wolves) but dropped slightly this year, particularly in the interior of Yellowstone. It is worth noting that there were two packs (Snake River and Huckleberry) which occasionally utilized the southern portion of Yellowstone but were not included in the population estimate (see wolf pack summaries). Breeding pairs (defined as an adult male and an adult female with at least two pups that survive through the end of the year) remained consistent with the historical average. Pack size in 2018 ranged from 3 to 19, averaging 8.7 in size. Park-wide, 24 pups survived to year end, split between northern Yellowstone (12) and the interior (12) of the park.

## Wolf-Prey Relationships

Project staff detected 151 kills that were definitely, probably, or possibly made by wolves in 2018: 95 elk (62.9%), 25 bison (16.6%), 11 mule deer (7.3%), 3 deer of unknown species (2.0%), 2 coyotes (3.0%), 2 pronghorn (1.3%), 1 grizzly bear (0.6%), 1 mountain lion (0.6%), and 11 unidentified animals (7.3%). The composition of wolf-killed elk was: 22.1% calves, 6.3% yearlings, 22.1% adult females, 37.9% adult males, 3.2% adults of unknown sex, and 8.4% of unknown sex and age. Wolf predation was monitored intensively for two months of the year – one month in early winter (mid-November to mid-December), one month in late winter (March). In recent years predation studies have included three months in spring-summer (May-July) but that study was not done in 2018. The type of prey killed by wolves varied by time period, but consisted primarily of elk.

## Winter Studies

During the March 2018 late winter study period, air and ground teams discovered 44 ungulate carcasses fed on by wolves. Thirty-three (75%) of these ungulates were killed by wolves, including 18 elk, 9 bison, 5 deer, and 1 unknown species. Three of the elk (17%) were calves, one (6%) was a yearling, seven (39%) were adult females, six (33%) were adult males, and one (6%) was of unknown age and sex. Wolves also fed on 11 ungulates they did not kill, 9 of which were bison.

During the November-December 2018 early winter study period, air and ground teams discovered 33 ungulate carcasses fed on by wolves. Twenty-seven (82%) of these ungulates were killed by wolves, which included 21 elk, 4 bison, 1 deer, and 1 unknown species. Seven of the elk (33%) were calves, five (24%) were adult females, and nine (43%) were adult males. The wolves also fed on six bison that they did not kill.

## Mortalities

Three radio-collared wolves died in 2018. One adult (Wapiti 1091F) and one old adult (Mollie's 779F) died of unknown natural causes as their necropsies were delayed due to remoteness and exact cause of death could not be determined

with certainty; although evidence suggests they died after being kicked by an ungulate. The third wolf (1116U), an old adult, died after being shot outside the park. In addition, staff recorded four uncollared wolf deaths. Two wolves, the alpha female of the Lamar Canyon pack (formally-collared 926F) and the alpha male of the new 1005F group, were harvested during the wolf hunting season in Montana and one subordinate adult female was harvested during Wyoming's wolf hunting season. The last uncollared wolf was a female 8-month old pup likely kicked and killed by an elk or deer. This is the first year since 1995 we recorded no intraspecific-caused mortality, which is usually the leading cause of natural mortality in the park.

## Disease

There was no evidence of any major disease mortality. Mange was present in several coyotes and foxes in or near the park boundary but was not recorded in any wolves in 2018.

Table 1 . Yellowstone wolf population estimate as of 12/31/18.

Yellowstone Wolf Population Estimate as of 12-31-18	Adults	Pups	Total
<b>NORTHERN RANGE</b>			
8 Mile	8	4	12
1005F group	3		3
Junction Butte	8	3	11
Lamar Canyon	2	3	5
Crevice Lake	5	2	7
Other (1049F)	1		1
Northern Range Totals	27	12	39
<b>NON-NORTHERN RANGE</b>			
Bechler (no collars)	4		4
Cougar Creek (no collars)	7	3	10
Mollie's	4	3	7
1118F group	1		1
Wapiti	13	6	19
Non-Northern Range Totals	29	12	41
<b>YNP Total</b>	<b>56</b>	<b>24</b>	<b>80</b>

COVER: A Mollie's wolf waits for an opportunity. This elk was later killed by the pack after a three day standoff. NPS Photo - K. Cassidy

