

WYOMING GRAY WOLF MONITORING AND MANAGEMENT

2018 ANNUAL REPORT



Prepared by the Wyoming Game and Fish Department in cooperation with the National Park Service, U.S. Fish and Wildlife Service, USDA-APHIS-Wildlife Services, and Eastern Shoshone and Northern Arapahoe Tribal Fish and Game Department to fulfill the U.S. Fish and Wildlife Service requirement to report the status, distribution and management of the gray wolf population in Wyoming from January 1, 2018 through December 31, 2018.



EXECUTIVE SUMMARY

At the end of 2018, the wolf population in Wyoming remained above minimum delisting criteria; making 2018 the 17th consecutive year Wyoming has exceeded the numerical, distributional, and temporal delisting criteria established by the U.S. Fish and Wildlife Service. At least 286 wolves in ≥ 46 packs (including ≥ 20 breeding pairs) inhabited Wyoming on December 31, 2018. Of the total, there were ≥ 80 wolves and ≥ 9 packs (including 7 breeding pairs) in Yellowstone National Park, ≥ 10 wolves and ≥ 2 packs (no breeding pairs) in the Wind River Reservation, and ≥ 196 wolves and ≥ 35 packs (including ≥ 13 breeding pairs) in Wyoming outside Yellowstone National Park and the Wind River Reservation (WYO). A total of 177 wolf mortalities were documented statewide in Wyoming in 2018: 172 in WYO, 3 in Yellowstone National Park, and 2 in the Wind River Reservation. Causes of mortality included: human-caused = 159 (90% of mortalities); natural = 16 (9%); and unknown = 2 (1%). Sixty wolves were captured and telemetry collared for monitoring and research in 2018.

In 2018, the Wyoming Game and Fish Department implemented a wolf hunting season with the biological objective to reduce the wolf population to approximately 160 wolves in the Wolf Trophy Game Management Area. A mortality limit of 58 wolves was divided between 14 hunt areas in WYO. Wolf hunting seasons were open from September 1, 2018 through December 31, 2018 with the exception of hunt area 12, which opened on October 15, 2018. A total of 43 wolves (39 legal and 4 illegal) were killed during the wolf hunting season. Wolves could also be taken in any legal manner in Wyoming where they are designated as predatory animals. Forty-two wolves were taken by the public under predatory animal status in 2018.

Wolves were confirmed to have killed 71 head of livestock (55 cattle, 15 sheep and 1 horse) statewide in Wyoming in 2018. An additional 7 cattle (5 calves and 2 cows/yearlings) and 1 horse were confirmed as injured by wolves. Twenty-three packs were involved in ≥ 1 livestock conflict statewide in Wyoming, 16 packs were involved in ≥ 2 livestock conflicts and 12 packs were involved in ≥ 3 livestock conflicts. Sixty-six wolves were lethally removed by agencies or the public following livestock conflict in an effort to reduce livestock losses to wolves.

A total of $\geq \$1,526,334$ was spent on wolf monitoring and management activities in Wyoming in 2018 for all jurisdictions combined as follows: Wyoming Game and Fish Department = $\geq \$630,010$ ($\geq \$460,903$ for wolf monitoring and management and $\$169,107$ for livestock damage compensation); USDA Wildlife Services = $\$35,324$; Grand Teton National Park = $\$141,000$; Wind River Reservation = $\$20,000$; and Yellowstone National Park = $\$700,000$.

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BACKGROUND

Beginning in 1995, the U.S. Fish and Wildlife Service reintroduced 41 gray wolves (wolves) into Yellowstone National Park, Wyoming as a nonessential experimental population under the Endangered Species Act with the goal of reestablishing a recovered gray wolf population in the northern Rocky Mountains. The U.S. Fish and Wildlife Service was the federal agency charged with administering, monitoring, and managing the wolf population following reintroduction until wolves reached recovery levels and Endangered Species Act protections could be removed (“delisting”). The wolf population expanded quickly in number and distribution throughout northwest Wyoming. The population reached the required delisting criteria by late 2002 and has exceeded the recovery criteria every year since. More information on wolves and the history of the wolf reintroduction program can be found on the U.S. Fish and Wildlife Service website and the Wyoming Game and Fish Department website at the following links:

<https://www.fws.gov/mountain-prairie/es/grayWolf.php>

<https://wgfd.wyo.gov/Wildlife-in-Wyoming/Large-Carnivore/Wolves-in-Wyoming>

Wolves were delisted in Wyoming in September 2012 following the approval of the Wyoming Gray Wolf Management Plan, Wyoming Game and Fish Commission regulations, and Wyoming Statutes by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2012). This delisting decision was challenged in U.S. District Court in Washington, D.C., which overturned the delisting and relinquished management authority for wolves in Wyoming back to the U.S. Fish and Wildlife Service. The District Court decision was subsequently appealed by the U.S. Fish and Wildlife Service and State of Wyoming in the U.S. Court of Appeals in Washington, D.C., which ruled in favor of the U.S. Fish and Wildlife Service and State and returned management of wolves to the State of Wyoming on April 25, 2017. Since delisting, wolves have been monitored and managed by the National Park Service in Yellowstone National Park and Grand Teton National Park, the Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department in cooperation with the U.S. Fish and Wildlife Service Lander Fish and Wildlife Conservation Office on tribal lands in the Wind River Reservation, the U.S. Fish and Wildlife Service on the National Elk Refuge, and the State of Wyoming in all remaining areas of Wyoming outside these jurisdictions. Each management agency has different laws, regulations, and/or management plans governing wolf management and, accordingly, each jurisdiction has varying wolf management objectives and philosophies. The following is a summary of the management direction by agency.

National Park Service

The National Park Service is responsible for monitoring and managing wolves in national parks in Wyoming. The National Park Service’s primary wolf management approach is to allow natural processes to occur within the boundaries of national parks with minimal human intervention. More information on National Park Service wolf programs in Wyoming can be found at the following links:

<https://www.nps.gov/yell/learn/nature/wolfmgnt.htm>

<https://www.nps.gov/grte/index.htm>

Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department

The Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department, in cooperation with the U.S. Fish and Wildlife Service Lander Fish and Wildlife Conservation Office, is responsible for monitoring and management of wolves on tribal lands within the boundaries of the Wind River Reservation. The Wind River Reservation Wolf Management Plan designates wolves as a trophy game animal, but there were no open hunting seasons in 2018 and wolves could only be legally killed to defend life or property. For more information, see the Wind River Reservation Wolf Management Plan at:

https://www.fws.gov/mountain-prairie/es/species/mammals/wolf/Wind_River_Res_Wolf_Plan_20070413.pdf

National Elk Refuge

The National Elk Refuge, managed by the U.S. Fish and Wildlife Service, was established to provide winter habitat and supplemental winter feeding for the Jackson Elk Herd. The U.S. Fish and Wildlife Service is responsible for management of all wildlife species, including wolves, within National Elk Refuge boundaries. More information on the National Elk Refuge can be obtained at:

https://www.fws.gov/refuge/national_elk_refuge/

Wyoming Game and Fish Department

Wolves in Wyoming outside Yellowstone National Park and the Wind River Reservation (WYO) are monitored and managed by the Wyoming Game and Fish Department. The Wyoming Game and Fish Department wolf management approach is to maintain a recovered wolf population in Wyoming while balancing the need to minimize wolf conflicts with livestock and wild ungulate herds. Wyoming's Gray Wolf Management Plan also seeks to incorporate public hunting opportunity into its wolf population management strategy. Wyoming's wolf management framework is more complex than the National Park Service's and the Wind River Reservation's and warrants more detailed explanation. As required by state law, wolves in WYO are managed under the dual classifications of trophy game animal and predatory animal as outlined in the Wyoming Gray Wolf Management Plan and approved by the U.S. Fish and Wildlife Service. There are 3 wolf management "zones" in WYO, as follows:

1. *Wolf Trophy Game Management Area (WTGMA)*: Wolves are designated as trophy game animals year-round within the WTGMA. Wolves in the WTGMA are managed similar to other trophy game species (e.g., black bears and mountain lions) and may only be taken by the public when in the act of doing damage to private property, in self defense, under the authority of a lethal take permit, or by licensed hunters during an open wolf hunting season. Livestock owners who have confirmed livestock damage caused by wolves in the WTGMA may qualify for compensation from the Wyoming Game and Fish Department.
2. *Seasonal WTGMA*: Wolves are designated as trophy game animals in the Seasonal WTGMA from October 15 through the last day of February of the subsequent year and as

predatory animals from March 1 to October 14 each year. Wolves may be taken by the public similar to wolves in the WTGMA while they are designated as trophy game animals, or may be taken as predatory animals for the remainder of the year (see below). Livestock owners who have confirmed livestock damage caused by wolves in the Seasonal WTGMA may qualify for compensation from the Wyoming Game and Fish Department on a year-round basis regardless of the date damage occurred.

3. *Areas when and where wolves are designated as predatory animals:* Wolves are designated year-round as predatory animals in areas outside of the WTGMA and also within the Seasonal WTGMA from March 1 to October 14 (see above). Predatory animals may be taken anytime in any legal manner. Livestock owners who have confirmed wolf depredation on livestock outside the WTGMA/Seasonal WTGMA do not qualify for compensation from the Wyoming Game and Fish Department unless their private land is bisected by the WTGMA or Seasonal WTGMA boundary.

For more information on the wolf management framework in WYO, including the Wyoming Gray Wolf Management Plan and wolf management and hunting regulations, please visit the following link:

<https://wgfd.wyo.gov/Wildlife-in-Wyoming/Large-Carnivore/Wolves-in-Wyoming>

Wolf Population Delisting Criteria and Post-Delisting Monitoring

The U.S. Fish and Wildlife Service set specific recovery goals for wolves in the northern Rocky Mountains that were required to be met prior to delisting. The wolf population in the northern Rocky Mountains must also continue to meet or exceed the U.S. Fish and Wildlife Service's delisting criteria post-delisting to ensure the population remains recovered. The U.S. Fish and Wildlife Service developed minimum delisting criteria of ≥ 300 wolves and ≥ 30 breeding pairs (a pack with at least 1 adult male and 1 adult female wolf that successfully raise at least 2 pups of the year until December 31) in the northern Rocky Mountains for 3 consecutive years. These criteria were developed using input from many wolf experts from around the world.

Additionally, the U.S. Fish and Wildlife Service developed delisting criteria that required the states to maintain a 50% buffer above minimum delisting criteria (i.e., ≥ 450 wolves and ≥ 45 breeding pairs in the northern Rocky Mountains) to ensure the population never fell below minimum delisting goals. The delisting criteria were then subdivided equally among the states of Montana, Idaho, and Wyoming, resulting in a minimum population requirement of ≥ 150 wolves and ≥ 15 breeding pairs in each state at the end of the calendar year. Under the terms of the delisting agreement between Wyoming and the U.S. Fish and Wildlife Service, the state of Wyoming is required to maintain wolves at or above the minimum delisting criteria of ≥ 100 wolves and ≥ 10 breeding pairs in WYO, with Yellowstone National Park and the Wind River Reservation providing the additional ≥ 50 wolves and ≥ 5 breeding pairs necessary to meet the ≥ 150 wolf and ≥ 15 breeding pair requirement for the state (U.S. Fish and Wildlife Service 2012).

Under the Endangered Species Act, states are required to manage delisted species in a sustainable manner to ensure the population will remain above the minimum delisting criteria into the foreseeable future. Once delisting occurs, the U.S. Fish and Wildlife Service is required,

in cooperation with the states, to monitor the status of delisted species. The primary goal of post-delisting monitoring is to provide the U.S. Fish and Wildlife Service with a mechanism for evaluating the status of the population and ensure states are managing the delisted population at or above minimum delisting criteria. This annual report is a product of cooperation between all agencies in Wyoming with wolf monitoring and management responsibility and provides the U.S. Fish and Wildlife Service with the required information for their post-delisting monitoring evaluation for the 2018 calendar year.

Reporting Wolf Population Data by Jurisdiction

Generally, states are solely responsible for monitoring and managing delisted species. In Wyoming, however, multiple large jurisdictions where the state does not have management authority, primarily Yellowstone National Park and the Wind River Reservation, contain significant portions of the wolf population and/or suitable wolf habitat. This sharing of large portions of the wolf population adds complexity to management in Wyoming and made it difficult to determine which jurisdiction was responsible for what proportion of minimum delisting criteria. Therefore, it was necessary to clarify how many wolves and breeding pairs each jurisdiction would contribute toward minimum delisting criteria (i.e., ≥ 150 wolves and ≥ 15 breeding pairs in Wyoming at the end of the calendar year). The U.S. Fish and Wildlife Service and state of Wyoming agreed on a framework that would assign proportions of the minimum delisting criteria to the 3 major jurisdictions as follows:

1. The state of Wyoming is responsible for maintaining ≥ 100 wolves and ≥ 10 breeding pairs in WYO. While the state does not have management authority over wolves in all areas in WYO such as Grand Teton National Park and the National Elk Refuge, these areas are small and the wolf packs using these areas are not solely contained within their boundaries. Therefore, wolves in Grand Teton National Park and the National Elk Refuge are assigned to WYO.
2. Yellowstone National Park, in combination with the Wind River Reservation, is expected to contribute the remaining ≥ 50 wolves and ≥ 5 breeding pairs necessary to meet the ≥ 150 wolf and ≥ 15 breeding pair requirement. Data for these jurisdictions are reported independently in the body of this report.

