

WYOMING GRAY WOLF MONITORING AND MANAGEMENT: 2020 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 report the status and management of the gray wolf population in Wyoming from January 1, 2020 through December 31, 2020.



EXECUTIVE SUMMARY

At the end of 2020, the gray wolf (wolf) population in Wyoming remained above minimum delisting criteria, making 2020 the 19th consecutive year Wyoming has exceeded the numerical, distributional, and temporal delisting criteria established by the U.S. Fish and Wildlife Service. At least 327 wolves in ≥ 44 packs (including ≥ 22 breeding pairs) inhabited Wyoming statewide on December 31, 2020. Of the total, there were ≥ 147 wolves and ≥ 24 packs (including ≥ 11 breeding pairs) in the Wolf Trophy Game Management Area (WTGMA), ≥ 123 wolves and ≥ 9 packs (including ≥ 7 breeding pairs) in Yellowstone National Park, ≥ 21 wolves and ≥ 3 packs (including ≥ 2 breeding pairs) in the Wind River Reservation, and ≥ 36 wolves and ≥ 8 packs (including ≥ 2 breeding pairs) resided in areas where wolves are designated primarily as predatory animals in Wyoming. A total of 119 wolf mortalities were documented statewide in Wyoming in 2020: 71 in the WTGMA, 43 in areas where wolves are primarily designated as predatory animals, 4 in Yellowstone National Park, and 1 in the Wind River Reservation. Causes of mortality included: human-caused = 104 (87% of mortalities); natural = 11 (9%); and unknown = 4 (4%). Forty-three wolves were captured and radio-collared for monitoring and research in 2020.

In 2020, the Wyoming Game and Fish Department implemented a wolf hunting season with the biological objective to stabilize the wolf population at approximately 160 wolves in the WTGMA. A mortality limit of 51 wolves was divided between 13 hunt areas in the WTGMA and 1 hunt area in the Seasonal WTGMA (hunt area 12). Wolf hunting seasons were open from September 15, 2020 through December 31, 2020 with the exception of hunt area 12 (opened on October 15, 2020) and hunt area 13 (closed March 31, 2021). The hunting season for each hunt area closed at the season end date or when the mortality limit in the hunt area was met, whichever occurred first. A total of 31 wolves were killed during the wolf hunting season in 2020.

Wolves were confirmed to have killed or injured 76 head of livestock (54 cattle, 12 sheep, and 10 chickens) and 1 dog statewide in Wyoming in 2020. Fourteen packs were involved in ≥ 1 livestock conflict statewide. Forty-three wolves were lethally and legally removed by agencies or the public in an effort to reduce livestock losses to wolves.

Suggested Citation: Wyoming Game and Fish Department, U.S. Fish and Wildlife Service, National Park Service, USDA-APHIS-Wildlife Services, and Eastern Shoshone and Northern Arapahoe Tribal Fish and Game Department. 2021. Wyoming Gray Wolf Monitoring and Management 2020 Annual Report. K.J. Mills and Z. Gregory, eds. Wyoming Game and Fish Department, 5400 Bishop Blvd. Cheyenne, WY 82006.

Available for download at:
https://wgfd.wyo.gov/WGFD/media/content/PDF/Wildlife/Large%20Carnivore/WYWOLF_ANNUALREPORT_2020.pdf

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
BACKGROUND	iv
WOLF POPULATION MONITORING	
SUMMARY OF WOLF POPULATION MONITORING STATEWIDE.....	1
WYO	1
Population and breeding pair status	1
Mortality	5
Disease monitoring	6
Population trend	8
Genetic monitoring	10
Capture and telemetry collaring.....	10
Predatory animal areas	10
WIND RIVER RESERVATION	11
Population and breeding pair status	11
Capture and telemetry collaring.....	11
Mortality	11
YELLOWSTONE NATIONAL PARK	11
Population and breeding pair status	11
Capture and telemetry collaring.....	12
Mortality	13
Disease monitoring	13
WOLF MANAGEMENT	
SUMMARY OF WOLF MANAGEMENT STATEWIDE.....	14
WYO	14
Hunting	14
Livestock conflicts	19
Unacceptable impacts to ungulates or elk feedgrounds	22
Predatory animal areas	23
WIND RIVER RESERVATION	23
YELLOWSTONE NATIONAL PARK	23
OUTREACH IN WYO	24
EXPENDITURES	24
CONTRIBUTORS	25
ACKNOWLEDGEMENTS	25
LITERATURE CITED	26

LIST OF FIGURES

Figure 1.	Wolf management areas and home ranges of wolf packs in Wyoming.....	2
Figure 2.	Minimum number of wolves in the WTGMA	4
Figure 3.	Minimum number of wolf packs and confirmed breeding pairs in the WTGMA	4
Figure 4.	Average pack size for wolf packs in the WTGMA.....	5
Figure 5.	Number of wolf mortalities by cause of death in the WTGMA	6
Figure 6.	Proportion of wolves captured in winter that tested positive for canine distemper virus in the WTGMA	7
Figure 7.	Minimum number of wolves at the beginning of the calendar year and proportion of wolf packs that qualified as a breeding pair in the WTGMA at the end of the calendar year.....	9
Figure 8.	Minimum number of wolves and breeding pairs in the WTGMA at the end of the calendar year	9
Figure 9.	Minimum number of wolves in Yellowstone National Park and the Wind River Reservation	13
Figure 10.	Wolf hunt areas in northwest Wyoming	15
Figure 11.	Number of wolves taken during wolf hunting seasons by month and year.....	17
Figure 12.	Proportion of adult, subadult, and juvenile wolves taken during wolf hunting seasons	17
Figure 13.	Minimum number of wolves and percent human-caused mortality required to stabilize wolf population growth in the WTGMA.....	18
Figure 14.	Proportion of wolves present in the WTGMA at the beginning of the calendar year killed by non-hunting human-causes.....	18
Figure 15.	Confirmed wolf-livestock conflicts and wolves killed in conflict control actions in the WTGMA and Seasonal WTGMA	20
Figure 16.	Minimum number of wolf packs and number of wolf packs that were involved in ≥ 1 confirmed livestock conflict in the WTGMA and Seasonal WTGMA	20
Figure 17.	Land status where confirmed wolf-livestock conflicts occurred in the WTGMA and Seasonal WTGMA	21
Figure 18.	Wolf conflicts with cattle and sheep per month in the WTGMA and Seasonal WTGMA	21
Figure 19.	Compensation paid for confirmed livestock damage caused by wolves in the WTGMA and Seasonal WTGMA	22

LIST OF TABLES

Table 1.	Wolf packs, pack size, wolf mortality and wolf-livestock conflict in Wyoming	3
Table 2.	Summary of wolf mortality by cause of death in the WTGMA	6
Table 3.	Wolf packs, pack size, wolf mortality and wolf-livestock conflict in Yellowstone National Park and the Wind River Reservation.....	12
Table 4.	Summary of the wolf hunting season in the WTGMA and Seasonal WTGMA	16
Table 5.	Confirmed wolf-livestock conflicts and wolves killed in conflict control actions in the WTGMA and Seasonal WTGMA	19
Table 6.	Confirmed wolf-livestock conflicts in the WTGMA and Seasonal WTGMA	21