## Yellowstone National Park Wolf Population 1995-2018

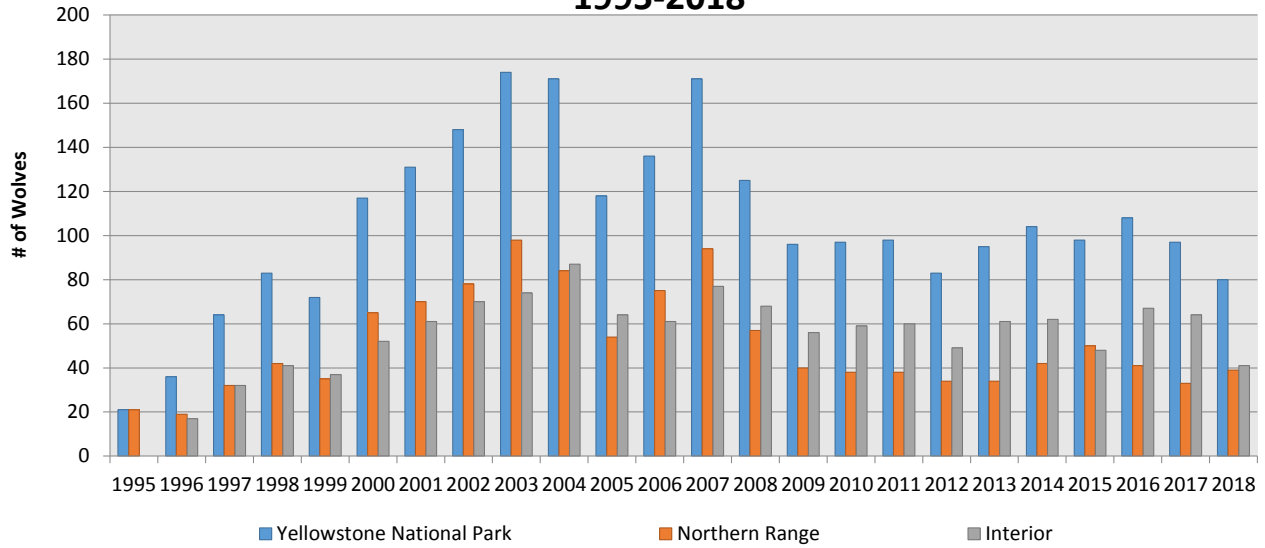


Figure 1. Yellowstone National Park early winter wolf numbers from 1995-2018.