For purposes of this report, data are presented on the wolf population as a whole in Wyoming and are further summarized by the 3 major jurisdictions (i.e., WYO, Yellowstone National Park, and the Wind River Reservation) to allow for proper evaluation of the wolf population both statewide and by major jurisdiction.

WYOMING GRAY WOLF MONITORING AND MANAGEMENT **2018 ANNUAL REPORT**

WOLF POPULATION MONITORING

SUMMARY OF WOLF POPULATION MONITORING STATEWIDE

At the end of 2018, the wolf population in Wyoming remained above minimum delisting criteria; making 2018 the 17th consecutive year Wyoming has exceeded the numerical, distributional, and temporal delisting criteria established by the U.S. Fish and Wildlife Service. At least 286 wolves in ≥ 46 packs (including ≥ 20 breeding pairs) inhabited Wyoming on December 31, 2018. Of the total, there were ≥ 80 wolves and ≥ 9 packs (including 7 breeding pairs) in Yellowstone National Park, ≥ 10 wolves and ≥ 2 packs (no breeding pairs) in the Wind River Reservation, and ≥ 196 wolves and ≥ 35 packs (including ≥ 13 breeding pairs) in Wyoming outside Yellowstone National Park and the Wind River Reservation (WYO). A total of 177 wolf mortalities were documented statewide in Wyoming in 2018: 172 in WYO, 3 in Yellowstone National Park, and 2 in the Wind River Reservation. Causes of mortality included: human-caused = 159 (90% of mortalities); natural = 16 (9%); and unknown = 2 (1%). Sixty wolves were captured and telemetry collared for monitoring and research in 2018.

Wolf Population Monitoring in WYO

Population and Breeding Pair Status

The minimum number of wolves in Wyoming on December 31, 2018 was determined using standard wolf monitoring methods used since their reintroduction. The number of wolves in individual packs was estimated at the end of the year by counting wolves from the air during aerial telemetry flights and capture operations, observations confirmed by qualified agency personnel, or pictures of known packs taken with remote cameras. Only pack observations obtained by agency personnel from December 2018 through March 2019 were included to ensure they were reflective of the minimum number of wolves present on December 31, 2018. Miscellaneous, mostly solitary, wolves were included in the estimate only if the animal was not a member of a known pack. In WYO, wolf monitoring is most intensive in the Wolf Trophy Game Management Area (WTGMA) with less intensive monitoring in the Seasonal WTGMA and predatory animal areas (Figure 1). Packs with territories overlapping jurisdictional boundaries (e.g., state, national park, tribal boundaries, etc.) were assigned to the jurisdiction which held the majority of their documented locations during 2018. The final minimum population count was the sum of all pack counts and miscellaneous wolves known to be present on December 31, 2018.

Breeding pair status was also determined using the same methods since wolves were reintroduced to the northern Rocky Mountains. Denning behavior was confirmed for individual packs using aerial and ground telemetry and ground investigations during spring. The presence of pups with packs was confirmed using observations made during aerial and ground monitoring efforts, investigations of potential den and rendezvous sites, howling surveys, reports confirmed by

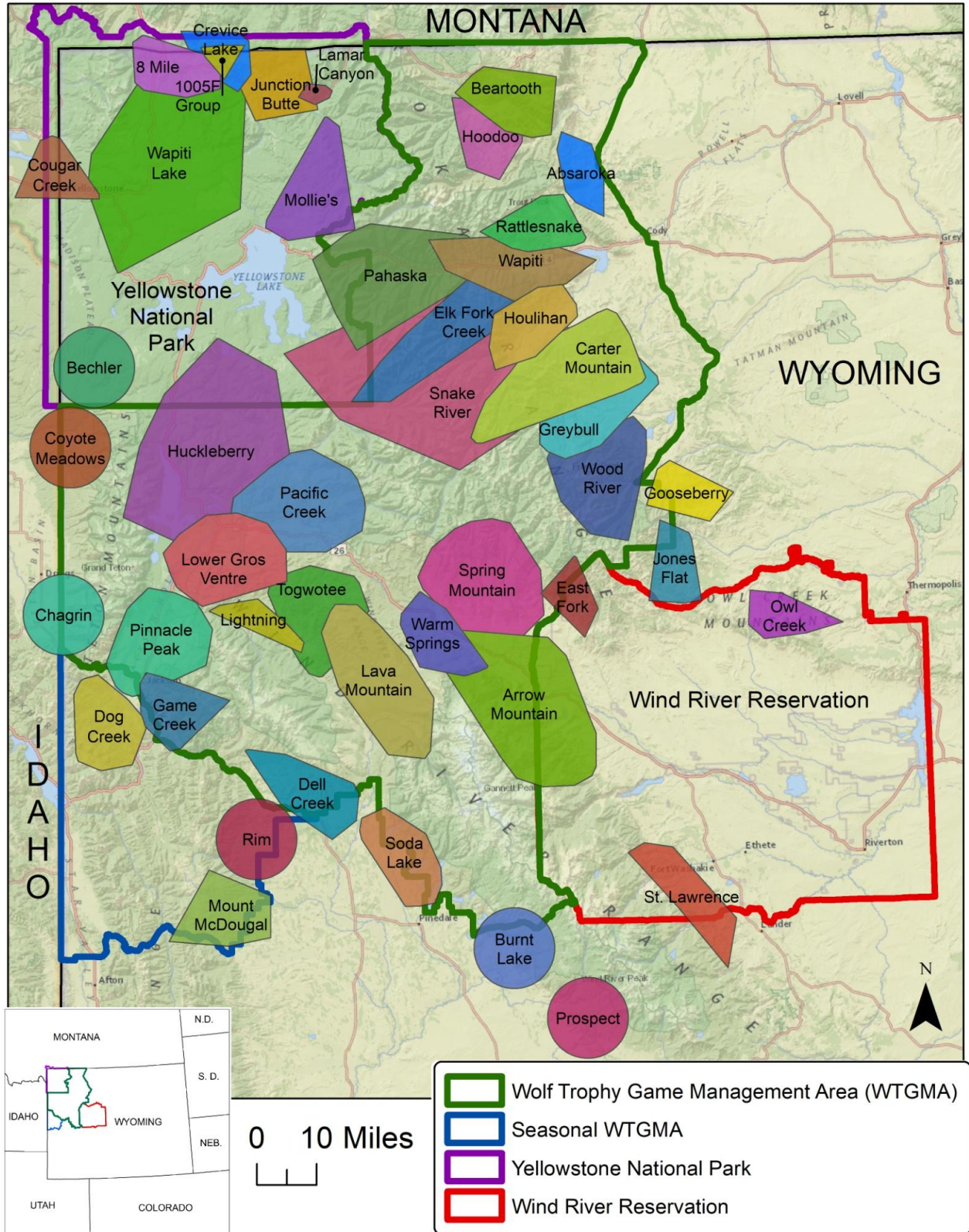


Figure 1. Home ranges of confirmed wolf packs in Wyoming on December 31, 2018.

Table 1. Wolf packs, wolf mortality, and livestock killed by wolf packs in WYO and statewide in 2018.

WOLF PACK ^{1,2}	MINIMUM PACK SIZE	DOCUMENTED MORTALITIES					KNOWN		CONFIRMED LOSSES ⁹					
		NATURAL	HUMAN ³	UNKN ⁴	HUNTING ⁵	PRED. ANIMAL ⁶	CONTROL ⁷	DISPERSED	MISSING ⁸	CATTLE	SHEEP	DOGS	OTHER	
<u>Wyoming Outside Yellowstone National Park and the Wind River Reservation (WYO)</u>														
Absaroka	2						12				3			
<u>Arrow Mountain</u>	11					1								
Beartooth	3		1		1			1						
Burnt Lake	4			1			1					1		
Carter Mountain	4				1		3					3		
Chagrin [^]	3													
<u>Coyote Meadows[^]</u>	5											3		
Dell Creek	3		1	1				1				2		
<u>Dog Creek</u>	10							2						
East Fork [^]	2												1	
<u>Elk Fork Creek</u>	9				3					1				
Ferris Mountain							1							
Game Creek	3													
Gooseberry	3							1	5			1		
<u>Green River</u>					2							4		
Greybull River	5				4									
<u>Hoodoo</u>	9				3			4				2		
<u>Horse Creek</u>			6		1				1			1		
Houlihan	3				2			1				1		
<u>Huckleberry[^]</u>	10								1					
Jones Flat	5						8	4					4	
<u>Kinky Creek</u>			1		1			3	1			4		
<u>Lava Mountain</u>	8				2				1			4		
Lightning	2				4									
<u>Lower Gros Ventre</u>	8		1	2	1			1	2					
<u>Mount McDougal</u>	5				2		6							
Needle Creek														
<u>Pacific Creek</u>	6		1		3									
<u>Pahaska[^]</u>	11		1		1				2					
<u>Pinnacle Peak</u>	8							3	2	2		7		
Prospect	2							2						
Rattlesnake	3				1				1					
Rim	2						2					2		
<u>Slate Creek</u>			2		1			5	3			4		
Snake River	6				1				2					
<u>Soda Lake</u>	9						5							
Spring Mountain	3													
<u>Steamboat</u>			1							1		2		
Togwotee	3	3							1					
Wapiti	5				3									
Warm Springs	3		2					2				2	1	
Washakie														
<u>Windy Mountain</u>			1											
Wood River	3													
Misc wolves (WTGMA)	8	2			2			5				4		
Misc wolves (Other)	7							15	13			3	11	
WYO Total	196	14	11	2	39	42	64	18	4	4	54	15	0	1
Yellowstone N.P. Total	80	2	1	0	0	0	0	0	0	0	0	0	0	0
Wind River Res. Total	10	0	0	0	0	2	0	0	0	0	1	0	0	0
WYOMING TOTAL	286	16	12	2	39	44	64	18	4	4	55	15	0	1

1 Underlined packs are counted as breeding pairs toward recovery goals.

2 Strikethrough packs were not documented during 2018 and/or did not exist on Dec. 31, 2018 and are not displayed in Figure 1.

3 Excludes wolves killed in control actions and legal harvest.

4 Number of wolves that died of unknown causes.

5 Number of wolves legally taken in trophy game hunts. Includes 1 wolf from 1118F's group assigned to Yellowstone National Park.

6 Number of wolves taken by the public as predatory animals. Includes 1 from the Owl Creek and 2 from the St. Lawrence packs assigned to the Wind River Reservation.

7 Number of wolves killed in control by agencies and private citizens in WY in 2018. Includes 10 wolves from the Sugarloaf pack assigned to the Wind River Reservation.

8 Collared wolves that became missing in 2018.

9 Number of livestock and domestic animals confirmed killed by wolves in WYO. Does not include 7 cattle and 1 horse injured by wolves.

[^] Border pack shared with Idaho, Yellowstone National Park or the Wind River Reservation; assigned to WYO.

qualified agency personnel, pictures taken with remote cameras, evaluations of changes in pack size, or a combination of methods. If 1 adult male and 1 adult female and ≥ 2 pups were adequately documented at the end of the calendar year, they were counted as a known breeding pair. The Wind River Reservation and Yellowstone National Park minimum wolf population and breeding pair estimates were counted using analogous methods. The Wyoming Game and Fish Department will continue using approved methods for monitoring the wolf population through the 5 year post-delisting monitoring period and also investigate alternative methods for future wolf monitoring and management.

As of December 31, 2018, ≥ 196 wolves in ≥ 35 packs, including ≥ 13 breeding pairs, were documented in WYO; ≥ 152 wolves in ≥ 28 packs resided primarily in the WTGMA and ≥ 44 wolves in ≥ 7 packs resided in areas where wolves are designated primarily as predatory animals (Figure 1; Table 1). Pack size ranged from 2 to 11 and averaged 5.2 wolves per pack. Thirteen packs qualified as breeding pairs on December 31, 2018; 11 were located in the WTMGA and 2 were located in the Seasonal WTGMA (Figure 1; Table 1).

Population Trend

The WYO end of year wolf population decreased 18% from ≥ 238 wolves at the end of 2017 to ≥ 196 wolves at the end of 2018 and remained above the minimum delisting criterion of at least 100 wolves (Figure 2). Breeding pairs decreased from ≥ 19 in 2017 to ≥ 13 in 2018 and remained above the minimum delisting criterion of at least 10 breeding pairs (Figure 3). Nine packs identified as breeding pairs in 2017 also qualified as breeding pairs at the end of 2018 (Arrow Mountain, Coyote Meadows, Elk Fork Creek, Hoodoo, Lava Mountain, Mount McDougal, Pacific Creek, Pahaska, and Pinnacle Peak; Table 1). Four packs not identified as breeding pairs in 2017 qualified as breeding pairs in 2018 (Dog Creek, Huckleberry, Lower Gros Ventre, and Soda Lake; Table 1).