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 (ESA) 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 met the required recovery 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 (Wyoming Game and Fish Commission 2011, 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 in September 2014. 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 wolf 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/wolves.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 on tribal lands within the Reservation. 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

The Wyoming Game and Fish Department'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 statute [W.S. 23-1-101(a)(xii)(B)(I) and (II)] and Wyoming Game and Fish Commission Regulation Chapter 21 Gray Wolf Management (Chapter 21), wolves in areas under the State's jurisdiction 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 (Wyoming Game and Fish Commission 2011, U.S. Fish and Wildlife Service 2012). According to the regulatory documents listed above, there are 3 wolf management zones outside Yellowstone National Park and tribal lands within the Wind River Reservation (this area is referred to as WYO throughout the report), as follows:

1. *Wolf Trophy Game Management Area (WTGMA)*: Wolves are designated as trophy game animals year-round within the WTGMA and are actively monitored and managed by the Wyoming Game and Fish Department with the goal of maintaining the state's commitment of ≥ 100 wolves and ≥ 10 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) solely within this area. 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 the WTGMA and also within the Seasonal WTGMA from March 1 to October 14 (see above). Predatory animals are not managed under the jurisdiction of the Wyoming Game and Fish Department and 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 WTMGA or Seasonal WTGMA boundary.

The Wyoming Game and Fish Department wolf management objective is to maintain a recovered wolf population in the WTGMA while balancing the need to minimize wolf conflicts with livestock and maintain wild ungulate herds. Wyoming's Gray Wolf Management Plan also seeks to incorporate public hunting opportunity into its wolf population management strategy (Wyoming Game and Fish Commission 2011). Wolves are not actively monitored or managed where designated as predatory animals, including the Seasonal WTGMA. Therefore, data presented in this report will focus primarily on the WTGMA, with data presented for predatory animals if available and/or applicable.

For more information on the wolf management framework in Wyoming, 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 criteria 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 recovery criteria post-delisting to ensure the population remains recovered. The U.S. Fish and Wildlife Service required a minimum recovery criteria of ≥ 300 wolves and ≥ 30 breeding pairs 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% safeguard above minimum recovery criteria (i.e., ≥ 450 wolves and ≥ 45 breeding pairs in the northern Rocky Mountains) to further ensure the population did not drop below minimum recovery 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 committed 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 for a minimum of 5 years. 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 2020 calendar year.

Reporting Wolf Population Data by Jurisdiction

Generally, states are solely responsible for monitoring and managing delisted species. In Wyoming, however, multiple jurisdictions contain significant portions of the wolf population and/or suitable wolf habitat, primarily Yellowstone National Park and tribal lands on the Wind River Reservation, where the state does not have management authority. 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) as follows:

1. The Wyoming Game and Fish Department committed to maintain ≥ 100 wolves and ≥ 10 breeding pairs in the WTGMA in northwest Wyoming. While the state does not have management authority over wolves in all areas in the WTGMA 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 included in the WTGMA.
2. Combined, Yellowstone National Park and Wind River Reservation are expected to contribute the remaining ≥ 50 wolves and ≥ 5 breeding pairs necessary to meet the total ≥ 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 three primary jurisdictions to allow for proper evaluation of the wolf population both statewide and by individual jurisdiction.

WYOMING GRAY WOLF MONITORING AND MANAGEMENT

2020 ANNUAL REPORT

WOLF POPULATION MONITORING

SUMMARY OF WOLF POPULATION MONITORING STATEWIDE

At the end of 2020, the wolf population in Wyoming remained above minimum delisting criteria, making 2020 the 19th consecutive year Wyoming has exceeded the numerical, distributional, and temporal delisting criteria established by the U.S. Fish and Wildlife Service. At least 327 wolves in ≥ 44 packs (including ≥ 22 breeding pairs) inhabited Wyoming statewide on December 31, 2020. Of the total, there were ≥ 147 wolves and ≥ 24 packs (including ≥ 11 breeding pairs) in the Wolf Trophy Game Management Area (WTGMA), ≥ 123 wolves and ≥ 9 packs (including ≥ 7 breeding pairs) in Yellowstone National Park, ≥ 21 wolves and ≥ 3 packs (including ≥ 2 breeding pairs) in the Wind River Reservation, and ≥ 36 wolves and ≥ 8 packs (including ≥ 2 breeding pairs) resided in areas where wolves are designated primarily as predatory animals in Wyoming. A total of 119 wolf mortalities were documented statewide in Wyoming in 2020: 71 in the WTGMA, 43 in areas where wolves are primarily designated as predatory animals, 4 in Yellowstone National Park, and 1 in the Wind River Reservation. Causes of mortality included: human-caused = 104 (87% of mortalities); natural = 11 (9%); and unknown = 4 (4%). Forty-three wolves were captured and radio-collared for monitoring and research in 2020.

Wolf Population Monitoring in the WTGMA

Population and Breeding Pair Status

The minimum number of wolves in the Wolf Trophy Game Management Area (see map in Figure 1) on December 31, 2020 was determined using standard wolf monitoring methods used since reintroduction. The number of wolves in individual packs was estimated at the end of the year by counting wolves during telemetry flights and capture operations, observations by, or confirmed by, qualified agency personnel, or pictures of known packs taken with remote cameras. Only pack observations obtained by agency personnel from December 2020 through March 2021 were included to ensure they were reflective of the minimum number of wolves present on December 31, 2020. Miscellaneous, mostly solitary, wolves were included in the estimate only if the animal was not a member of a known pack. Pairs and trios formed in 2020 and early 2021 are included in the miscellaneous wolf category and are not included as packs if they had not established a stable territory. Packs with territories overlapping jurisdictional boundaries (e.g., state, national park, tribal boundaries, etc.) and packs overlapping the WTGMA boundary were assigned to the area which held the majority of their documented locations during 2020. The final minimum population count was the sum of all pack counts and miscellaneous wolves known to be present on December 31, 2020 (see Table 1).

Breeding pair status for packs in the WTGMA 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