## 2018 Yellowstone Wolf Pack Territories

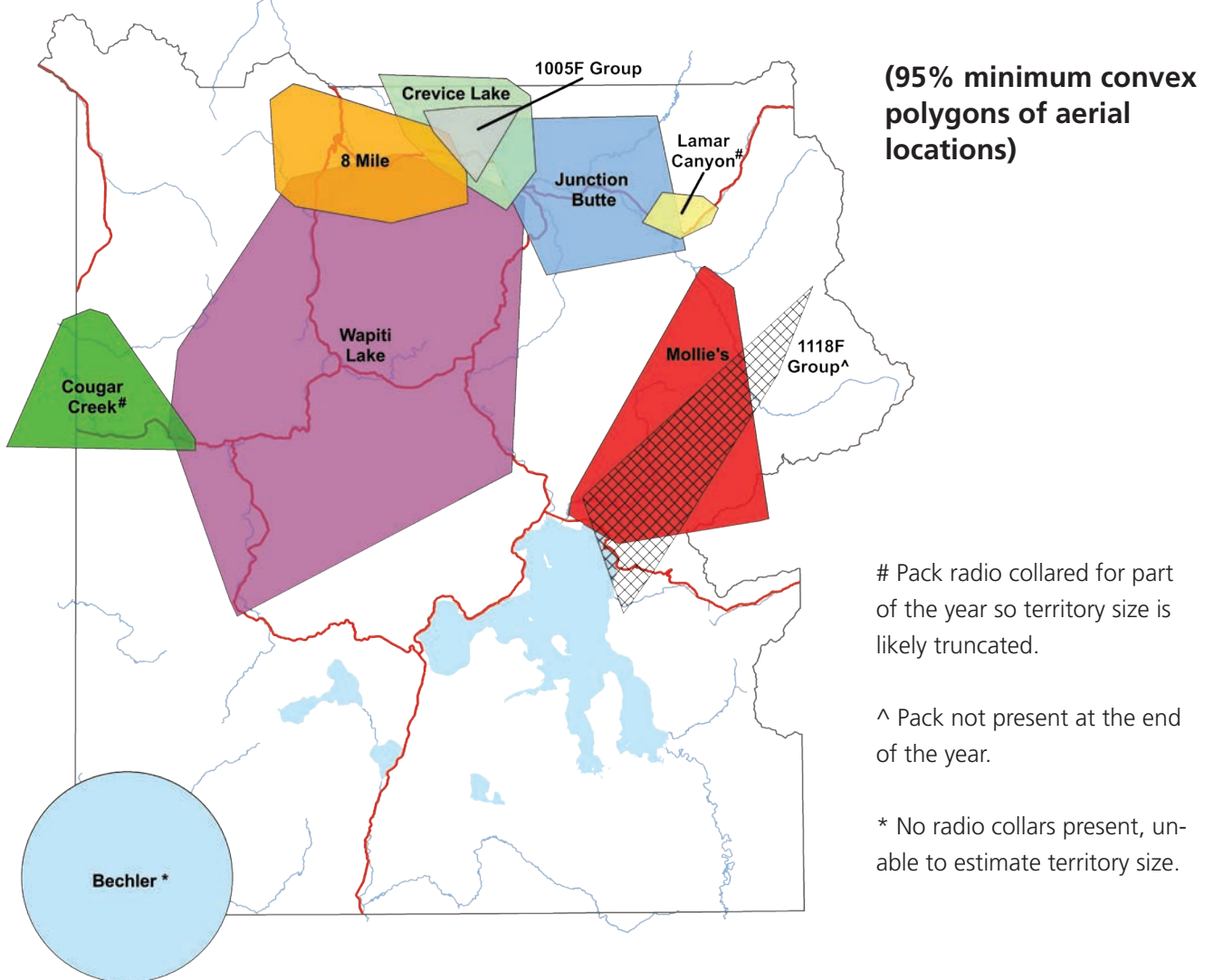


Table 2. Confirmed collared wolf mortalities in Yellowstone National Park in 2018.

Wolf #/Sex	Pack	Age Class	Date of Death	Cause of Death
1091F	Wapiti Lake	Adult	1/3/2018	Natural Unknown
1116U (Hermaphrodite)	Cougar Creek	Old Adult	2/28/2018	Human Other
779F	Mollie's	Old Adult	3/29/2018	Natural Unknown

### Pup Survival

Each year staff attempt to establish early pup counts at dens by either observing wolves from the ground through spotting scopes or, more often, taking photos of the den area during tracking flights. Early pup counts for each pack generally begin in late May and early June when pups are more consistently outside of den holes. For some packs whose densites are unknown or difficult to observe, we do not get pup counts until the pups are moved to a rendezvous site in late summer or early fall. This year the Wolf Project documented at least 38 pups born to eight different packs. Once again we were able to get exceptionally early counts from the Junction Butte pack (first pup sighting was May 7th of two pups only ~15 days old) but most pup counts were much later in the year. Both the Junction Butte (11 pups from 3 litters) and Wapiti Lake (7 pups from 2 litters) packs produced multiple litters. Of the minimum 38 pups produced in all packs, 24 (63.2%) pups survived to the end of the year.

### Wolf Capture

Twelve wolves in five packs were captured and collared in 2018. Five of these were recollars to replace old or malfunctioned transmitters. In addition to marking them, a number of measurements and biological samples were taken while the wolf was sedated. Five females, six males, and one her-  
Table 3 . Wolves captured and handled in 2018.

Wolf #/ Sex	Date of Capture	Age	Color	Pack
1116U	1/17/2018	Old Adult	Black	Cougar Creek
1117M	1/17/2018	Old Adult	Black	Cougar Creek
1118F	1/17/2018	Adult	Gray	Mollie's
1005F	2/12/2018	Adult	Black	8 Mile
1119F	2/12/2018	Yearling	Gray	8 Mile
1106M	12/9/2018	Yearling	Gray	8 Mile
1154F	12/9/2018	Yearling	Black	8 Mile
1049F	12/9/2018	Adult	Black	Alone
1014M	12/9/2018	Adult	Black	Wapiti Lake
1015M	12/9/2018	Adult	Black	Wapiti Lake
1155M	12/9/2018	Adult	Black	Wapiti Lake
1156M	12/9/2018	Yearling	Black	Wapiti Lake



Wapiti Lake female protecting her pups, who are approximately 4 weeks old. NPS photo - D. Stahler

maphrodite were captured; two were old adults ( $\geq 6$  years old), six were adults (2-5 years old), and four were yearlings.

## Wolf Management

Wolf management activities included den site closures and several hazing events. Staff continued to manage wolf viewing areas in Slough Creek, Lamar Valley, Hayden Valley, and other areas where wolves were frequently observed. Public outreach included presenting 177 formal talks (including 16 at scientific conferences), giving 75 interviews, helping at least 9,000 people view wolves, making 29,100 visitor contacts, and presenting 329 informal talks in the field.