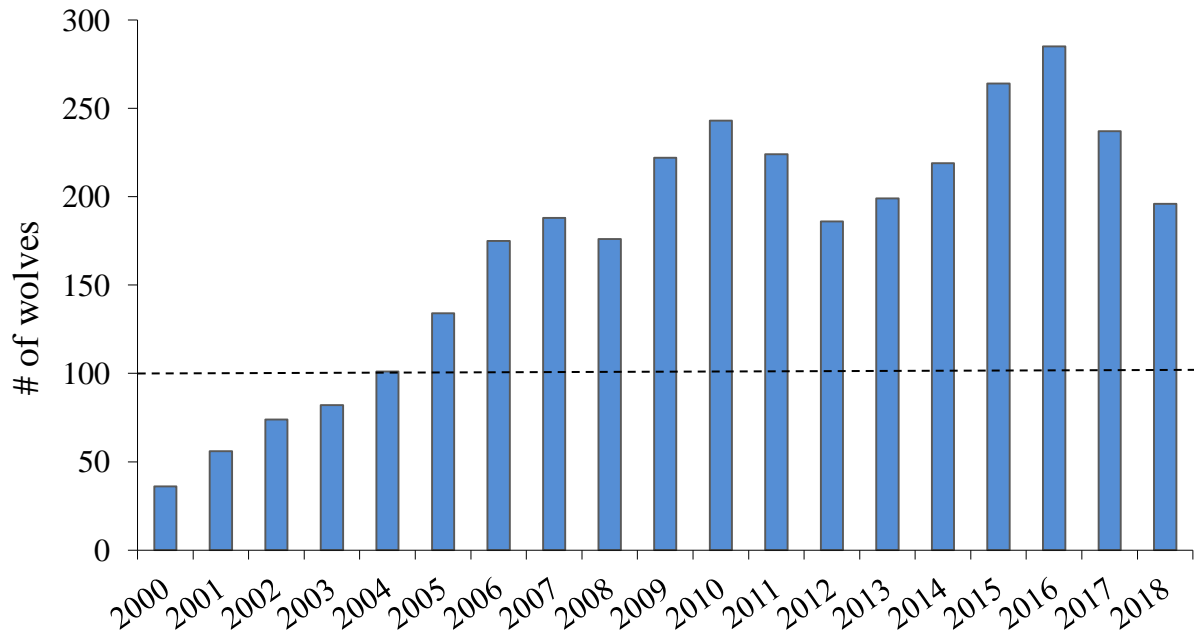


Figure 2. Minimum number of wolves in WYO from 2000-2018. (The dashed line indicates the ≥ 100 wolves minimum delisting criterion)

The number of wolf packs in WYO was reduced 13% from ≥ 40 packs at the end of 2017 to ≥ 35 packs at the end of 2018 (Figure 3). Three new packs established in 2018 (Game Creek, Jones Flat, and Lightning) and the Snake River pack shifted their territory outside Yellowstone National Park and were assigned to WYO in 2018 (Table 1). Nine packs documented at the end of 2017 did not exist on December 31, 2018 (Table 1). There was little evidence suggesting the presence of wolf packs in the WTGMA that were not documented in the minimum end of 2018 wolf population estimate. The vast majority of wolf observations recorded in WYO could be attributed to documented packs included in this report. Average pack size at the end of the calendar year were the lowest since 2000 (5.2 wolves per pack) and were the result of human-caused mortality and natural density-dependent population regulation (Figure 4).

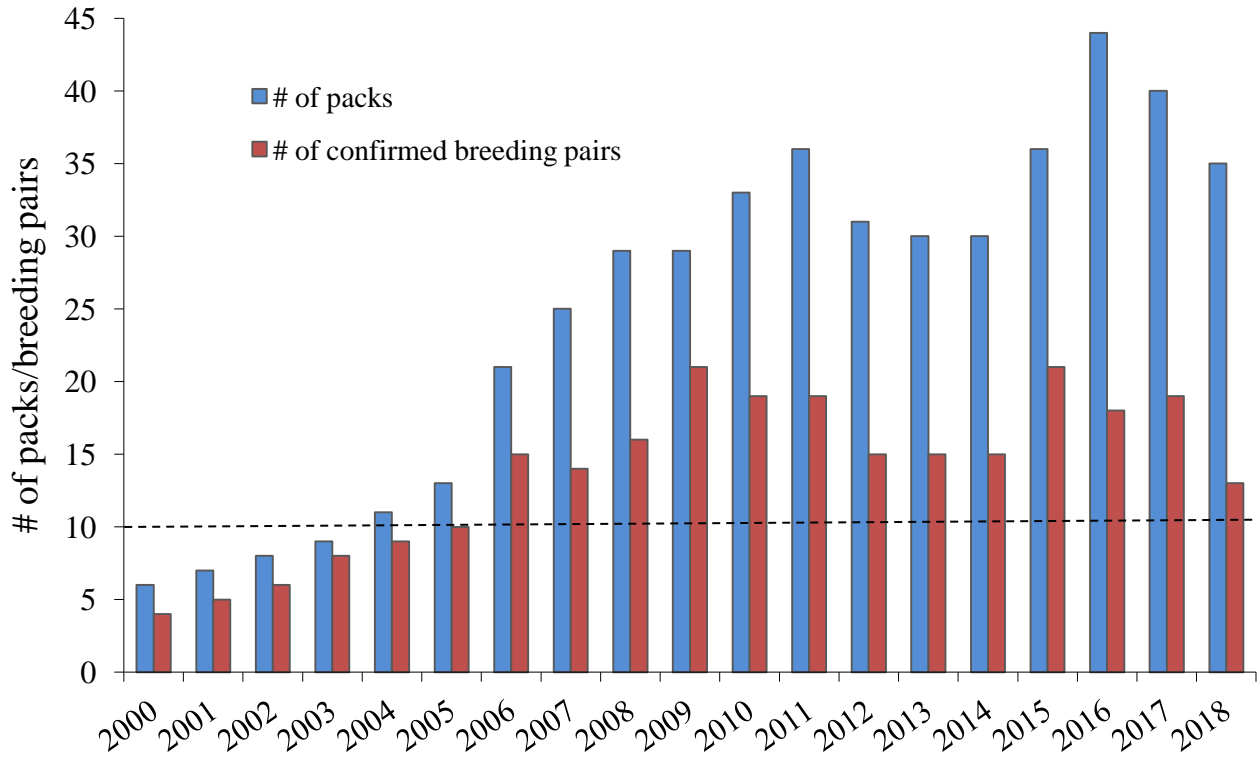


Figure 3. Minimum number of wolf packs and confirmed breeding pairs in WYO from 2000-2018. (The dashed line indicates the ≥ 10 breeding pair minimum delisting criterion)

The number of wolves, wolf packs, breeding pairs, and average pack size were reduced primarily through human-caused mortality, but natural processes driven by density-dependent mechanisms also contributed to these reductions. Density-dependent mechanisms are factors that increase mortality and/or reduce pup recruitment when wildlife populations are at high density, causing a resultant limitation or reduction of population growth. Evidence for density-dependent limitation of the wolf population in the WTGMA in 2018 include increasing disease prevalence, reduced reproduction and recruitment, and increased intraspecific aggression between wolf packs (i.e., wolves killing other wolves; Table 1). For example, intraspecific aggression increased as wolf density increased in the northern range wolf population in Yellowstone National Park, contributing to reduced population growth at high density (Cubaynes et al. 2014). Similarly, documentation of much higher intraspecific aggression between wolves in WYO in 2018 suggests density-dependence was a factor influencing wolf population growth (Table 1).

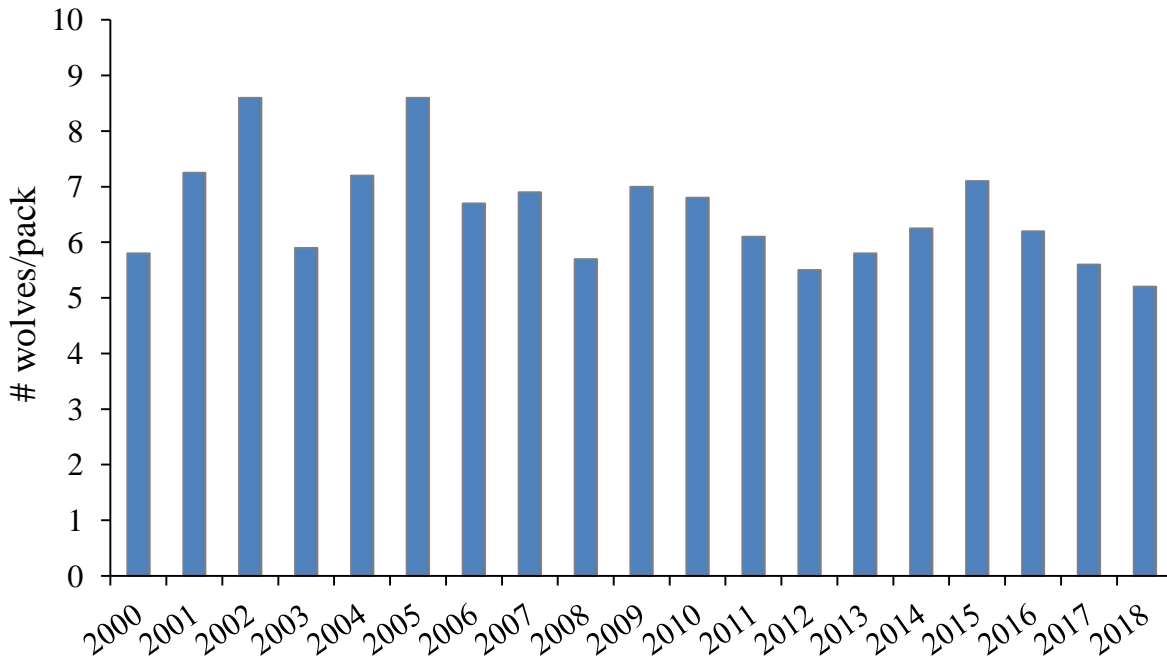


Figure 4. Average wolf pack size at the end of the calendar year in WYO from 2000-2018.

Reproduction and recruitment of pups was markedly low in 2018, providing further evidence of density-dependent factors within the WYO wolf population. Evidence includes 7 packs for which denning and production of pups could not be verified despite having breeding individuals available in the pack during the breeding season (e.g., East Fork, Green River, Slate Creek, Spring Mountain, Wood River, and Togwotee), 6 packs with small litter sizes in mid-summer (≤ 3 pups, e.g., Beartooth, Houlihan, Carter Mountain, Chagrin, Game Creek, and Rattlesnake), and 3 packs that appeared to den but did not include pups during the post-denning period (e.g., Dell Creek, Horse Creek, and possibly Snake River). The relationship between the minimum number of wolves in the WTGMA compared to the proportion of packs that qualified as a breeding pair in the WTGMA at the end of the calendar year demonstrates a pattern of reduced pup recruitment as the wolf population in the WTGMA increases (Figure 5). This relationship supports the contention that density-dependence was a significant factor limiting pup recruitment in WYO in 2018.

Sarcoptic mange (mange; *Sarcoptes scabiei*) infection is relatively uncommon in the WYO wolf population, yet was documented in 2018 at a higher rate than in previous years. Five packs in WYO and 1 in the Wind River Reservation were documented to have mange from early 2018 through early 2019. The entire litter of pups and possibly some adults from the Horse Creek pack succumbed to mange in mid-summer through autumn 2018 (Table 1). An adult captured in early 2018 from the Horse Creek pack showed slight signs of mange infection, and was a precursor for infection throughout this pack. The proportion of wolves infected with canine distemper virus (distemper) has also been increasing concordant with increasing wolf density from 2015 through early 2018, and may have been a factor in reduced recruitment. The Wyoming Game and Fish Department will continue to monitor and analyze wolf population dynamics in the WTGMA and implement an adaptive management framework to appropriately manage wolf population trends as described in the Wyoming Gray Wolf Management Plan.

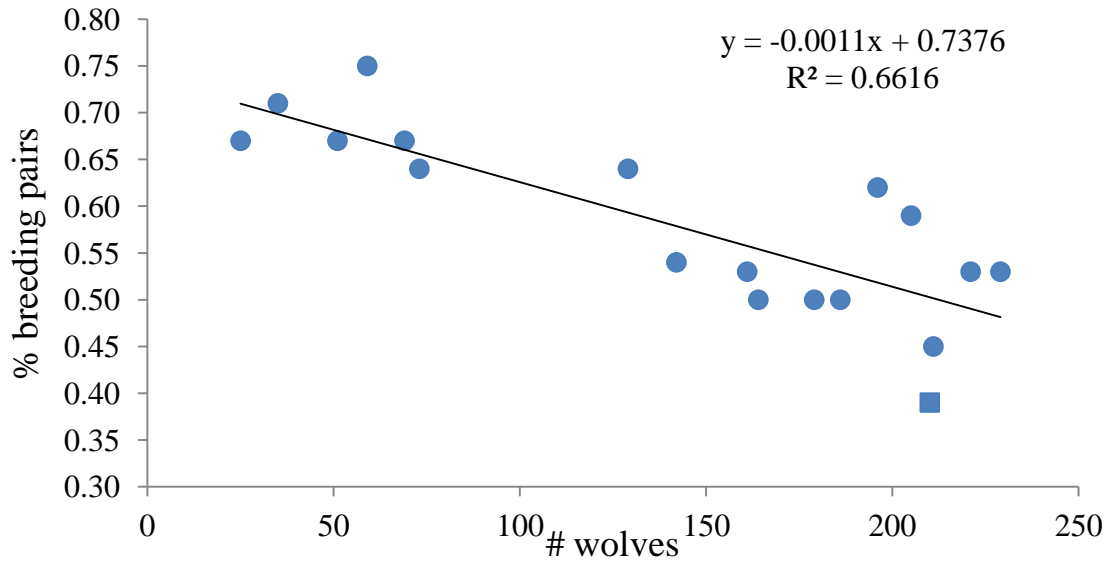


Figure 5. Minimum number of wolves present in the Wolf Trophy Game Management Area (WTGMA) compared to the proportion (%) of packs that qualified as a breeding pair in the WTGMA at the end of the calendar year from 2000-2018. (Excludes a statistical outlier in 2009; “■” indicates the data point for 2018)

Capture and Telemetry Collaring

Very high frequency (VHF) and global position system (GPS) telemetry collars are the primary tools used for monitoring wolf populations in Wyoming. VHF collars were used for general monitoring purposes and GPS collars provided more fine scale data for specific monitoring or research projects. Wolves were captured using ground or aerial capture techniques. Collars were affixed to captured wolves and personnel collected morphological information, genetic samples, and blood for disease testing. Collared wolves were released on site and monitored to document territories, movements (including dispersal), pack size, pack composition, breeding status and success, to mitigate livestock conflicts, and to aid in law enforcement investigations.