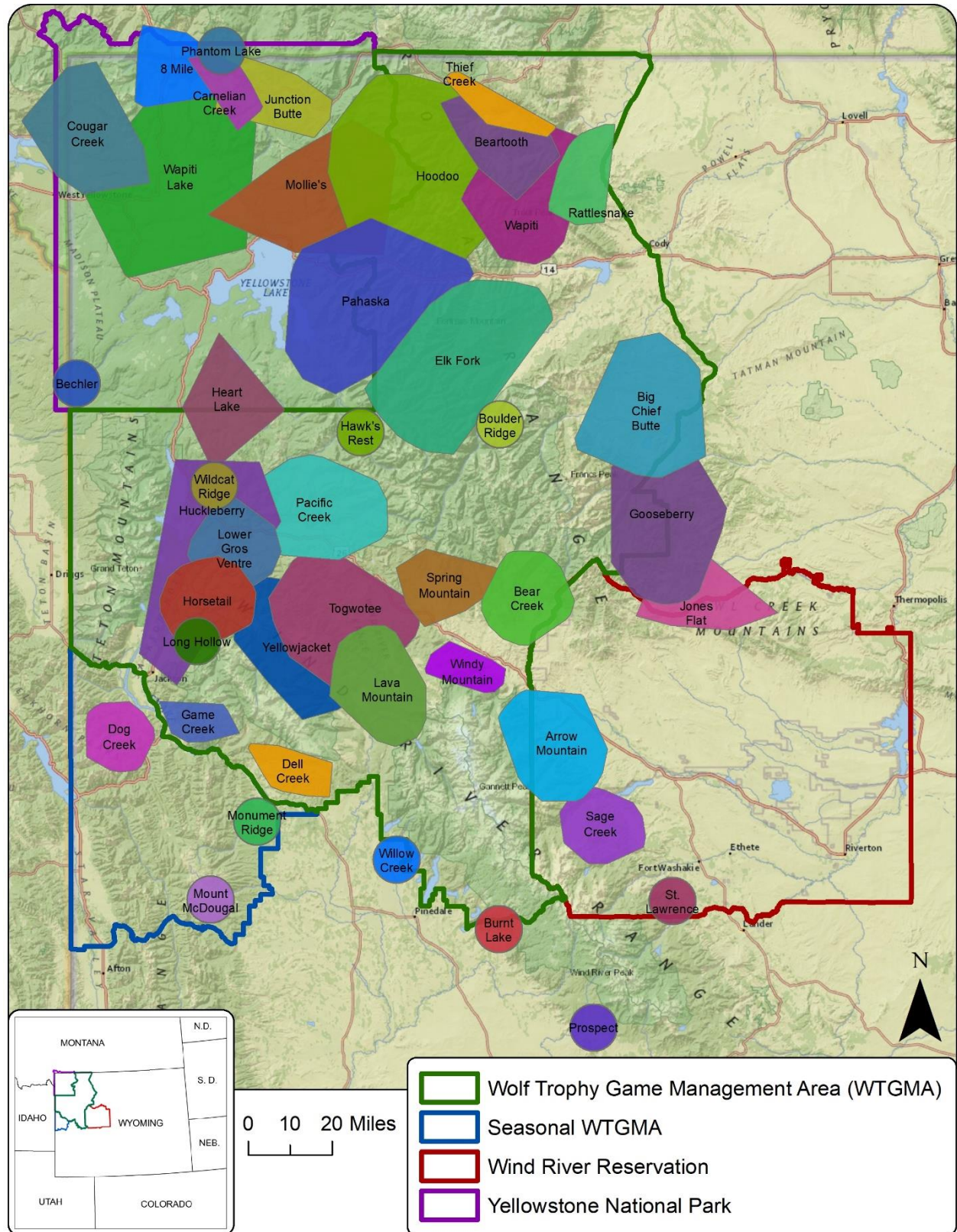


Figure 1. Wolf management areas and home ranges of wolf packs in Wyoming in 2020

Table 1. Wolf packs, minimum pack size at the end of the calendar year, wolf mortality, and wolf-livestock conflicts in Wyoming in 2020.

WOLF PACK ^{1,2}	MINIMUM PACK SIZE	DOCUMENTED MORTALITIES						KNOWN		CONFIRMED CONFLICTS ⁹				
		NATURAL	HUMAN ³	UNKN ⁴	HUNTING ⁵	PRED. ANIMAL ⁶	CONTROL ⁷	DISPERSED	MISSING ⁸	CATTLE	SHEEP	DOGS	OTHER	
WOLF TROPHY GAME MANAGEMENT AREA														
Bear Creek^	7	2		2										
Beartooth	3	1												
Big Chief Butte	2													
Boulder Ridge	2													
Chagrin^	1													
Coyote Meadows^		1												
Dell Creek	3					1	6			3				
East Fork^	1													
Elk Fork Creek	7					1								
Game Creek	7					5								
Greybull River							1	3	4					
Gulch		1								1				
Haw k's Rest^	5													
Hoodoo^	3					2	1	2	3					
Horsetail Creek	4	1												
Houlihan							1			1				
Huckleberry	3	1	1				4	1	4					
Lava Mountain	9					2		1	9					
Lightning		1						1						
Long Hollow	4													
Low er Gros Ventre	11					2		1						
Needle Creek														
Pacific Creek	6			1	1									
Pahaska^	10	1		1				1						
Pinnacle Peak						1		4						
Rattlesnake	6						8			6				
Spring Mountain	3	1			1					1				
Thief Creek	2					1								
Togw otee	11									3		1		
Wapiti	6					1	2			3				
Wildcat Ridge	3	1												
Windy Mountain	6					1								
Yellow jacket	5	1			2	1			9					
Misc. w olves	17					6	3			4			10	
WTGMA TOTAL	147	4	5	4	31	0	27	14	0	51	0	1	10	
PREDATORY ANIMAL AREAS														
Burnt Lake	4							1						
Dog Creek^	6	1					5	1	12					
Gooseberry	3							1						
Jones Flat^	2					1	1							
Monument Ridge	2					1								
Mount McDougal	9					5								
Prospect	3									1				
Soda Lake														
Willow Creek	2							2						
Misc. w olves	5	2	2			9	12			2	1			
PRED. AREAS TOTAL	36	2	3	0	0	22	16	1	0	3	13	0	0	
WYO Total	183	6	8	4	31	22	43	15		54	12	1	10	
YNP Total	123	4	0	0	0	0	0	5	4	0	0	0	0	
WRR Total	21	1	0	0	0	0	0	1	0	0	0	0	0	
WYOMING TOTAL	327	11	8	4	31	22	43	21	4	54	12	1	10	

1 Underlined packs are counted as breeding pairs on December 31, 2020.

2 Strikethrough packs were not documented during 2020 and/or did not exist on Dec. 31, 2020 and are not displayed in Figure 1.

3 Excludes wolves killed in control actions and legal hunting.

4 Number of wolves that died of unknown causes.

5 Number of wolves legally taken during the regulated hunting season.

6 Number of wolves taken by the public as predatory animals.

7 Number of wolves killed in lethal control actions, including agency-directed control, defense of private property and on lethal take permits.

8 Collared wolves that became missing.

9 Number of conflicts between wolves and livestock/domestic animals confirmed in WYO. "OTHER" includes 10 chickens killed by the Lamar Canyon pack.

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

ground monitoring efforts, investigations of potential den and rendezvous sites, howling surveys, reports confirmed by 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 Wyoming Game and Fish Department will continue using approved methods for monitoring the wolf population while also investigating alternative methods for future wolf monitoring and management.

As of December 31, 2020, ≥ 147 wolves in ≥ 24 packs, including ≥ 11 breeding pairs, were documented in the WTGMA (Figures 1, 2, and 3; Table 1). Pack size ranged from 2 to 11 and averaged 5.3 wolves per pack (Figure 4; Table 1).