Wyoming, Idaho, and Montana conducted wolf hunts outside of YNP, and three wolves (one from Lamar Canyon, one from 1118F group and one from 1005F group) that primarily lived within the boundaries of YNP were legally harvested. Additionally, wolf 1118F was shot and injured in WY, returned to the park, and was still alive at the end of 2018.

## Outreach

Early in 2018 Rick McIntyre retired from the National Park Service after 43 years of service. Over the course of his career Rick spoke to hundreds of thousands of people about wolves and natural ecosystems, fostering an appreciation and love for the wild. Rick was exceedingly patient and calm and used those skills to teach people not only about wolves but also appropriate ways to behave near wildlife and in a national park. For decades Rick has taken detailed notes on wolf behavior and will likely remain the human being who has watched wild wolves for the most hours in all of human history. Thank you, Rick, for your unfailing dedication.

## Other Projects

Wolf Project Leader Doug Smith advised the relocation program for Isle Royale wolves on Isle Royale National Park. The project relocated 4 wolves from the mainland to the island in the fall of 2018 and the project will continue in 2019.



Rick McIntyre, a long-time Yellowstone Wolf Project employee, retired in early 2018. Retirement looks much the same for Rick. . Photo - R. Donovan

# Using Radio Collars to Study Yellowstone Wolves

by Kira Cassidy

*“Can you check the fit of his collar?” Doug Smith, the Yellowstone Wolf Project Leader, asks while a sedated wolf rests its head in his lap. I reach over, away from the second tranquilized wolf in front of me and slide my hand under the collar. The wolf’s fur is thick and warm and for a few seconds my fingers are out of the cold and start to thaw. I tilt my hand but can’t quite turn it all the way—about 3 finger’s width of space is between the wolf’s neck and the collar.*

*“It seems perfect.” I respond as Doug holds the collar and gently pulls forward.*

*“It won’t slide off but it’s not too tight. And this adult is done growing.” He starts to attach the locking bracket and nuts, then asks both Biologist Dan Stahler and Biological Technician Erin Stahler to also check the collar’s fit after they’ve finished securing the collar on the third wolf lying between them. Every handler checks and rechecks each collar. Not only does this help eliminate any human error but takes advantage of averaging out individual handler’s tendencies to find that best fit.*



In light snow, Doug Smith and Erin Stahler fit a sedated wolf with a radio collar.

Since the reintroduction of gray wolves to Yellowstone National Park in 1995 and 1996, radio collars have been used as the main tool for monitoring and research. Collaring efforts were never intended to be used as tool to locate wolves for public viewing. Now, 24 years, 7 wolf generations, and 616 collars later, radio-collaring remains an important method to collect all kinds of data and has undergone its own technological evolution.

When wolves were first brought to Yellowstone every wolf was radio-collared. At the time the population was fairly small and every wolf was enormously valuable to the success of the reintroduction. Once the wolf population grew and expanded, there wasn’t a strong need to have every individual marked so the Yellowstone Wolf Project decided to cut back on the number of radio-collars deployed (figure 3). At this stage, the collaring objectives were to maintain telemetry contact with packs not individuals.

By the late 2000’s GPS radio-collar technology was becoming more reliable and started to replace the use of the standard VHF (Very High Frequency) collars used for so many years. The battery-life of all types of collars was also improving with some current collars lasting up to seven years. Though more expensive, GPS satellite collars ultimately offer more options for data collection and increasingly rigorous scientific questions can be answered by combining GPS movement information and observational data. Yellowstone National Park is one of the best places in the world to integrate monitoring tools and achieve significant scientific results.

A great deal of care and consideration is taken when deciding how, when, and most-importantly WHY to radio-collar any animal. Collaring of Yellowstone wolves was first mandated under the USFWS’s reintroduction plan to facilitate monitoring of the newly restored wolf population in Rocky Mountains. Annual counts of individuals, packs, and breeding pairs were necessary to meet Endangered Species Act delisting criteria and radio collars were the most effective tool available for this type of large carnivore monitoring. Simultaneous to this collaring mandate, the Wolf Project established long-term ecological studies on the effects of wolf recovery on ecosystem structure and function. Over the last two decades, radio collars have been instrumental to the scientific discovery about wolves. Studies on predator-prey interactions, social dynamics, dispersal, survival, reproduction, and multi-carnivore interactions that have benefited by the use of radio collars have placed



The final stages of attaching a radio collar include cinching it down with a driver or pliers.

Yellowstone wolves in the spotlight of large carnivore science and conservation. Building on this success, radio collar technology will continue to be integrated with other monitoring and analytical tools to keep Yellowstone wolves at the frontier of science discovery. The Wolf Project undergoes detailed and careful examination of all collaring and handling procedures, guided by NPS wildlife veterinarians and professional approved protocols.