Forty-seven wolves from 23 packs were collared in 2018 in WYO (aerial = 45; ground = 2), including 1 recapture. At the end of 2018, there were 49 wolves in 26 packs and 4 single wolves that were being monitored with telemetry collars (53 wolves total; 27% of the year-end population in WYO). Thirty-seven collared wolves died in 2018 (20% of wolf mortalities).

Winter wolf capture efforts continued through the end of March 2019 in conjunction with 2018 year-end population surveys, at which point a total of 83 wolves in 31 packs and 7 single wolves were being monitored via telemetry collars (90 wolves total; approximately 46% of the WYO population at the end of March 2019). The proportion of collared individuals is generally highest at the end of winter following aerial capture efforts and decreases throughout the remainder of the year as pups are born and collared wolves die, disperse, or when collars fail.

Mortality

Wolf mortality was monitored in WYO using multiple methods. The primary method used to identify wolf mortalities occurring from non-hunting related causes was through the tracking of telemetry collared wolves. Telemetry collars were programmed to change pulse rate after the

collar remained motionless for 5 hours, thereby allowing managers to monitor collared wolves for mortality status and investigate the site to evaluate cause-specific mortality and collect carcasses for further evaluation through necropsy. Wolf hunting mortality in the WTGMA and predatory animal areas was monitored via mandatory reporting and registration by successful hunters as required in Wyoming Game and Fish Commission Chapter 47 Gray Wolf Hunting Season (Chapter 47) regulation and Wyoming Statute 23-1-304(d). This requirement allowed Wyoming Game and Fish Department personnel to document mortality, collect information on harvested wolves, update mortality limits in the WTGMA/Seasonal WTGMA, and close wolf hunting seasons when the mortality limit was met. Cooperating agencies also provided information on wolf mortalities, including wolves killed in control actions by USDA Wildlife Services. Wolf mortalities from all causes were documented and confirmed, including those found by the public, cooperating agencies, and Wyoming Game and Fish Department personnel.

In 2018, 172 wolves were known to have died in WYO; 102 in the WTGMA, 6 in the Seasonal WTGMA, and 64 in areas where wolves are designated as predatory animals year-round (Figure 6; Tables 1 and 2). Causes of mortality included: conflict control = 64; predatory animal take by the public = 42; hunting = 39; natural = 14; other human causes = 11; and unknown causes = 2 (Figure 6; Tables 1 and 2). The 11 wolf deaths from other human causes included 6 illegal kills, 2 wolves wounded but not recovered during the hunting season, and 3 vehicle collisions; all but 1 wolf (killed in a vehicle collision) occurred in the WTGMA. Four wolves (counted in the “other human causes” category above) were illegally killed in addition to 39 legal kills during the open wolf hunting season in the WTGMA and Seasonal WTGMA, yielding a total of 43 wolves counted toward the hunting season mortality limit. Three of the wolves that were illegally killed were shot and left in hunt area 13 (2 wolves) and hunt area 9 (1 wolf) and the final wolf was killed by a hunter without a license in hunt area 1.

Table 2. Summary of wolf mortality in WYO in 2018 by cause of death and wolf management area. (number of wolves known to be alive in 2018 was calculated as 196 alive at end of 2018 + 172 total mortalities in 2018 = 368 total wolves).

Cause of death	Total	% of mortality	% of wolves alive in 2018	WTGMA	Seasonal WTGMA	PRED
Conflict Control	64	37.2	17.4	39	0	25
Predatory Animal Take	42	24.4	11.4	0	4	38
Hunting	39	22.7	10.6	37	2	0
Natural	14	8.1	3.8	14	0	0
Other human causes	11	6.4	3.0	10	0	1
Unknown	2	1.2	0.5	2	0	0
Total Mortality	172	100.0	46.7	102	6	64

The number of wolves that died in 2018 (172 wolves) was higher than in 2017 (164 wolves; includes 2 wolves that died in 2017 but were discovered after the 2017 annual report was published; Figure 6). Wolf hunting in the WTGMA yielded similar mortalities as 2017, but take of predatory animals increased (Figure 6). Natural mortality included 7 wolves killed by other wolves, 5 pups in the Horse Creek pack that succumbed to mange infection, 1 wolf that died of starvation following injury and 1 from unknown natural causes. The mortality rate from natural

causes in 2018 was higher than previous years and accounted for just over 8% of wolf mortalities compared to <5% in previous years, exerting a greater influence on population trend than is typical. A combination of human-caused mortality and natural factors reduced the wolf population in WYO by 18% (see “*Population Trend*” section; Figure 2).

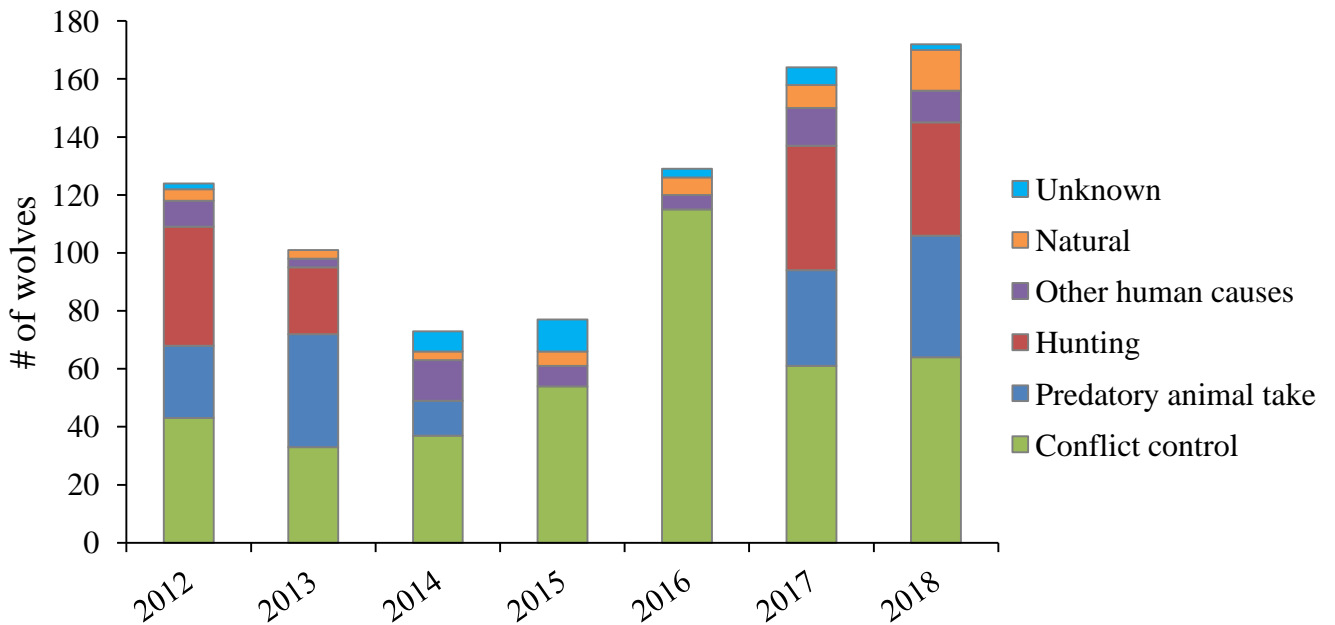


Figure 6. Number of confirmed wolf mortalities by cause of death in WYO from 2012-2018. (Wolves were listed under the Endangered Species Act in portions of 2014-2017)

Disease Monitoring

Disease presence and prevalence in wildlife populations are generally density-dependent, meaning the risk of a particular disease impacting a population increases as population density increases. Wolves are no exception, with evidence that the presence and prevalence of both mange and distemper infections in wolf populations are most common at high population and wolf pack density (Almberg et al. 2010, 2012). Both diseases may kill adult and juvenile wolves, but primarily manifest population declines through increased pup mortality and low pup recruitment (Almberg et al. 2009). While evidence for mange and distemper has been present in the wolf population in Wyoming, they have had little impact on wolf population dynamics outside Yellowstone National Park (Jimenez et al. 2010, Almberg et al. 2012). Human-caused mortality in the wolf population in WYO appears to have held the population below the threshold where disease outbreak would be more likely, however, the WYO wolf population increased rapidly following the reinstatement of Endangered Species Act protections in 2014 and remained at relatively high density from 2015 through early 2018 (Figures 2 and 3). This increase in population density in WYO is correlated with an increase in detection of mange and distemper in the WYO wolf population as discussed individually below. The Wyoming Game and Fish Department will continue to monitor the disease in the WYO wolf population and whether reduced population densities correlate with reduced disease.

Mange: Mange is a highly contagious skin disease caused by mites and is commonly found in wolf populations throughout the world. Mange was first detected in WYO in 2002 (Jimenez et

al. 2010). Documentation of mange was higher in WYO in 2018 than in recent years. Two wolves captured in February 2018 from 2 packs (Slate Creek and Horse Creek) in the Jackson area showed signs of mange. The Slate Creek pack failed to produce pups and did not exist at the end of 2018 (Table 1). Five dead pups from the Horse Creek pack were collected by Wyoming Game and Fish Department personnel in mid-August and were determined by the Wyoming State Veterinary Laboratory to have died from mange and associated skin infection (Table 1). Each pup was emaciated and showed symptoms of mange over 33-80% of their bodies. An adult wolf from the Horse Creek pack killed during the wolf hunting season was likewise suffering from severe mange infection. The Horse Creek pack did not exist at the end of 2018 (Table 1). Wolves in the St. Lawrence pack assigned to the Wind River Reservation also demonstrated symptoms of mange in 2018, including 2 wolves from this pack that died in WYO in 2018. Wolves captured or observed from 4 packs (Dog Creek, Huckleberry, Lightning, and Soda Lake) in early 2019 also displayed symptoms of mange infection, 1 of which was recovering. The Wyoming Game and Fish Department will continue to monitor mange in WYO wolves and how it correlates with reduced wolf density.

Distemper: Distemper is a highly contagious disease that infects domestic dogs, coyotes, foxes, raccoons, skunks, and wolves. Based on other areas of the world that have experienced epizootic distemper infections, these diseases will occasionally cause mortality, particularly among pups. Outbreaks usually remain localized in specific areas/years and do not threaten regional wolf population viability. There was no documented mortality caused by distemper during 2018. However, the proportion of wolves captured during winter that tested positive for distemper infection has increased since 2015 (Figure 7) and is correlated with increasing wolf population density in WYO (Figure 2). Distemper outbreaks have been correlated to reduced pup recruitment and wolf population declines in northern Yellowstone National Park, and may similarly have contributed to reduced pup recruitment in WYO in 2018.

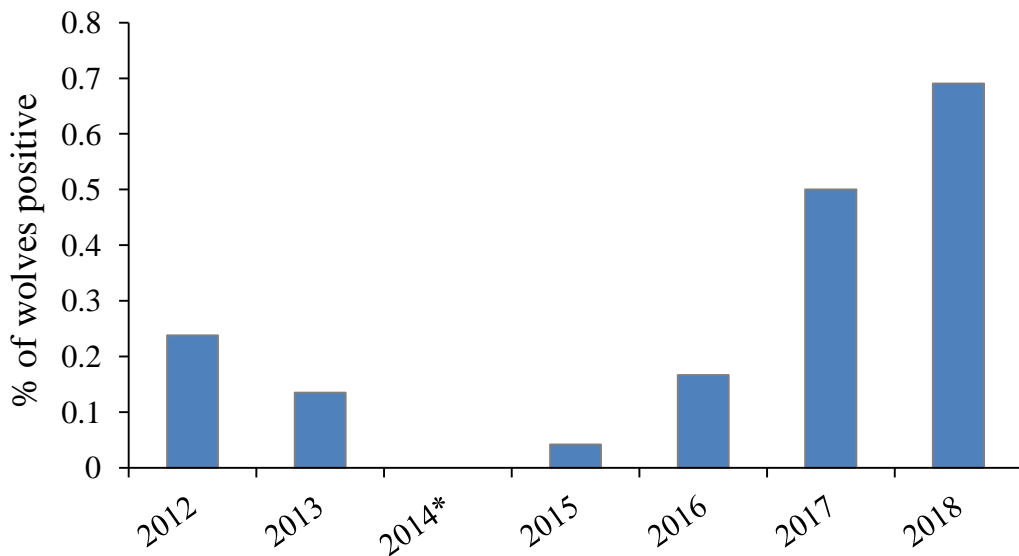


Figure 7. Proportion of wolves captured in winter (November through March) that tested positive for canine distemper virus in Wyoming outside Yellowstone National Park and the Wind River Reservation (WYO). (*Too few wolves were captured following Endangered Species Act relisting of the wolf population in winter 2015 to allow for an adequate sample)

Canine Parvovirus: Canine parvovirus is also a highly contagious disease that caused significant population level impacts for wolf populations throughout North America primarily in the 1980's (Kreeger 2003). The U.S. Fish and Wildlife Service and Yellowstone National Park have surveyed for evidence of canine parvovirus while managing Wyoming wolf populations and found a high rate of infection (>80% of wolves exposed) with no apparent deleterious effects to individual wolves or the population (Almberg et al. 2009, Jimenez et al. 2012). The Wyoming Game and Fish Department has not tested samples for canine parvovirus to date but continues to retain samples from all captured wolves that could be tested for canine parvovirus if the need arises in the future.