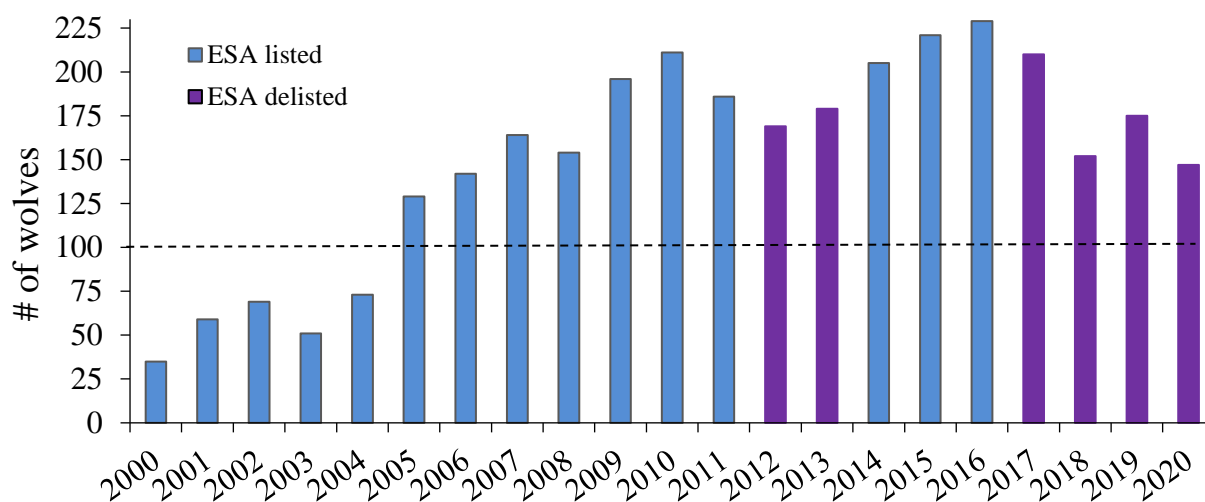


Figure 2. Minimum number of wolves in the WTGMA at the end of the calendar year. (The dashed line indicates the ≥ 100 wolf minimum delisting criterion)

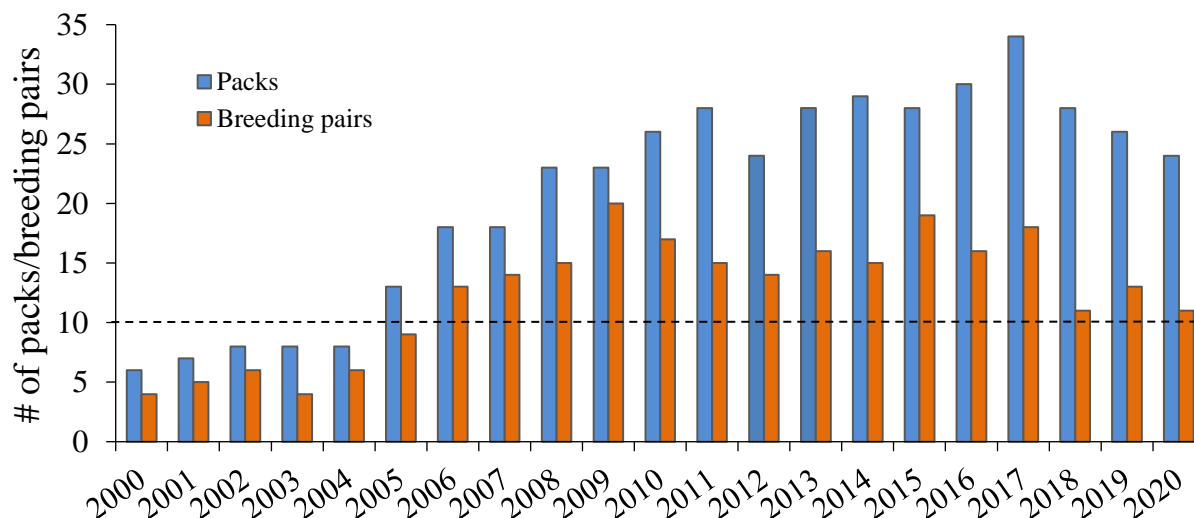


Figure 3. Minimum number of wolf packs and breeding pairs in the WTGMA at the end of the calendar year. (The dashed line indicates the ≥ 10 breeding pair minimum delisting criterion)

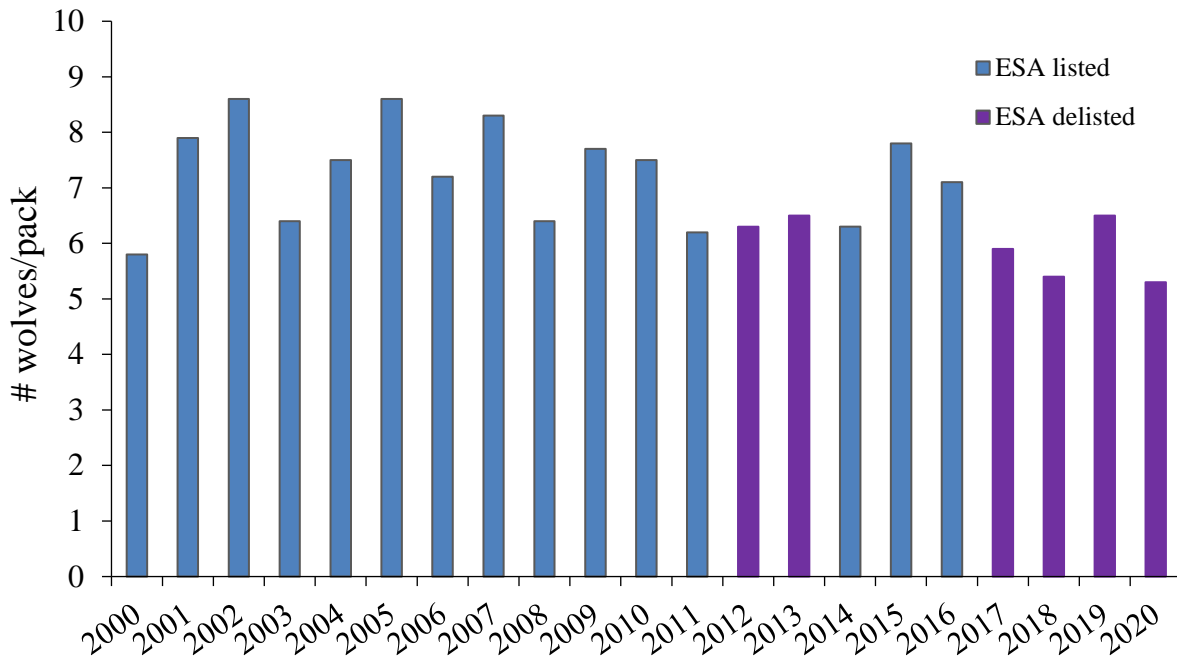


Figure 4. Average pack size for wolf packs in the WTGMA at the end of the calendar year.