Scientific data relies on eliminating biases so a radio-collared wolf's behavior and decisions must accurately reflect its demographic, population, and even its species for the data

to be worthwhile. For science's sake, and for the wolf's sake, collars cannot cause a wolf any issues—positive or negative.

Fitting radio-collars on wolves is an art form that takes experience and careful attention to each wolf's well-being. Wolf Project personnel consider the size, sex, and age of each wolf before adjusting a final collar neck size. For example, collaring male pups in their first winter can be the most challenging – it is important to fit these individuals slightly loose because young males stand to gain the most mass as they climb their growth curve in their first few years of life. Additionally, some wolves are naturally thinner, lankier, stockier or more muscular than others; so each collar is fit to the individual. The collars used by the Yellowstone Wolf Project weigh approximately 500 grams (0.5 kg) which amounts to 0.8-1.8% of the wolf's total body mass in proportion to the collar. This weight is less than 5% of the maximum allowable weight agreed-on by veterinarians for gray wolves based on their body weight, muscle mass, and morphology.

Wolves wearing radio-collars do not act any differently than wolves without radio-collars—we have no evidence suggesting collars influence rates of dispersal, mortality, survival, breeding success, and leadership. And the collar does not seem to bother the wearer at all. The Wolf Project has not recorded increased scratching or rubbing for wolves wearing collars; the wolves seem to completely ignore their

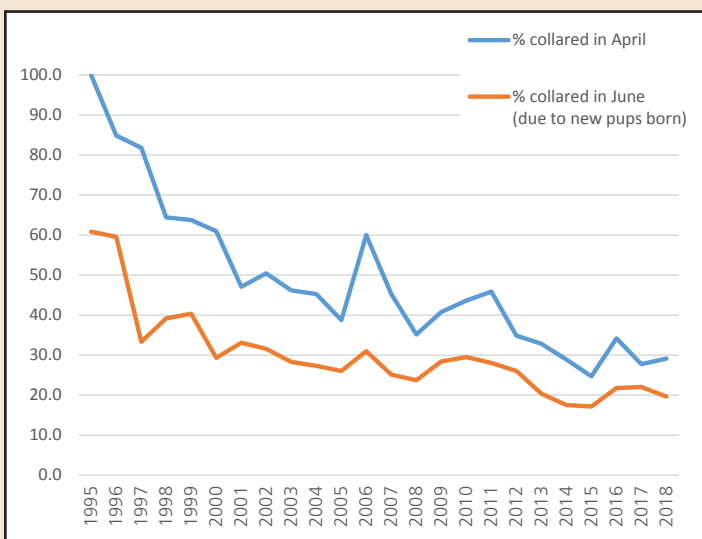


Figure 3. Percent of wolf population collared in April and June of each year.



Processing and collaring often go best when captured wolves can be grouped together, allowing the entire team to work together. Pictures are Erin (left) and Dan (right) Stahler.

own collars. A few packs have made collar-chewing a bit of a fun past-time - between 2017-2018 the anomalous Cougar Creek pack chewed off three of their six collars. This likely occurs when curious pack mates, probably younger animals who are more prone to chewing on each other in general, key in on the novelty of a collar. Besides these few exceptions, the collars appear to be completely ignored.

A few wolf packs in Yellowstone have territories in thicker forested areas or more remote areas of the park which makes capture and monitoring difficult. Because these packs are more challenging to deploy radio-collars, other tools like remote camera traps are used to monitor. This type of data is limited compared to radio-collar data but the information can be used to accurately estimate total wolf numbers and density, pack sizes, and sometimes reproduction in the pack. Noninvasive genetic data can also be collected, primarily from scat and hair left behind on the landscape, and used to identify unique DNA profiles of individuals. Some Yellowstone research has relied on such methods for documenting pack size and reproduction.

Due to this great care and concern for wolf welfare, only three wolves (<1%) have died due to collaring efforts in the last 24 years. This is well below the rate considered acceptable (2-3%) for wildlife handling studies and had our mortality been at that level 12-18 wolves would have died.

Studying a charismatic apex predator of Yellowstone National Park is continually a fascinating, rewarding, and humbling experience. The Wolf Project goals and research constantly

adjusts to current technology, National Park Service and veterinarian guidance, and the wolves themselves. Because of the team of people dedicated to the welfare of Yellowstone's wildlife, radio-collaring remains a safe and effective way to study the mysterious and wild gray wolf. Through the 24 years of wolf research in Yellowstone National Park, many questions have been answered, and more have emerged, about wolf ecology, their societies, and vulnerabilities to humans and human-altered changes to ecosystems. The curiosity, and the science, continues.