Genetic Monitoring

The U.S. Fish and Wildlife Service determined that, in addition to minimum population criteria, genetic interchange must also occur between the 3 wolf recovery areas in the northern Rocky Mountains. To monitor whether this delisting criterion is met, the U.S. Fish and Wildlife Service requires that all states collect and analyze genetic samples from wolf populations in the northern Rocky Mountains. Analysis of genetic interchange will be conducted cooperatively between U.S. Fish and Wildlife Service and the states of Wyoming, Montana, and Idaho on a periodic basis (possibly every 12-20 years following 3-5 wolf generations). Genetic samples will continue to be collected from wolves in WYO to ensure enough genetic information is available to determine whether genetic interchange is occurring in the northern Rocky Mountains.

In 2018, genetic samples were collected from 139 wolves that will be used in analysis of genetic interchange. Genetic samples were collected from 93 wolves that died and 46 wolves captured for monitoring purposes. As required by Chapter 47, 39 samples were submitted by wolf hunters who took wolves designated as trophy game animals and samples were voluntarily submitted by members of the public for 20 of 41 (49%) wolves taken as predatory animals.

Wolf Population Monitoring on the Wind River Reservation

Population and Breeding Pair Status

In 2018, wolves were classified as a trophy game animal on tribal lands in the Wind River Reservation, for which there was no open season and legal take could only occur to defend life or property. Wolves first recolonized the Wind River Reservation in 2003 and are currently distributed across the Wind River and Owl Creek mountain ranges (Figures 1 and 8). The wolf subpopulation in the Wind River Reservation slowly increased through 2013 and has since fluctuated between 10 and 20 wolves (Figure 8). As of December 31, 2018, ≥ 10 wolves in ≥ 2 packs, including no breeding pairs, were documented on the Wind River Reservation (Figures 1 and 8; Table 3).

Capture and Telemetry Collaring

One wolf was captured and collared from the St. Lawrence pack for population monitoring purposes in 2018. At the end of 2018, 1 wolf in the Owl Creek pack was collared.

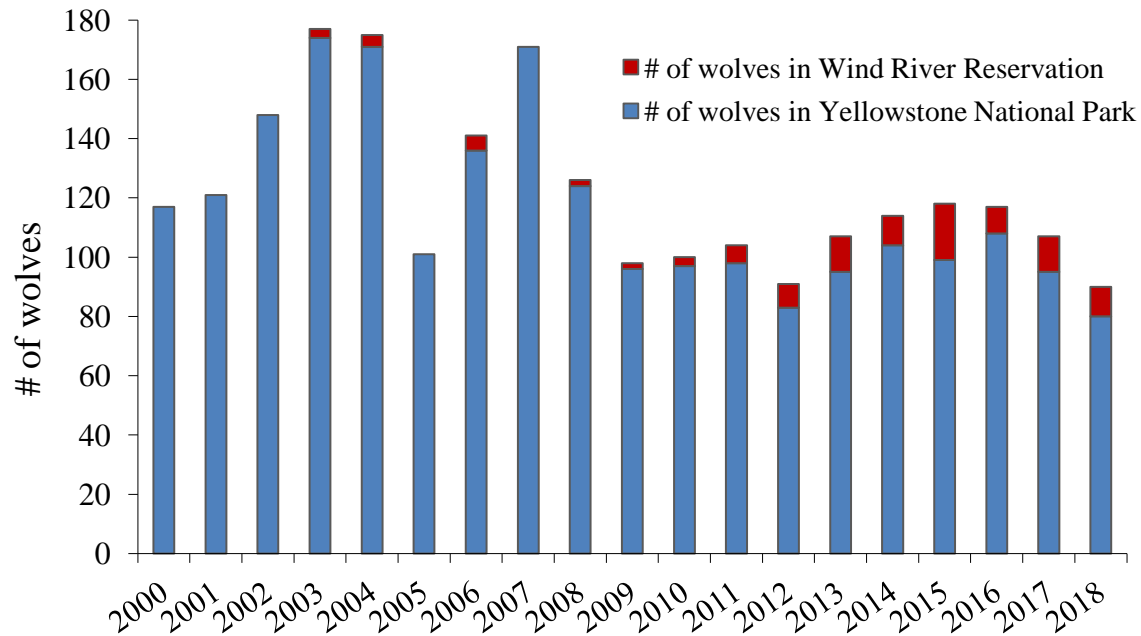


Figure 8. Minimum number of wolves in Yellowstone National Park and the Wind River Reservation from 2000-2018.

Table 3. Wolf packs, mortality, and livestock killed by wolf packs present in Yellowstone National Park and the Wind River Reservation in 2018.

WOLF PACK ^{1,2}	MINIMUM PACK SIZE ³	DOCUMENTED MORTALITIES				KNOWN		CONFIRMED LOSSES ⁷			
		NATURAL ⁴	HUMAN ⁴	UNKN ⁵	HUNTING CONTROL	DISPERSED	MISSING ⁶	CATTLE	SHEEP	DOGS	OTHER
Yellowstone National Park Northern Range											
<u>8 Mile[^]</u>	12					3					
<u>Junction Butte</u>	11										
<u>Lamar Canyon</u>	5										
<u>Crevice Lake</u>	7										
<u>Prospect Peak</u>								1			
1005F Group	3										
Misc wolves	1										
Yellowstone National Park Non-Northern Range											
<u>Bechler[%]</u>	4										
<u>Cougar Creek</u>	10		1								
<u>Mollie's</u>	7	1				2					
<u>Wapiti Lake</u>	19	1									
Misc wolves	1										
Yellowstone National Park Total⁸	80	2	1	0	0	0	5	1	0	0	0
Wind River Reservation											
<u>Owl Creek[*]</u>	6										
<u>St. Lawrence[*]</u>	4					2			1		
<u>Sugarloaf[^]</u>											
Misc/Lone wolves											
Wind River Reservation Total⁹	10	0	0	0	0	2	0	0	1	0	0
Total in Yellowstone N.P. and Wind River Res	90	2	1	0	0	2	5	1	1	0	0

1 Underlined packs qualified as breeding pairs on December 31, 2018 and count toward recovery goals.

2 Strikethrough packs were not documented during 2018 and/or did not exist on Dec. 31, 2018 and are not displayed in Figure 1.

3 Minimum pack size is reported as of December 31, 2018.

4 Excludes wolves killed in control actions and legal harvest.

5 Does not include pups that disappeared before winter.

6 Collared wolves that became missing in 2018.

7 Includes only livestock and domestic animals confirmed killed by wolves.

8 Mortality in and confirmed livestock killed by wolf packs assigned to Yellowstone National Park that occurred in WYO are reported in Table 1.

9 Mortality in and confirmed livestock killed by wolf packs assigned to the Wind River Reservation that occurred in WYO are reported in Table 1.

% Border pack with ID, assigned to Yellowstone National Park.

^ Border pack with MT, assigned to Yellowstone National Park.

* Border pack with WYO, assigned to the Wind River Reservation. Mortality and depredation that occur in these packs but outside the Wind River Reservation are reported in Table 1.

Mortality

Two wolves from the St. Lawrence pack were killed in a lethal control action for livestock conflicts on tribal lands in the Wind River Reservation in 2018 (Table 3).

Wolf Population Monitoring in Yellowstone National Park

Population and Breeding Pair Status

There were ≥ 80 wolves in ≥ 9 packs, including 7 breeding pairs, living primarily in Yellowstone National Park at the end of 2018 (Figure 8, Table 3). Overall, wolf numbers fluctuated little from 2009 to 2017 (83-108 wolves) but dropped slightly in 2018, particularly in the interior of Yellowstone after the Snake River pack shifted into WYO (Figure 8). Breeding pairs remained consistent with the historic average. Pack size in 2018 ranged from 3 to 19, averaging 8.7 in size (Table 3). Park-wide, 24 pups survived to year end, split between northern Yellowstone (12 pups) and the interior (12 pups) of the park (Table 3).

Capture and Telemetry collaring

Twelve wolves in 5 packs were captured and collared in Yellowstone National Park in 2018. Five of these were re-collars 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, 6 males, and 1 hermaphrodite were captured; 2 were old adults (≥ 6 years old), 6 were adults (2-5 years old), and 4 were yearlings.

Mortality

Three radio-collared wolves died in Yellowstone National Park in 2018 (Table 3). One adult (Wapiti 1091F) and 1 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 4 uncollared wolf deaths. Two wolves, the uncollared alpha female of the Lamar Canyon pack (old adult 926F) and the alpha male of the new 1005F group (adult), were harvested during the wolf hunting season in Montana and 1 subordinate female (adult) 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 in Yellowstone National Park, which is usually the leading cause of natural mortality in the park.

Disease Monitoring

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

WOLF MANAGEMENT

SUMMARY OF WOLF MANAGEMENT STATEWIDE

In 2018, the Wyoming Game and Fish Department implemented a wolf hunting season with the biological objective to reduce the wolf population to approximately 160 wolves in the Wolf Trophy Game Management Area. A mortality limit of 58 wolves was divided between 14 hunt areas in WYO. Wolf hunting seasons were open from September 1, 2018 through December 31, 2018 with the exception of hunt area 12, which opened on October 15, 2018. A total of 43 wolves (39 legal and 4 illegal) were killed during the wolf hunting season. Wolves could also be taken in any legal manner in Wyoming where they are designated as predatory animals. Forty-two wolves were taken by the public under predatory animal status in 2018.

Wolves were confirmed to have killed 71 head of livestock (55 cattle, 15 sheep and 1 horse) statewide in Wyoming in 2018. An additional 7 cattle (5 calves and 2 cows/yearlings) and 1 horse were confirmed as injured by wolves. Twenty-three packs were involved in ≥ 1 livestock conflict statewide in Wyoming, 16 packs were involved in ≥ 2 livestock conflicts and 12 packs were involved in ≥ 3 livestock conflicts. Sixty-six wolves were lethally removed by agencies or the public following livestock conflict in an effort to reduce livestock losses to wolves.

Wolf Management in WYO

Hunting

Wolf Hunting Season Background: Chapter 47 governs wolf hunting in WYO and was part of the management framework evaluated and approved by the U.S. Fish and Wildlife Service during the delisting process. Wolf hunting regulations for 2018 were approved by the Wyoming Game and Fish Commission and outlined specific hunt areas, mortality limits, season dates, and other wolf hunting regulations in WYO. Chapter 47 included reporting requirements for all wolves taken by the public as trophy game or predatory animals and required that telemetry collars, if present, be surrendered to Wyoming Game and Fish Department. Trapping was not legal for wolves designated as trophy game animals in 2018. There were no hunting season dates or limits for wolves occupying areas where and when they were designated as predatory animals and, accordingly, wolves could be hunted year round in any legal manner in these areas.

The Wyoming Game and Fish Department delineated 14 wolf hunt areas in the WTGMA and Seasonal WTGMA for 2018 (Figure 9). Two new hunt areas (13 and 14) were created to better direct wolf hunting mortality. The Wyoming Game and Fish Department combined the mortality limit for hunt areas 6 and 7 to allow for greater flexibility for the public. The mortality limits for hunt areas 8, 9 and 11 were also combined because the packs present in these hunt areas regularly cross hunt area boundaries in the broader Gros Ventre River drainage, thus a combined mortality limit provided a more comprehensive approach to wolf management in these areas (Figure 9; Table 4). As outlined in the Wyoming Gray Wolf Management Plan, the Wyoming Game and Fish Commission approved wolf hunting seasons were in conjunction with big game hunting seasons in autumn (Table 4). The wolf hunting season previously opened on October 1st but was shifted to September 1st in 2018 to allow greater hunting opportunity, especially in view of the higher mortality limit approved for the 2018 hunting season. The wolf hunting season in hunt area 12 (the Seasonal WTGMA) differed from the other 13 hunt areas by opening on

October 15 (the date wolves changed from predatory animal to trophy game animal designation as prescribed by Wyoming Statute 23-1-101(a)(xii)(B)(II)) but closed on the same date as the other 13 hunt areas (December 31, 2018) or when the mortality limit was met. Wolf hunting mortality was regulated by mortality limits established for each hunt area using a general license hunting structure. Hunters could purchase up to 2 wolf hunting licenses for the 2018 season. Legal and illegal wolf mortality that occurred during the open hunting season counted toward these mortality limits. The season for each hunt area closed when the mortality limit was met or at the season end date, whichever occurred first.