Mortality

Wolf mortality was monitored in the WTGMA using multiple methods. The primary method used to identify wolf mortalities not associated with hunting was through the tracking of radio-collared wolves. The information provided by tracking collars allows 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 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 if 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 2020, 71 wolves were known to have died in the WTGMA (Figure 5; Tables 1 and 2). Causes of mortality included: hunting = 31; conflict control = 27; other human causes = 5; natural = 4; and unknown causes = 4 (Figure 5; Tables 1 and 2). The 5 wolf deaths from other human causes included 3 illegal kills, 1 capture related mortality, and 1 wounding loss during the hunting season. Natural mortalities included 3 wolves killed by other wolves and 1 wolf killed in an avalanche. The number of wolves that died in the WTGMA in 2020 (71 wolves) was similar to the average number of mortalities from 2012-2020 (75 wolves; Figure 5).

Table 2. Summary of wolf mortality by cause of death in the WTGMA in 2020.

Cause of death	Total	% of mortality	% of wolves
Hunting	31	43.7	14.2
Conflict control	27	38.0	12.4
Other human causes	5	7.0	2.3
All Human Causes	63	88.7	28.9
Natural	4	5.6	1.8
Unknown	4	5.6	1.8
Total Mortality	71	100.0	32.6

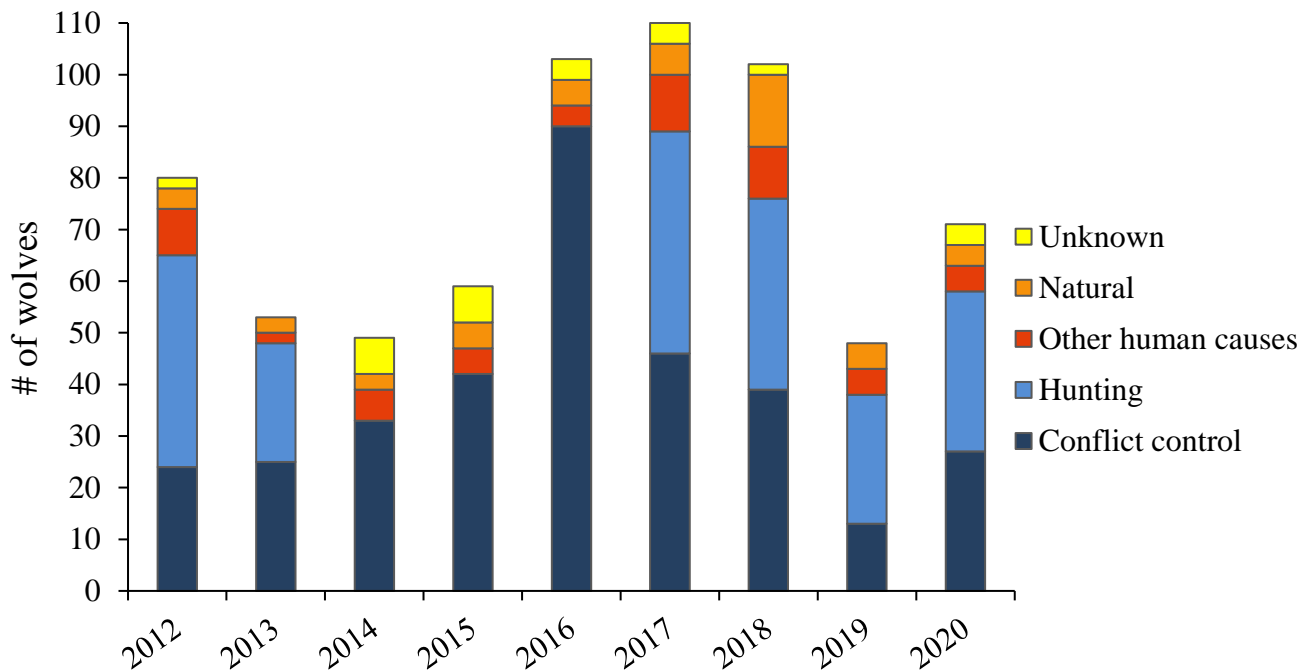


Figure 5. Number of wolf mortalities by cause of death in the WTGMA during the calendar year. (Wolves were listed under the Endangered Species Act in portions of 2014-2017)

Disease Monitoring

Disease presence and prevalence in wildlife populations is 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 densities (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). Management actions

such as hunting and conflict control in the WTGMA appears to have held the population below the threshold where disease outbreak would be more likely, however, the WTGMA 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 WTGMA was correlated with an increase in detection of mange and distemper in the wolf population through 2018. Documentation of disease in the WTGMA wolf population was markedly reduced during 2019 and 2020 as the population was managed at lower density (Figures 2, 3 and 6). The Wyoming Game and Fish Department will continue to monitor disease in the WTGMA wolf population and whether reduced population density continues to 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 Wyoming outside Yellowstone National Park in 2002 (Jimenez et al. 2010). As expected, documentation of mange continued to remain low in the WTGMA in 2020. The Game Creek pack continued to use the same territory and homesites used formerly by the Horse Creek pack, which was mostly killed by mange in 2018, and showed signs of significant mange infection in winter 2019/20 and 2020/21. The Department will continue to monitor mange in wolves and how it correlates with reduced wolf density.

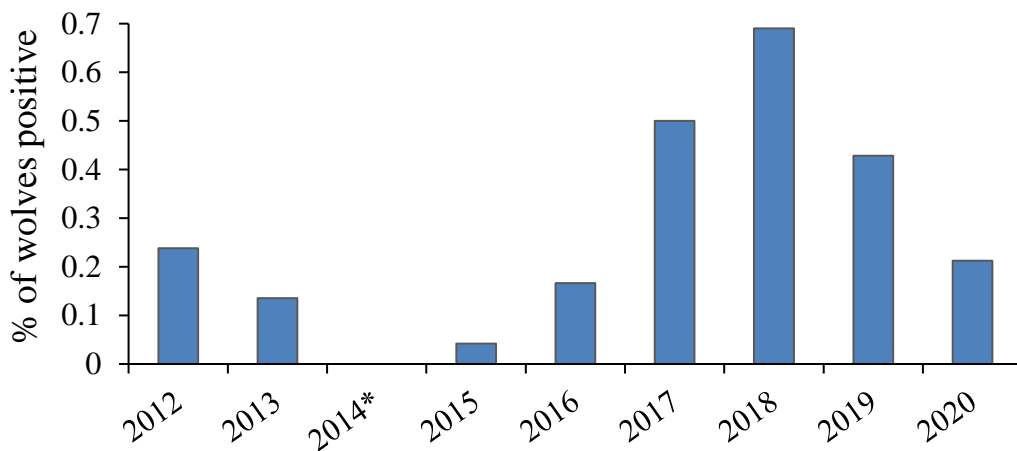


Figure 6. Proportion of wolves captured in winter (November through March) that tested positive for canine distemper virus in WTGMA. (*Too few wolves were captured following Endangered Species Act relisting of the wolf population to allow for an adequate sample)

Distemper: Distemper is a highly contagious disease that infects species such as 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. The proportion of wolves captured during winter that tested positive for distemper infection increased from 2015 through 2018 (Figure 6) and was correlated with increasing wolf population density in the WTGMA (Figure 2). The proportion of wolves that tested positive during winter capture in 2020 (November 2020-March 2021) continued to decrease from a high in 2018 following population peaks after wolves were relisted

in 2014 through early 2017. Decreasing prevalence of distemper has been correlated with a reduction in wolf population density in the WTGMA from 2018-2020 (Figure 6). There were no documented wolf mortalities caused by distemper during 2020.