A sedated wolf sleeps off the drug.



## **Wolf Pack Summaries**

### ***8 Mile (12 wolves; 8 adults, 4 pups)***

After the 2018 breeding season the alpha male went missing but the role was taken on by elderly beta 962M. Total pack numbers changed very little when the uncollared alpha female produced four pups because a group of four adult females dispersed to form 1005F's group in the fall. In late November, 962M was injured after a fight with the Wapiti Lake pack. He was unable to keep up with the pack and could only travel short distances. After recovering from the injury, 962M was observed with the alpha female and several packmates, but became a loner by year's end.

### ***963F group (unknown number of wolves, monitored by MTFWP)***

After travelling alone for much of the 2017-2018 winter 963F did not den and shifted her movements outside Yellowstone National Park by the spring. She became part of a pack of wolves monitored by Montana Fish, Wildlife, and Parks.

### ***Crevice Lake (7 wolves; 5 adults, 2 pups)***

This new pack was stable for most of 2018, successfully raising three pups into the late fall. In late November, the pack encountered 1005F's group resulting in social disruption. Although, conflict between rival packs is not uncommon, rarely does it lead to pack splitting and reconfiguration. Following this encounter, the Crevice Lake pack split, with the adult males (alpha 1108M, 1107M, and old "Graybeard") traveling for weeks with 1005F and two other females (likely their sisters or nieces from the 8 Mile pack). The Crevice Lake females and pups (with no radio-collars) were only seen once during December. End of year pack numbers reflect the Crevice Lake pack size before the switch with 1005F group.

### ***1005F group (3 wolves; 3 adults)***

For much of 2017-2018, 1005F and several other young females from the 8 Mile pack were only sporadically with the main 8 Mile pack. A few females were believed to have denned separately and after rejoining 8 Mile for a few months, left again by the fall 2018. The four females, including 1005F, 1119F, 1049F, and an uncollared gray, were joined by a large jet-black male of unknown origin. This group was carving out a territory on the Northern Range until the alpha male was legally shot during a foray north of the park boundary. Three of the four females remained together and following an encounter with the Crevice Lake pack, joined up with the Crevice males (who are possibly their brothers from the 8 Mile pack) for a few weeks in December. End of year pack numbers do not count the Crevice Lake wolves.

### ***Prospect Peak (0 wolves)***

Alpha male 964M's collar was untrackable due to a dead battery and the pack was only observed a few times in early 2018 with two to three wolves. Likely the pack either disintegrated due to death and dispersal or shifted out of the park.

### ***Junction Butte (11 wolves; 8 adults, 3 pups)***

All four Junction Butte pack females bred and produced pups in 2018, three of them at the popular Slough Creek den area visible from the campground road. The fourth female, 1109F, denned along the Yellowstone River by herself and was occasionally helped by one of the two pack males. By late May, as many as 11 pups were counted at the Slough den, nursed by all three females. Wolf 1109F returned to the pack, having lost her pups to unknown natural causes. Subordinate male 996M showed an unusual infatuation with the small pups, at times he would roughly play and try to pick them up and this led to the death of at least one pup and possible more. The adult females were protective over the pups and sometimes aggressively pinned 996M when he was close, but otherwise he behaved as a normal subordinate member of the pack. Only three pups survived the summer and it is unknown how the others died. Again this year, the dominant female role switched, this time from 969F back to 907F (who had been the alpha from May 2016 to May 2017) and 969F remained with the pack in a subordinate role. The pack expanded their territory east as they outnumbered their neighbors, Lamar Canyon and Mollie's.

### ***Lamar Canyon (5 wolves; 2 adults, 3 pups)***

Former Alpha female 926F's collar slipped off in early May inside her den and the pack became untrackable (no other collared members). Before breeding season in early 2018, the 4.5 year old uncollared female showed dominance over 926F. Chance sightings of this pack were rare until October when the pack adults were observed with five pups, the first successful litter for the pack since 2015. It is unknown if the pups' mother was 926F or the 4.5 year old uncollared alpha female or a mix of both. In late November the pack was travelling near Silver Gate, Montana outside of the Yellowstone boundary and 926F was legally shot. By the end of the year the pack consisted of two adults and three pups.

### ***Mollie's (7 wolves; 4 adults, 3 pups)***

Long-time alpha female 779F's reign ended when she died in late March 2018, possibly due to a kick from an ungulate while hunting. She was pregnant at the time. Beta female 978F denned and had pups, as did subordinate female 1118F (see 1118F's group write-up). The pack members split their assistance to these females, and spatial movements of the

females did not overlap with one another. By the end of the year Mollie's consisted of only seven wolves (three of them pups), which is the smallest the pack has been since 2013. Unlike previous years, the Mollie's rarely travelled to the northern range, perhaps avoiding larger, more experienced packs.