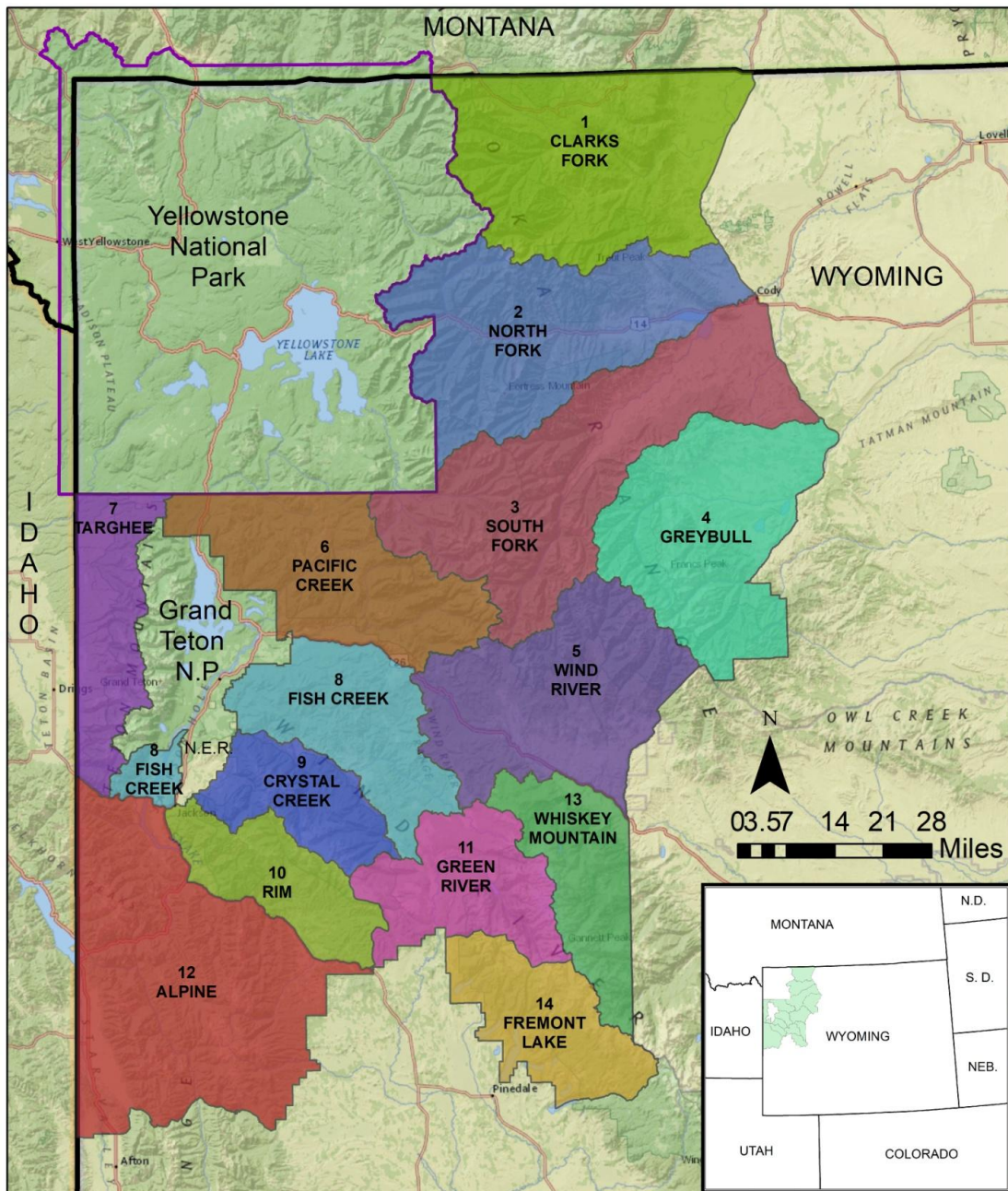


Figure 9. Wolf hunt areas for the 2018 wolf hunting season in northwest Wyoming.

Total wolf mortality limits were set to reduce the WTGMA wolf population from ≥ 210 wolves at the start of 2018 to approximately 160 wolves at the end of 2018. Wolf mortality limits were determined using data collected annually on wolf population dynamics and human-caused mortality in the WTGMA. All forms of mortality, in addition to estimates of recruitment and wolf population demographics, were considered in the mortality limit calculation. The Wyoming Game and Fish Department predicted the population would be reduced in the WTGMA from ≥ 210 wolves at the beginning of 2018 to approximately 160 wolves at the end of 2018 if 49.5% of the wolves present at the beginning of 2018 died from all human-caused mortality. The average non-hunting human-caused mortality rate since 2009 (22.8%) was then subtracted from 49.5% to obtain a 26.7% wolf hunting mortality rate, which equaled a total mortality limit of 56 wolves when applied to the minimum wolf population estimate of ≥ 210 wolves present in the WTGMA at the beginning of 2018 (i.e., the end of 2017 minimum wolf population). The total mortality limit of 56 wolves was sub-divided among 13 hunt areas in the WTGMA. An additional 2 wolves were included in the total mortality limit to be applied to hunt area 12, the Seasonal WTGMA (Table 4).

Table 4. Summary of hunting seasons and wolves taken during hunting seasons and as predatory animals in WYO in 2018.

WGFD WOLF HUNTER HARVEST SUMMARY 2018					3/22/2019 4:00 PM	
HUNT AREA	QUOTA FROM REGS	SEASON DATES		HARVEST COUNTED TOWARDS QUOTA *1	AREA STATUS	DATE/TIME AREA CLOSED
		GENERAL				
1	7	September 1 - December 31		7	CLOSED	11/11/2018 @ 7:30 am
2	8			7	CLOSED	Dec. 31 per Regulation
3	5			3	CLOSED	Dec. 31 per Regulation
4	4			4	CLOSED	12/26 @ 5:00 pm
5	3			0	CLOSED	Dec. 31 per Regulation
6, 7	3			3	CLOSED	12/22 @ 12:30 pm
8, 9, 11	15			14	CLOSED	Dec. 31 per Regulation
10	5			1	CLOSED	Dec. 31 per Regulation
12	2	Oct 15 - Dec 31	2	CLOSED	11/21 @ 8:30 AM	
13	5	September 1 - December 31		2	CLOSED	Dec. 31 per Regulation
14	1			0	CLOSED	Dec. 31 per Regulation
Total 2018 Trophy Quota	58	Total 2018 Trophy Harvest		43		
STATE WIDE	PREDATORY	No Quota	Total 2018 Predatory Animal Take *2	42		

*1 All legal harvest or illegal human-caused gray wolf deaths that occur during an open hunting season will apply to the quota.

*2 Total harvest for Gray Wolves designated as predatory animals.

Wolf Hunting in the Trophy Game Areas: A total of 2,654 wolf hunting licenses were sold to 2,478 individuals (2,222 residents and 256 nonresidents) for the 2018 wolf hunting season, similar to the number sold in 2017 (2,527 licenses). One hundred seventy-six individuals purchased 2 wolf hunting licenses, a revision included in the 2018 wolf hunting season regulation. A total of 43 wolves out of the 58 wolf mortality limit were taken during open wolf hunting seasons in the 14 hunt areas; 39 were legally taken and another 4 were illegally killed during the hunting season and were applied to the mortality limit (Table 4). Of wolves illegally taken, 2 were in hunt area 13, 1 in hunt area 1 and 1 in hunt area 9. Four of the 14 hunt areas closed prior to the established December 31, 2018 closing date (Table 4). Four individuals killed 2 wolves each during the hunting season. Three of the 39 legally hunted wolves (8% of wolves legally taken) wore a functioning telemetry collar, which was less than the proportion of collared wolves in the WTGMA at the beginning of the hunting season (26% collared) suggesting that there was not hunter selection for collared wolves. All hunters who legally killed a wolf complied with reporting and registration requirements.

Hunting mortality was recorded in 20 of 31 packs (64.5%) that regularly use the 14 hunt areas and 2 wolves that were solitary or from unknown pack origin (Table 1). Of the 20 packs that had ≥ 1 wolf taken in the hunt, 7 packs had 1 wolf taken (35%), 7 packs had 2 wolves taken (35%), and 6 packs had ≥ 3 wolves taken (30%). Unlike previous hunting seasons when mortality was concentrated in October, hunting mortality in 2018 was well distributed throughout the hunting season, with similar numbers of wolves taken in September (11 wolves, 25%), October (12 wolves, 28%), November (12 wolves, 28%) and December (8 wolves, 19%; Figure 10). Slightly more females than males (23 females:20 males) and more gray than black colored wolves (24 gray:19 black) were taken during the hunt. A higher proportion of adults (>2 years old) and similar proportion of subadult (1-2 years old) and juvenile (<1 year old) wolves were taken (19 adults:12 subadults:12 juveniles). The higher proportion of adults taken in 2018 compared to previous hunting seasons was likely a function of reduced availability of juvenile wolves during the hunting season, which was a result of reduced production and survival of pups in 2018 compared to previous years (see “Population Trend” section; Table 1).

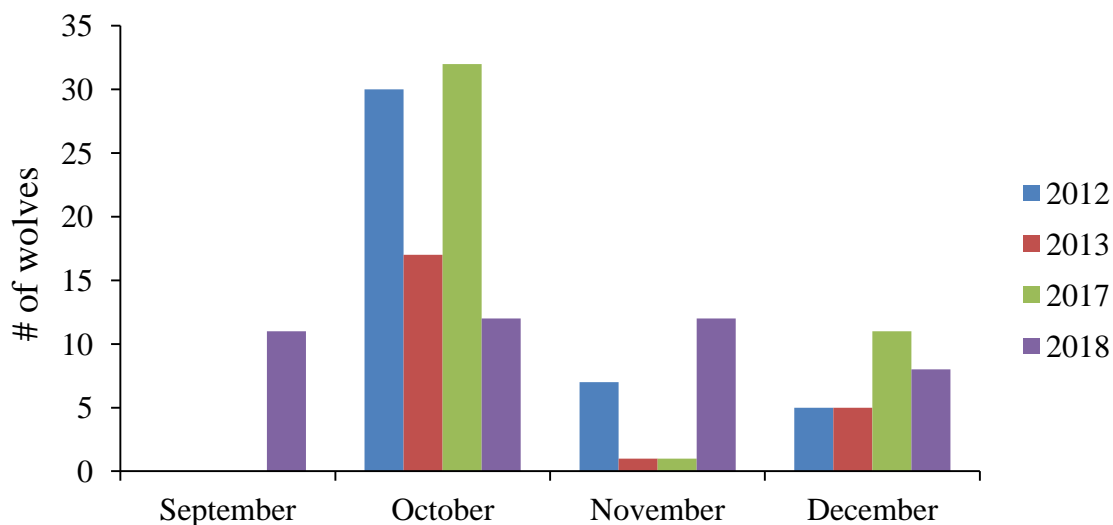


Figure 10. Number of wolves taken during wolf hunting seasons by month and year in the WTGMA and Seasonal WTGMA in northwest Wyoming.

Development of 2019 Wolf Hunting Seasons: Evaluation of the 2018 wolf hunting season data confirmed the hunting strategy in 2018 reduced the population as intended. The wolf population demonstrated a lower resilience to human-caused mortality in 2018 than predicted (13.3% human-caused mortality to stabilize the population vs. 25.8% predicted), which was influenced by density-dependent factors within the population as discussed in the “*Population Trend*” section above (Figures 5 and 11). Resilience to human-caused mortality will continue to be estimated with the best available data for the wolf population in the WTGMA, understanding all wildlife populations are dynamic. Wolf hunting regulations are revised annually using an adaptive approach that includes re-evaluation of all data collected during the previous year, internal review within the Wyoming Game and Fish Department, and a public input process. These data and other commitments made in the Wyoming Gray Wolf Management Plan and regulatory documents will be used to develop appropriate and scientifically defensible wolf hunting seasons in 2019 that will ensure the wolf population remains above minimum delisting criteria.

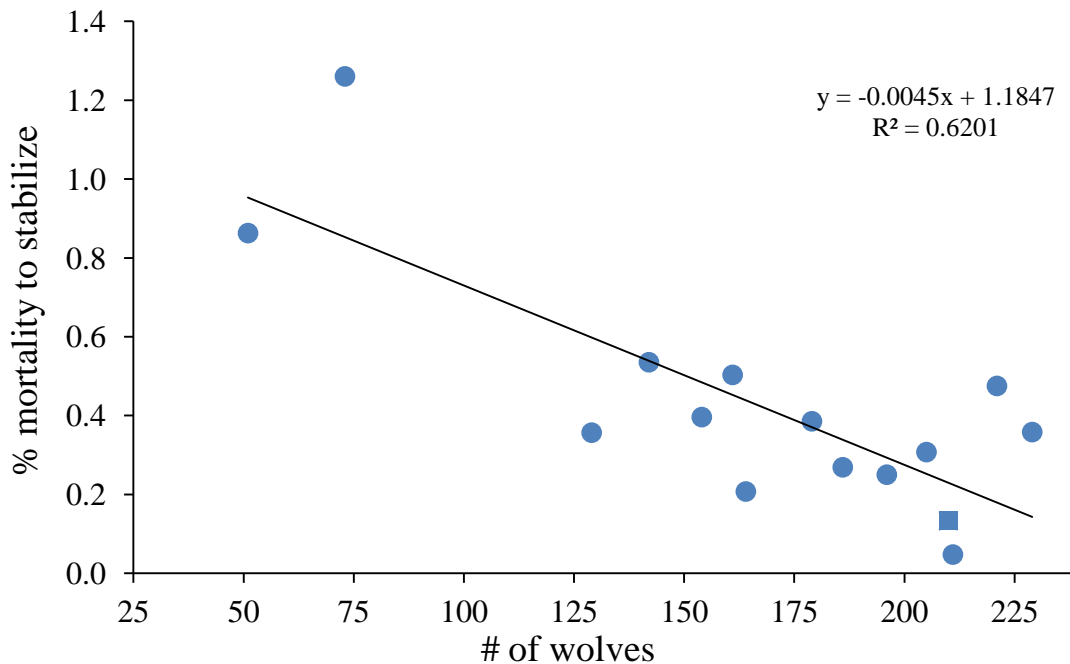


Figure 11. Minimum number of wolves in the WTGMA compared to the percent human-caused mortality required to stabilize wolf population growth in the WTGMA from 2004-2018. (The “■” indicates the 2018 data point)

Wolf Hunting in the Predatory Animal Areas: A total of 42 wolves were taken under predatory animal designation in 2018 (Figure 6; Tables 1, 2, and 4). All persons who took wolves under predatory animal designation complied with reporting requirements. Wolves killed as predatory animals were taken using firearms (29 wolves; 69%), traps (12 wolves; 29%), and other methods (1 wolf, 2%). Slightly more female than male wolves (23 females:19 males) were taken as predatory animals and more gray colored wolves were taken than black (21 gray:14 black:7 unreported). Most wolves taken as predatory animals were adults and subadults (13 adults:19 subadults:4 pups:5 unreported), which is expected because the majority of wolves present in largely unsuitable habitat outside the WTGMA/Seasonal WTGMA are mostly single adult and subadult wolves that are dispersing or members of small, newly established packs.