Canine Parvovirus: Canine parvovirus is a highly contagious disease that caused significant population level impacts for wolf populations throughout North America primarily in the 1980s (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 or other diseases if the need arises in the future.

Population Trend

The Wyoming Game and Fish Department closely monitors and manages the wolf population in the WTGMA because this is the area the state determined to have the most suitable habitat for long-term viability of wolves and would, therefore, maintain the number of wolves and breeding pairs required to meet population commitments outlined in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2012). The WTGMA end of year wolf population decreased 16% from ≥ 175 wolves at the end of 2019 to ≥ 147 wolves at the end of 2020 and remained above the minimum population commitment of ≥ 100 wolves (Figure 2; Table 1). Breeding pairs decreased 15% from ≥ 13 in 2019 to ≥ 11 in 2020 and remained above the minimum breeding pair commitment of ≥ 10 breeding pairs (Figure 3; Table 1). The number of wolf packs in the WTGMA was reduced from ≥ 26 packs at the end of 2019 to ≥ 24 packs at the end of 2020 (Figure 3). Seven packs established in 2020 (Big Chief Butte, Boulder Ridge, Horsetail Creek, Long Hollow, Thief Creek, Wildcat Ridge, and Yellowjacket; Figure 1; Table 1). Nine packs documented at the end of 2019 did not exist on December 31, 2020 or were assigned to other jurisdictions (Coyote Meadows; Table 1). There was little evidence suggesting the presence of any wolf packs in the WTGMA that were not documented. Average pack size at the end of 2020 (5.3 wolves per pack) was lower in 2020 than in previous years and is reflective of the general population reduction in the WTGMA (Figures 2, 3, and 4).

The decrease in population parameters in the WTGMA was the result of lower than average reproduction and recruitment of pups into the population and sustained levels of human-caused mortality in 2020 (Figures 5 and 7; Table 2). Despite fewer breeding pairs, lower wolf density in 2020 correlated with continued larger litter sizes in summer (5.5 pups per pack in 2019 and 5.2 in 2020 vs. a mean of 4.2 pups per pack from 2012-2018). Evidence of disease has declined in the WTGMA wolf population as wolf density has declined and appeared to factor little in wolf population dynamics in the WTGMA in 2020 (Figure 6).

The wolf population in the WTGMA has largely followed basic concepts of population theory over the course of recolonization and transfer to state management (e.g., density-dependence as seen in Figure 7). Predictable population responses to natural and human-caused perturbations allow for more precise estimation of the impact of management decisions. In addition, the dual

population objectives of wolf numbers and breeding pairs incorporates an added level of complexity for managing the wolf population in the WTGMA. However, throughout wolf recolonization in the WTGMA, the minimum number of breeding pairs has remained highly correlated to the minimum number of wolves in the WTGMA (Figure 8). This strong correlation allows for a high level of confidence in predicting how management actions, such as wolf hunting season, may impact both wolf and breeding pair numbers and may provide a mechanism for indirectly estimating the number of breeding pairs in the population with less invasive approaches (Figure 8).

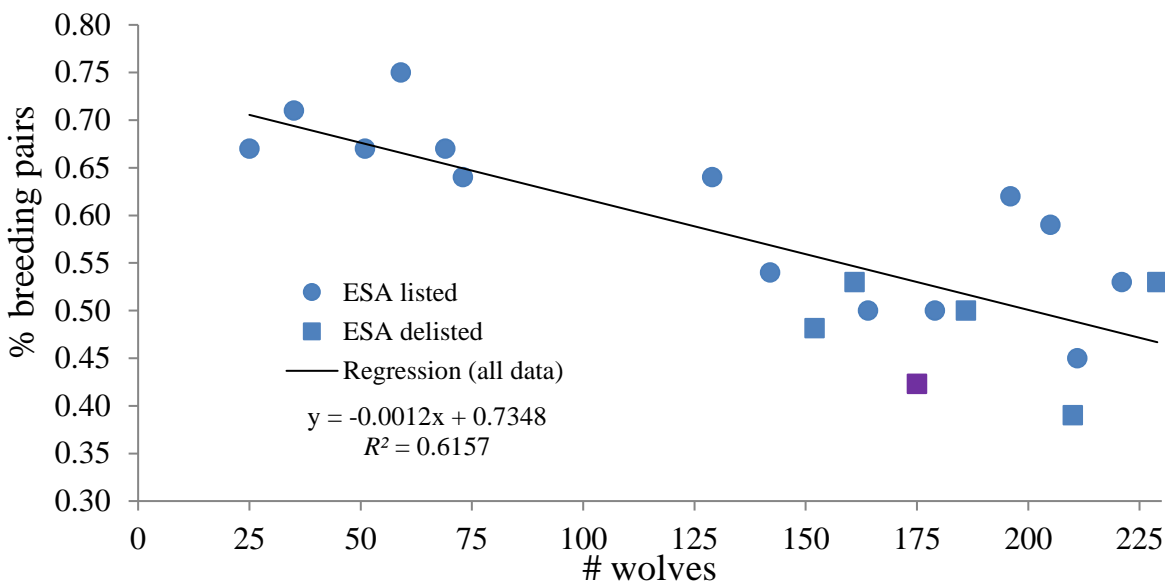


Figure 7. Minimum number of wolves present in the WTGMA at the beginning of the calendar year compared to the proportion (%) of packs that qualified as a breeding pair in the WTGMA at the end of the calendar year from 2000-2020. (“■” indicates the 2020 data point)

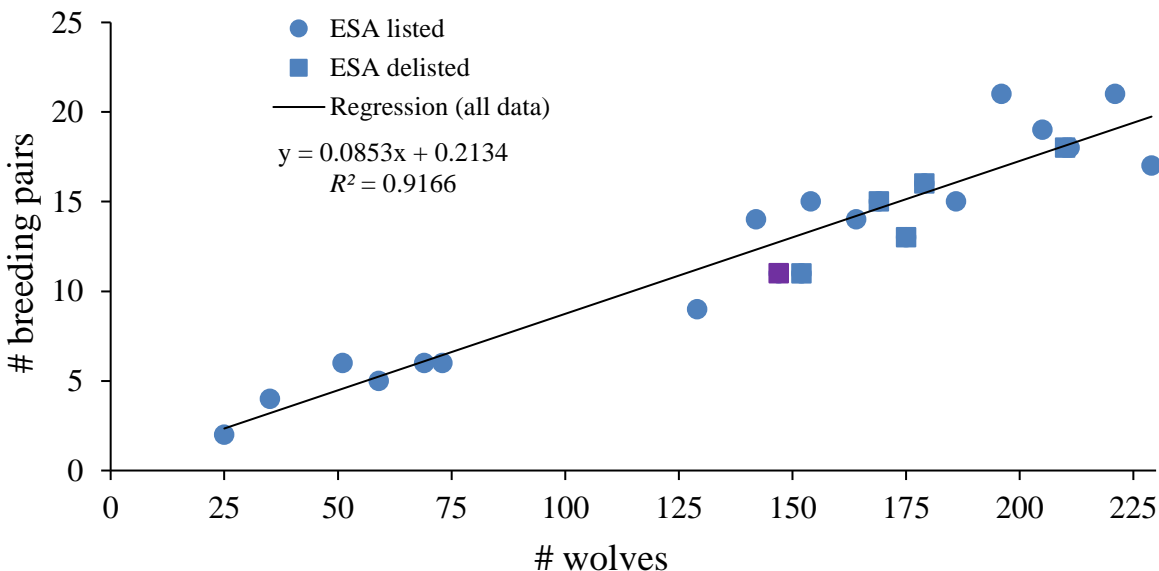


Figure 8. Minimum number of wolves and breeding pairs in the WTGMA at the end of the calendar year from 1999-2020. (“■” indicates the 2020 data point)

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 the 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: Wyoming Game and Fish Commission 2011). Genetic samples will continue to be collected from wolves in the WTGMA to ensure enough genetic information is available to determine whether genetic interchange is occurring in the northern Rocky Mountains.