### ***Wapiti Lake (19 wolves; 13 adults, 6 pups)***

The Wapiti Lake pack began 2018 as the largest pack in the park and after producing two litters (seven pups total) numbered as many as 22 by the fall. After a fight with the 8 Mile pack in late November, eight males from the Wapiti Lake pack stayed on the Northern Range while the alpha female, female yearlings (including 1104F), and pups made several trips to the southern part of their territory. By the end of the year the pack had not regrouped and the males were still on the Northern Range. Wapiti Lake's white alpha female, led the rest of pack like normal in their consistent territory between Old Faithful and Hayden Valley and up to Tower Junction. The end of year pack size reflects both groups of Wapiti Lake wolves together as the split occurred so late in the year.

### ***1118F (1 wolf; 1 adult, 0 pups)***

Two females from the Mollie's pack dispersed, denned separate from the main group, and tried to carve out a territory in the southern Pelican Valley/Lake Butte area. In the fall the pack's two pups and three adults were traveling along the eastern boundary of Yellowstone when the subordinate female was legally shot and killed. During this same event 1118F was shot and injured. 1118F slowly made her way back into the park and spent the rest of 2018 alone, scavenging on winter-killed ungulates and other pack's kills.

### ***Cougar Creek (10 wolves; 7 adults, 3 pups)***

During handling for collaring operations, it was found that the wolf assumed to be the alpha female was actually a hermaphrodite. This wolf, 1116U (U denotes neither male or female status given), died in late February due to an apparent gunshot wound outside the park. Unfortunately, the alpha male 1117M's collar was chewed off a few weeks later and the pack, once again, became untrackable. A sighting in early 2019 found the Cougar Creek pack with 10 wolves; at least 3 of them were pups and uncollared alpha male 1117M was still with the pack.

### ***Bechler (4 wolves; 4 adults, 0 pups)***

Trail cameras placed near the Bechler pack's traditional den showed four adult wolves using the area all winter and into late April. A black bear was photographed going into the den about eight days after the wolves localized. After that the wolves only occasionally travelled past and no sign of pups in

the traditional rendezvous indicated the pups were lost. We relied on trail cameras and chance sightings to monitor this pack and determined there may still be about four adults in the pack by the end of the year.

### ***1049F***

Originally from the 8 Mile pack, 1049F dispersed to help form 1005F's group but when the group encountered the Crevice Lake pack and her pack mates began to travel with the Crevice Lake males, 1049F moved off on her own for the rest of the year.

### ***Other wolves***

*Snake River (6 adults, 0 pups – not counted as part of YNP population)* - The Snake River pack shifted their territory outside Yellowstone's boundaries to the southeast and were largely monitored by Wyoming Game and Fish Department (WYGF). At years end, they did not have a successful breeding pair and were believed to be disbanded.

*Huckleberry (10 wolves; 4 adults, 6 pups – not counted as part of YNP population)* - The Huckleberry pack denned in the park in 2018, but spent most of its time outside of the Park and was monitored jointly by WYGF and Grand Teton National Park.

### **Publications**

- Cassidy, K.A. 2018. The annual cycle of aggression between wolf packs. *International Wolf*: 4-7.
- Cassidy, K.A., D.W. Smith, B.L. Borg, and S. Dewey. 2018. Wolf hunting adjacent to National Parks: measuring impacts to wolf populations, pack stability, and long-term research. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, WY, USA.
- Cross, P.C., F.T. van Manen, M. Viana, E.S. Almberg, D. Bachen, E.E. Brandell, M.A. Haroldson, P.J. Hudson, D.R. Stahler, and D.W. Smith. 2018. Estimating distemper virus dynamics among wolves and grizzly bears using serology and Bayesian state-space models. *Ecology and Evolution* 8:8726-8735.
- Kohl, M.T., D.R. Stahler, M.C. Metz, J.D. Forester, M.J. Kauffman, N. Varley, P.J. White, D.W. Smith, and D.R. MacNulty. 2018. Diel predator activity drives a dynamic landscape of fear. *Ecological Monographs* 88:638-652.
- Heppenheimer, E., K.E. Brzeski, R. Wooten, W. Waddell, L.Y. Rutledge, M.J. Chamberlain, D.R. Stahler, J.W. Hinton, and B.M. vonHoldt. 2018. Rediscovery of red wolf ghost alleles in a canid population along the American Gulf Coast. *Genes* 9:618.
- Martin, H.W., L.D. Mech, J. Fieberg, M.C. Metz, D.R. MacNulty, D.R. Stahler, and D.W. Smith. 2018. Factors

affecting gray wolf (*Canis lupus*) encounter rate with elk (*Cervus elaphus*) in Yellowstone National Park. *Canadian Journal of Zoology* 96:1032-1042.