Livestock Conflicts

During 2018, reported livestock that were killed or injured by wolves (“conflicts”) in the WTGMA and Seasonal WTGMA were investigated by the Wyoming Game and Fish Department or USDA Wildlife Services. Wildlife Services conducted investigations for reported livestock conflicts in the year-round predatory animal area. Only confirmed livestock conflicts are documented in this report consistent with Wyoming Game and Fish Commission Chapter 28: Regulation Governing Big or Trophy Game Animal or Game Bird or Gray Wolf Damage Claims (Chapter 28), which requires confirmed evidence at the scene or on the livestock carcass indicating wolves were more likely than not responsible for the death or injury of the individual livestock. All reported conflicts are investigated in the WTGMA and Seasonal WTGMA and provide annual comparisons for the number of confirmed livestock killed or injured by wolves occurring in these areas. All suspected conflict between livestock and wolves that is discovered in the WTGMA and Seasonal WTGMA is expected to be reported because verification is required to qualify for damage compensation or for wolf management actions to be initiated. Confirmed livestock conflicts with wolves where they are designated as predatory animals year-round as presented in this report should be considered a minimum.

In 2018, wolves in WYO were responsible for killing 70 head of livestock (Figure 12; Tables 1 and 5). Livestock confirmed to have been killed by wolves included 54 cattle (41 calves and 13 cows/yearlings), 15 sheep/lambs, and 1 horse (Figure 12; Tables 1 and 5). An additional 7 cattle (5 calves, 2 cows/yearlings) and 1 horse were confirmed to have been injured by wolves. The number of cattle killed by wolves was roughly halved in 2018 compared to 2017 and the number of sheep killed was likewise significantly lower (Figure 12; Table 5). Management actions included trapping and collaring wolves, intensive monitoring, lethal removal, non-lethal depredation prevention measures, and issuance of 29 lethal take permits to livestock producers (21 initial permits, 8 of which were renewed due to continued livestock conflict). Sixty-four wolves were killed in response to livestock conflict; 52 in agency-directed lethal control actions, 10 under authority of lethal take permits, and 2 were killed for defense of private property as provided in state statute and regulation (Figure 6; Tables 1 and 2). Thirty-nine of the 64 wolves killed were located in the WTGMA and the remaining 25 were in the year-round predatory animal area (Table 2). Non-lethal control, in the form of lighting, scare devices, and electrified fladry, was implemented on several private ranches to prevent conflicts.

Table 5. Confirmed livestock killed by wolves and wolves killed in conflict control actions in WYO from 2006-2018.

Livestock	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cattle	123	55	41	20	26	35	44	40	56	72	154	110	54
Sheep	38	16	26	195	33	30	112	33	6	62	88	81	15
Dogs	1	2	0	7	0	1	3	1	0	0	0	1	0
Goats	0	0	0	0	0	0	0	1	0	0	0	0	0
Horses	0	1	0	0	1	1	1	0	0	0	1	0	1
Livestock killed	162	74	67	222	60	67	160	75	62	134	243	191	70
Wolves killed	44	63	46	31	40	36	43	33	37	54	113	61	64

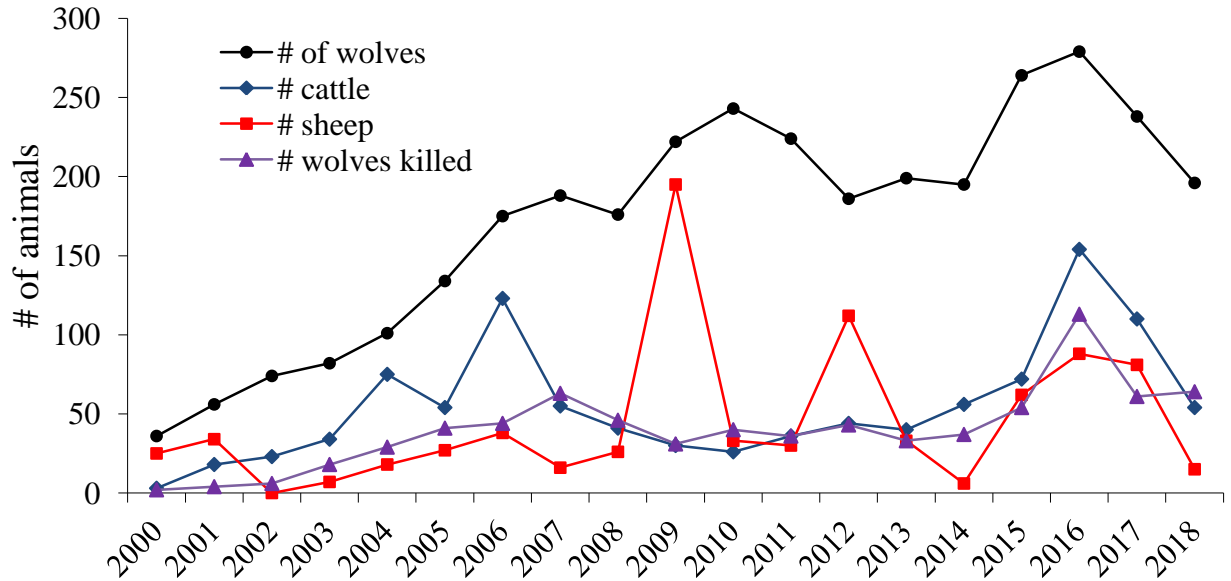


Figure 12. Minimum number of wolves, cattle and sheep killed by wolves, and wolves killed in conflict control actions in WYO from 2000-2018. (Injured livestock are not included)

Number of Packs Involved in Confirmed Livestock Conflicts: Twenty-two packs (51% of 43 packs that existed in 2018) in WYO were involved in ≥ 1 livestock conflict in 2018 (Figure 13; Table 1). Of the 22 packs involved in ≥ 1 livestock conflict, 17 packs (77% of conflict packs; 40% of packs in WYO) were involved in ≥ 2 conflicts; and 13 packs (59% of conflict packs; 30% of packs in WYO) were involved in ≥ 3 conflicts. A total of 20 packs were involved in confirmed cattle conflicts, of which the Absaroka, Carter Mountain, Lava Mountain, and Pinnacle Peak packs were responsible for 36% of total confirmed cattle conflicts (Table 1). Miscellaneous wolves not belonging to an identified pack were responsible for 47% of sheep conflicts (7 sheep), the remainder (53%) of sheep conflicts were from 2 packs (Jones Flat and Sugarloaf) in the predatory animal area (Table 1).

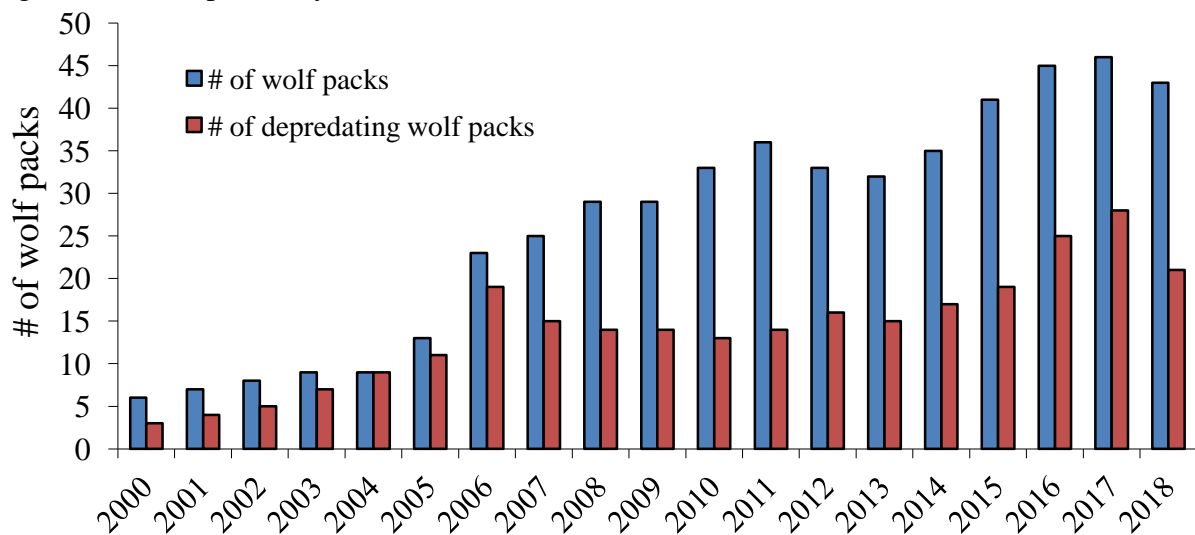


Figure 13. Minimum number of wolf packs present during the calendar year and number of wolf packs that were involved in ≥ 1 confirmed livestock conflict in WYO from 2000-2018.

Location of Livestock Conflicts: Land ownership is recorded for all instances of confirmed wolf-livestock conflict in the WTGMA and Seasonal WTGMA as part of routine investigation of reported conflicts. Land ownership is not consistently recorded for wolf-livestock conflicts in areas where wolves are designated as predatory animals year-round and are not included in this summary. In 2018, 52% (32 livestock; 25 cattle and 7 sheep) of all confirmed wolf-livestock conflicts in the WTGMA and Seasonal WTGMA were on public land and 48% (30 livestock; all cattle) of all conflicts were on private land (Figure 14). Cattle conflicts were slightly higher on private land compared to public property (Figure 14). All confirmed wolf-sheep conflicts in 2018 in the WTGMA and Seasonal WTGMA occurred on public land (Figure 14). Eight additional sheep conflicts from the predatory animal area were known to be on private property, but land ownership for the remainder was not recorded.

In 2018, confirmed wolf-cattle conflicts occurred in all but 2 wolf hunt areas (Table 6). Confirmed wolf-sheep conflicts occurred in the predatory animal area (53% of confirmed sheep conflicts), and in wolf hunt area 12 (47% of confirmed sheep conflicts), which is the Seasonal WTGMA (Table 6).

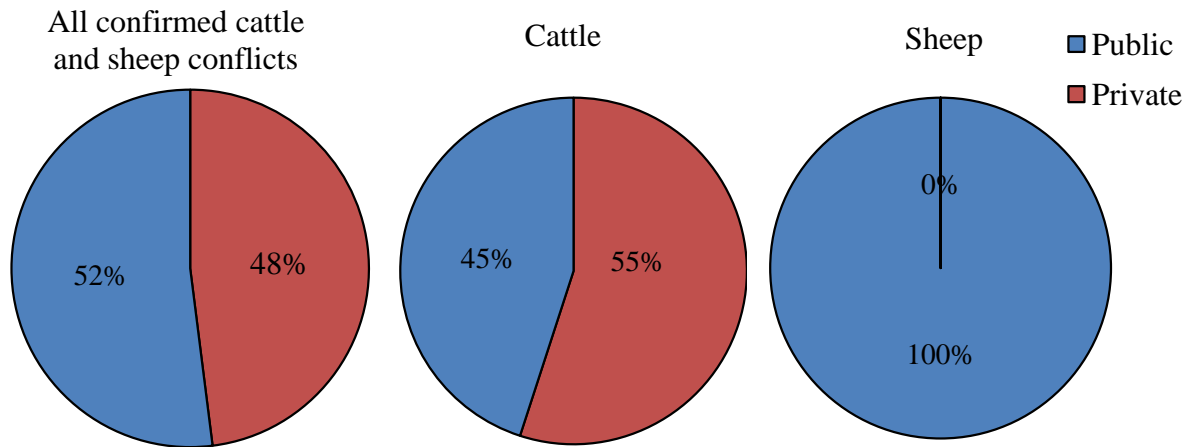


Figure 14. Land status where confirmed cattle and sheep conflicts with wolves occurred in the WTGMA and Seasonal WTGMA in 2018.

Table 6. Confirmed cattle and sheep conflicts with wolves in WYO by wolf hunt area (WHA) and in areas where wolves are designated as predatory animals year-round (Pred) in 2018.

WHA	1	2	3	4	5, 13	6	7	8	9	10	11, 13	12	Pred	Total
Cattle	5	0	2	6	4	0	3	11	2	2	10	3	6	54
Sheep	0	0	0	0	0	0	0	0	0	0	0	7	8	15
Total	5	0	2	6	4	0	3	11	2	2	10	10	14	69

Seasonal Trend in Livestock Conflicts: Cattle conflicts began in January, peaked in mid-summer, and then declined toward autumn (Figure 15). August saw the highest conflicts between wolves and cattle while the month of October was considerably lower in 2018 than in 2016 and 2017 (Figure 15). Sheep conflicts began in June and continued through September (Figure 16). Overall, sheep conflicts were down compared to 2016 and 2017 (Figure 16). The month of August saw the largest decline in sheep conflicts compared to the previous 2 years. The seasonal

trend in wolf-livestock conflicts was similar to other years and followed the pattern of open range grazing where livestock are distributed over large areas that overlap wolf distribution in northwest Wyoming during the summer and autumn.