In 2020, genetic samples were collected from 83 wolves in the WTGMA that will be used in analysis of genetic interchange. Genetic samples were collected from 55 wolves that died and 28 wolves captured for monitoring purposes. As required by Chapter 47, 31 samples were acquired from harvested wolves taken during authorized hunting seasons in the WTGMA in 2020.

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 the WTGMA. 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, survival, to mitigate livestock conflicts, and to aid in law enforcement investigations.

Twenty-eight wolves from 14 packs in the WTGMA were collared through aerial capture techniques in 2020, including 7 recaptures. At the end of 2020, there were 40 wolves in 18 packs and 1 single wolf being monitored with telemetry collars in the WTGMA (41 wolves total; 28% of the year-end population). Twenty-six collared wolves died in the WTGMA in 2020 (37% of total documented wolf mortalities). Winter wolf capture efforts continued through March 2021 in conjunction with year-end population surveys, at which point a total of 70 wolves in 21 packs and 2 single wolves were being monitored via telemetry collars in the WTGMA (72 wolves total; approximately 49% of the WTGMA population in March 2021). The proportion of collared individuals is generally highest at the end of winter following aerial capture efforts in March and decreases throughout the remainder of the year as pups are born in April and collared wolves die, disperse, or when collars fail.

Predatory Animal Areas

As of December 31, 2020, there were ≥ 36 wolves, ≥ 8 packs, and ≥ 2 breeding pairs in the predatory animal areas (including the Seasonal WTGMA) in Wyoming (Figure 1; Table 1). Forty-three wolf mortalities were documented in predatory animal areas in 2020, including; 22

taken by the public as predatory animals, 16 taken by USDA Wildlife Services, 3 from other human-causes, 2 from natural causes (1 by wolves, 1 by mange), and 1 from unknown causes (Table 1). Wolf captures included 3 wolves from 1 pack in the Seasonal WTGMA and 1 wolf from 1 pack in the predatory animal area. At the end of 2020, 6 wolves from 4 packs were being monitored via telemetry collars in predatory animal areas in Wyoming. Sixteen genetic samples were collected from wolves designated as predatory animals in 2020.

Wolf Population Monitoring on the Wind River Reservation

Population and Breeding Pair Status

The Wind River Reservation minimum wolf population and breeding pair estimates were counted using analogous methods as described for the WTGMA. 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 9). The wolf subpopulation in the Wind River Reservation slowly increased through 2013 and has since fluctuated between 10 and 20 wolves (Figure 9). As of December 31, 2020, ≥ 21 wolves in ≥ 3 packs, including ≥ 2 breeding pairs, were documented on the Wind River Reservation (Figures 1 and 9; Table 3). All confirmed packs existed along the eastern front of the Wind River Range. Two wolves were documented in the Owl Creek Mountains in the Wind River Reservation in January 2021 and were included in the miscellaneous wolf category (Table 3).

Capture and Telemetry Collaring

No wolves were captured in the Wind River Reservation in 2020.

Mortality

One wolf was killed by other wolves in the Owl Creek Mountains of the Wind River Reservation in 2020 (Table 3).

Wolf Population Monitoring in Yellowstone National Park

Population and Breeding Pair Status

The Yellowstone National Park minimum wolf population and breeding pair estimates were counted using analogous methods as described for the WTGMA. At the end of December 2020 there were ≥ 123 wolves in ≥ 9 packs, including ≥ 7 breeding pairs, living primarily in Yellowstone National Park (Figures 1 and 9; Table 3). This census was the highest since 2008 (124 wolves) and marked a one-year increase of 31% after a decade of very little population change year-to-year (Figure 9). Much of the growth was attributed to successful pup production and survival in multiple packs, most notably the Junction Butte pack which produced 4 litters and raised 18 pups through the end of the year.

The number of packs and breeding pairs was the same as the average over the last decade. Pack size in 2020 ranged from 4 to 35, averaging 13 in size. This average was higher than the long-

term average pack size of 9 to 10. Again, this average was largely driven by the exceptional size of the Junction Butte pack at 35 members. Average pack size not including Junction Butte was 11. Two other packs, 8 Mile and Wapiti Lake, had 21 and 20 members, respectively, making 2020 the only year with 3 packs of 20 or more members in mid-winter. The only year with 2 packs that large was 2000 when the Druid Peak pack had 27 and Nez Perce pack had 22 members. Every other year's official count has had no packs (15 years) or 1 pack (8 years) with at least 20 members.

Park-wide, at least 60 pups were produced, with an additional 4 litters that were known to be born but all died before they could be counted. Of the 60 pups counted, 52 survived (87%) to year end with far more in northern Yellowstone National Park (41) than the interior (11) of the park. At the end of 2020, pups comprised 42% of the park population, similar to 2019 (44%) but higher than the last decade average of 32%.

Table 3. Wolf packs, minimum pack size at the end of the calendar year, wolf mortality, and wolf-livestock conflicts in Yellowstone National Park and the Wind River Reservation in 2020.

WOLF PACK ^{1,2}	MINIMUM PACK SIZE	DOCUMENTED MORTALITY ³					KNOWN DISPERSED		MISSING ⁵		CONFIRMED CONFLICTS ⁶			
		NATURAL	HUMAN ⁴	UNKN	HUNTING	CONTROL					CATTLE	SHEEP	DOGS	OTHER
YELLOWSTONE NATIONAL PARK NORTHERN RANGE														
8 Mile [^]	21						2	3						
Phantom Lake	14													
Carnelian Creek	6	2						1						
Junction Butte	35	1												
Misc. wolves	3													
YELLOWSTONE NATIONAL PARK NON-NORTHERN RANGE														
Bechler [%]	4													
Cougar Creek	6						1							
Mollie's	7													
Wapiti Lake	20	1					2							
Heart Lake	6													
Misc. wolves	1													
Yellowstone National Park Total ⁷	123	4	0	0	0	0	5	4	0	0	0	0		
WIND RIVER RESERVATION														
Arrow Mountain [*]	9						1							
Owl Creek [*]		1												
Sage Creek	3													
St. Lawrence [*]	7													
Misc. wolves	2													
Wind River Reservation Total ⁸	21	1	0	0	0	0	1	0	0	0	0	0		
Total in Yellowstone N.P. and Wind River	144	5	0	0	0	0	6	4	0	0	0	0		

1 Underlined packs qualified as breeding pairs on December 31, 2020.

2 Strikethrough packs were not documented during 2020 and/or did not exist on Dec. 31, 2020 and are not displayed in Figure 1.