Metz, M.C. 6 September 2018. Wolves, bull elk, and the cost of shedding antlers. *The Nature Ecology and Evolution Community*. <https://natureecoevocommunity.nature.com/channels/521-behind-the-paper/posts/38536-wolves-bull-elk-and-the-cost-of-shedding-antlers>

Metz, M.C., D.J. Emlen, D.R. Stahler, D.R. MacNulty, D.W. Smith, and M. Hebblewhite. 2018. Predation shapes the evolutionary traits of cervid weapons. *Nature Ecology & Evolution* 2:1619-1625.

Saremi, N.F., M.A. Supple, A. Byrne, J.A. Cahill, L.L. Coutinho, L. Dalen, H.V. Figueiro, W.E. Johnson, H. J. Milne, S.J. O'Brien, B. O'Connell, D.P. Onorato, S.P.D. Riley, J.A. Sikich, D.R. Stahler, P.M. S. Villela, C. Vollmers, R.K. Wayne, E. Eizirik, R.B. Corbett-Detig, R.E. Green, C.C. Wilmers, and B. Shapiro. 2018. Mountain lion genomes provide insights into genetic rescue of inbred populations. *bioRxiv*: 482315.

Schweizer, R.M., A. Durvasula, J. Smith, S.H. Vohr, D.R. Stahler, M. Galaverni, O. Thalmann, D.W. Smith, E. Randi, E.A. Ostrander, R.E. Green, K.E. Lohmueller, J. Novembre, and R.K. Wayne. 2018. Natural selection and origin of a melanistic allele in North American gray wolves. *Molecular Biology and Evolution* 35:1190-1209.

vonHoldt, B.M., S.S. Ji, M.L. Aardema, D.R. Stahler, M.A.R. Udell, and J.S. Sinsheimer. 2018. Activity of genes with functions in human Williams–Beuren syndrome is impacted by mobile element insertions in the gray wolf genome. *Genome Biology and Evolution* 10:1546-1553.

Walker, L.E., M.J. Marzluff, M.C. Metz, A.J. Wirsing, L.M. Moskal, D.R. Stahler, and D.W. Smith. 2018. Population responses of common ravens to reintroduced gray wolves. *Ecology and Evolution* 8:11158-11168.

## Acknowledgements

We thank the many interested people who come forward every year to work with and help Yellowstone wolves. First and foremost, we thank the Wolf Project volunteers, without whom we would not be able to complete this research. We thank Yellowstone Forever for their support of this program. We also thank the many generous individuals, foundations, and organizations that have provided funding for the Wolf Project (through what is now Yellowstone Forever) since 1996. We also appreciate the safe piloting from Bob Hawkins of Sky Aviation, Jim Pope of Leading Edge, and Mark Packila of Wildlife Air. We would not be able to learn about wolves and teach the rest of the world without all of the above support. Thank you all.

## 2018 Wolf Project Volunteers

Name	Hours
Adam Fahnestock	288
Annie Merrill	438
Annie Stevens	288
Avery Mickey	296
Dylan Sanborn	288
Elise Loggers	296
Evan Shields	296
Jeremy SunderRaj	288
Lily Harrison	296
Lucas Henzler	288
Maddy Jackson	288
Mallory Abel	296
Megan Wright	296
Nels Christensen	296
Nicholas Riso	288
Nikki Tatton	296
Richard Brown	296
Sonia Howlett	288
Tessa Cardinal	288
Zach Fogel	288
TOTAL	5982



The Junction Butte pack contemplates its next move. NPS

Photo - D. Smith

BACK COVER: A Winter Study volunteer surveys the morning landscape. NPS Photo - D. Sanborn

For a complete list of our publications, please visit: [go.nps.gov/yellowwolves](https://go.nps.gov/yellowwolves)



Suggested citation: Smith, D., D. Stahler, K. Cassidy, E. Stahler, M. Metz, B. Cassidy, L. Koitzsch, L. Cato, C. Meyer, E. Loggers, J. Rabe, N. Tatton, R. Thomas-Kuzilik, and K. Koitzsch. 2019. Yellowstone National Park Wolf Project Annual Report 2018. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, WY, USA, YCR-2019-02.