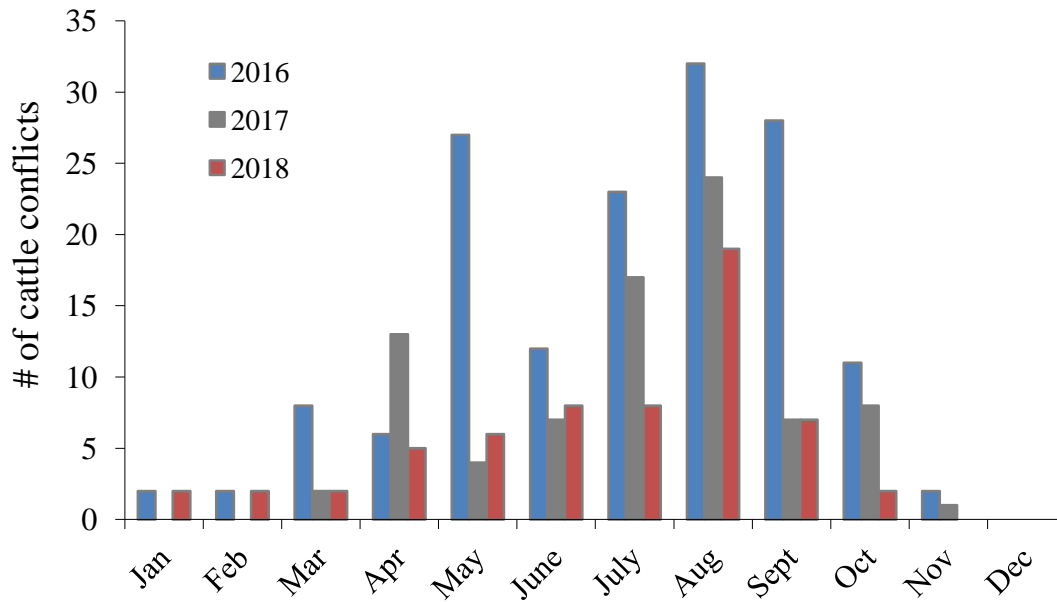


Figure 15. Number of confirmed wolf-cattle conflicts per month in WYO from 2016-2018.

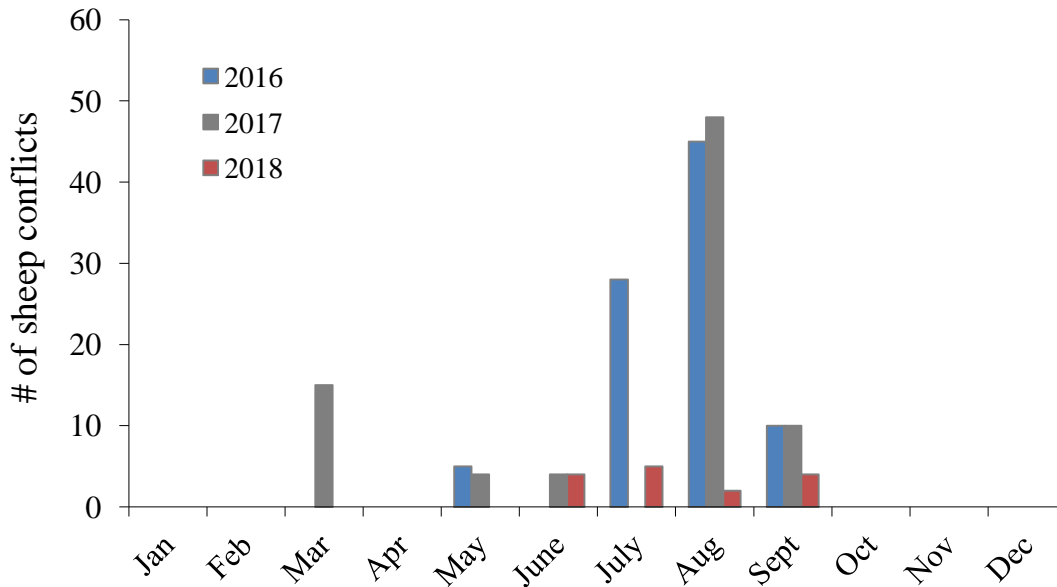


Figure 16. Number of confirmed wolf-sheep conflicts per month in WYO from 2016-2018.

Compensation for Livestock Damage Caused by Wolves: The Wyoming Game and Fish Department paid \$169,107 to compensate 21 livestock producers for livestock killed or injured by wolves during 2018 in the WTGMA and Seasonal WTGMA (Figure 17). Compensation payments were significantly lower in 2018 following >4 years of high wolf density and associated livestock damage and resultant compensation payments (Figures 1, 12 and 17; Table 5).

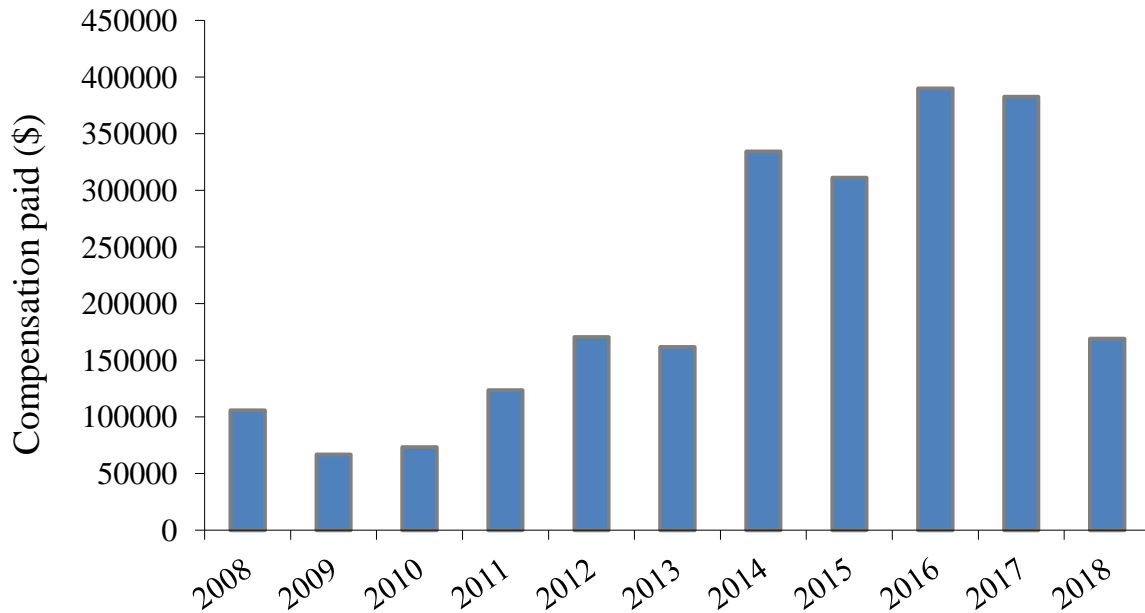


Figure 17. Compensation paid for confirmed livestock damage by wolves in WYO by calendar year 2008-2018.

Unacceptable Impacts to Ungulates or Elk Feedgrounds

Under the Wyoming Gray Wolf Management Plan, Wyoming Statute 23-1-304(j), and Wyoming Game and Fish Commission Chapter 21 Gray Wolf Management (Chapter 21) regulation, the Wyoming Game and Fish Department may lethally remove wolves when it is determined that “wolf predation is causing an unacceptable impact on a wild ungulate population or herd” or when a “wolf-wild ungulate conflict has occurred at any state operated elk feedground.” An “unacceptable impact on a wild ungulate population or herd” is defined in Chapter 21 as:

“Unacceptable impact on a wild ungulate population or herd” means any decline in a wild ungulate population or herd that results in the population or herd not meeting the Commission population management goals, objectives or recruitment levels established for the population or herd. The Department shall determine whether a decline in a wild ungulate population or herd constitutes an “unacceptable impact” and whether wolf predation is a significant factor causing the “unacceptable impact” based upon the best scientific data and information available.

In addition, under Chapter 21, wolves may be lethally removed for conflicts caused at state-operated elk feedgrounds only “when a gray wolf or wolves displace elk from a feedground and it results in one of the following conflicts:”

1. Damage to private stored crops by displaced elk; or,
2. Elk co-mingling with domestic livestock; or,
3. Displacement of elk from a feedground onto a highway right of way causing human safety concerns.

No agency directed lethal removal actions were taken in 2018 as there was no documentation of unacceptable impacts to ungulates or elk feedgrounds caused by wolves. Monitoring and

analyses of potential impacts to ungulate populations remain an integral part of ongoing management of wolves and their prey in WYO.

Wolf Management on the Wind River Reservation

In 2018, wolves were classed as a trophy game animal on the Wind River Reservation for which there was no hunting season and legal take could only occur to defend life or property. Reported livestock conflicts with wolves were investigated by the U.S. Fish and Wildlife Service Lander Fish and Wildlife Conservation Office or the Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department. One calf was confirmed to have been killed by the St. Lawrence pack in 2018 (Table 3). Two wolves were lethally removed in response to these depredations (Table 3).

Wolf Management in Yellowstone National Park

Wolf management activities in Yellowstone National Park 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.

Wyoming, Idaho, and Montana conducted wolf hunts outside of Yellowstone National Park and 3 wolves (1 from Lamar Canyon, 1 from 1118F group and 1 from 1005F group) that primarily live within the boundaries of the park were legally harvested. In addition, wolf 1118F was shot and injured in WYO and returned to the park (was still alive at the end of 2018).

OUTREACH

Outreach in WYO

In 2018, Wyoming Game and Fish Department personnel gave numerous formal presentations on wolf biology, monitoring, and management to the general public, special interest groups, school groups, civic organizations, other agencies and associations, and at scientific conferences. Public outreach in WYO included 10 public information gathering meetings discussing proposed regulatory changes for wolves in WYO and 8 “Living in Large Carnivore Country” workshops across Wyoming where information on wolf biology and ecology and large carnivore safety was presented. Wyoming Game and Fish Department personnel met with multiple conservation and sportsmen’s non-government organizations and several interested members of the public to discuss the status of the wolf population in Wyoming and wolf hunting season proposals. Wyoming Game and Fish personnel were interviewed for numerous magazine, newspaper, and television feature stories. As part of normal wolf monitoring and management activities, Wyoming Game and Fish personnel interacted with members of the public on a daily basis and made every effort to make these interactions positive and informative to increase the public’s involvement and understanding of wolf biology, monitoring and management throughout Wyoming.

Outreach in Yellowstone National Park

Public outreach in Yellowstone National Park included giving 177 formal talks (including 16 at scientific conferences), 75 interviews, helping at least 9,000 people view wolves, making 29,100 visitor contacts, and giving 329 informal talks in the field.

EXPENDITURES

WYO

The Wyoming Game and Fish Department spent \geq \$460,903 in wolf management program funds for wolf monitoring and management activities in calendar year 2018. Including funds paid for compensation of verified livestock damage caused by wolves (\$169,107), a total of \geq \$630,010 was spent by the agency in calendar year 2018. These figures should be considered a minimum because it is difficult to estimate significant ancillary costs of wolf management agency-wide. Grand Teton National Park spent \$141,000 on wolf monitoring activities in Grand Teton National Park in 2018. USDA Wildlife Services spent an additional \$35,324 on wolf management activities in WYO in 2018.

Wind River Reservation

A total of \$20,000 was spent on wolf monitoring and management in the Wind River Reservation in 2018 (\$16,000 by the U.S. Fish and Wildlife Service Lander Fish and Wildlife Conservation Office and \$4,000 by the Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department).

Yellowstone National Park

About \$700,000 was spent on monitoring and managing wolves in Yellowstone National Park in 2018; \$300,000 from federal funding and \$400,000 from private sources.

CONTRIBUTORS

Many personnel contributed to the content of the 2018 Wyoming Wolf Population Monitoring and Management Annual Report. Thanks go to all those who contributed.

Information presented in this report for the wolf population in WYO:

- Wyoming Game and Fish Department: Ken Mills and Zach Gregory analyzed data and edited the report. Large Carnivore Section: Clint Atkinson, Dan Bjornlie, Ron Blanchard, Mike Boyce, Justin Clapp, Colby Clark, Brian DeBolt, Luke Ellsbury, Becky Fuda, Andy Johnson, Ryan Kindermann, Dusty Lasseter, Phil Quick, Sean Ryder, Dan Thompson, and Zach Turnbull.

- Wyoming Game and Fish Wildlife Health Laboratory: Terry Creekmore, Hank Edwards, Jessica Jennings-Gaines, Katie Luukkonen, and Tara Stitzlein
- Wyoming State Veterinary Laboratory: Katie Bardsley, Joan Edwards and Donal O'Tool
- Grand Teton National Park: Sarah Dewey and John Stephenson
- Wildlife Services: Mike Foster, Vivian Meek, Rod Merrell, and Mike Burrell

Information presented in this report for the wolf population on the Wind River Reservation:

- U.S. Fish and Wildlife Service Lander Fish and Wildlife Conservation Office: Pat Hnilicka
- Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department: Art Lawson and Ben Snyder

Information presented in this report for the wolf population in Yellowstone National Park:

- National Park Service: Doug Smith, Dan Stahler, Erin Stahler, and Matthew Metz

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WYO

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Wind River Reservation

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Yellowstone National Park

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