3 Excludes wolves assigned to Yellowstone National Park that were killed outside Yellowstone National Park.

4 Excludes wolves killed in control actions and legal hunting.

5 Collared wolves that became missing in 2020.

6 Includes livestock and domestic animals confirmed killed or injured by wolves.

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

8 Mortality and conflicts with livestock 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.

Capture and Telemetry collaring

Fifteen wolves in 4 packs were captured and collared in 2020. All 15 collars were placed on previously uncollared wolves because wolves with old or malfunctioned transmitters were mostly living in large packs and were difficult to target during capture operations. Also, the high percentage of pups and yearlings in the population led to a high proportion of collars placed on

those age groups. New collars were deployed on 9 pups, 4 yearlings, 1 adult (2 years old), and 1 wolf with an estimated age between yearling and 3 years old. Sex ratio of newly collared wolves was skewed with 10 males and 5 females. In addition to the radio collar, staff took measurements and biological samples while the wolves were under the effects of the capture drugs.

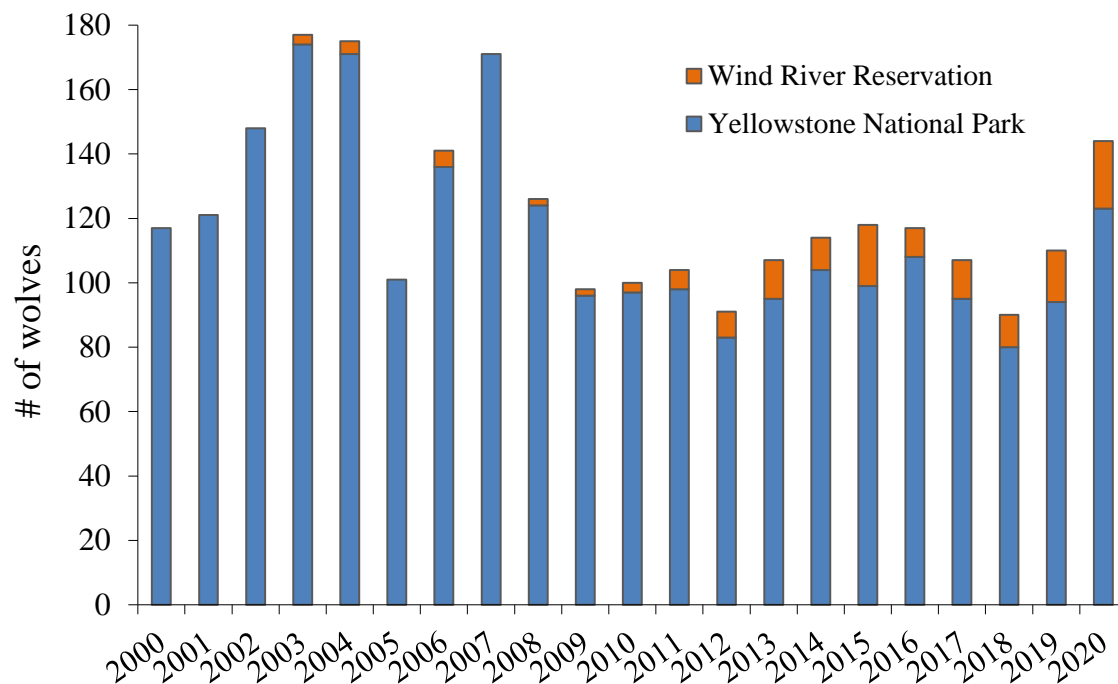


Figure 9. Minimum number of wolves in Yellowstone National Park and the Wind River Reservation at the end of the calendar year.

Mortality

Four wolves died in Yellowstone National Park in 2020, including 3 wolves killed by other wolves and 1 wolf that died of a severe abdominal infection of unknown cause (Table 3).

Disease Monitoring

There was no evidence of significant mortality caused by disease in 2020. By late December several members of the Junction Butte pack showed signs of hair thinning and loss, which may be an early indication of mange infection. We will continue to monitor the changes in infection at the individual, pack, and population levels. Wolf density in northern Yellowstone National Park is consistently higher than most other places wolves live. The abundance and density of predator species in the Greater Yellowstone Ecosystem leaves open the possibility of diseases such as canine distemper virus to occasionally cycle through (Almberg et al. 2010, 2012). The last documented outbreak of canine distemper virus in wolves in Yellowstone National Park was 2017.

WOLF MANAGEMENT

SUMMARY OF WOLF MANAGEMENT STATEWIDE

In 2020, the Wyoming Game and Fish Department implemented a wolf hunting season with the biological objective to stabilize the wolf population at approximately 160 wolves in the WTGMA. A mortality limit of 51 wolves was divided between 13 hunt areas in the WTGMA and 1 hunt area in the Seasonal WTGMA (hunt area 12). Wolf hunting seasons were open from September 15, 2020 through December 31, 2020 with the exception of hunt area 12 (opened on October 15, 2020) and hunt area 13 (closed March 31, 2021). The hunting season for each hunt area closed at the season end date or when the mortality limit in the hunt area was met, whichever occurred first. A total of 31 wolves were killed during the wolf hunting season in 2020.

Wolves were confirmed to have killed or injured 76 head of livestock (54 cattle, 12 sheep, and 10 chickens) and 1 dog statewide in Wyoming in 2020. Fourteen packs were involved in ≥ 1 livestock conflict statewide. Forty-three wolves were lethally and legally removed by agencies or the public in an effort to reduce livestock losses to wolves (27 in the WTGMA, 16 in predatory animal areas in WYO).

Wolf Management in the WTGMA

Hunting

Wolf Hunting Season Background: Chapter 47 governs wolf hunting in the WTGMA 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 2020 were approved by the Wyoming Game and Fish Commission and outlined specific hunt areas, mortality limits, season dates, and other wolf hunting regulations in the WTGMA and Seasonal WTGMA.

The Wyoming Game and Fish Department delineated 14 wolf hunt areas in the WTGMA and Seasonal WTGMA for 2020 (Figure 10). Some hunt areas were combined under one mortality limit to accommodate specific wolf pack movements and management objectives (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 and ran primarily from September 15th to December 31st (Table 4). The season in hunt area 13 was extended to end March 31st to allow greater opportunity to harvest wolves in areas used by the wintering Whiskey Mountain bighorn sheep herd (Figure 10; Table 4). 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)) and closed on December 31, 2020 (Figure 10; Table 4). 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 2020 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.

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 slightly reduced in the WTGMA from ≥ 175 wolves at the beginning of 2020 to approximately 160 wolves at the end of 2020 if 47.4% of the wolves present at the beginning of 2020 died from all human-caused mortality. The predicted non-hunting human-caused mortality rate (19.5%) was then subtracted from 47.4% to obtain a 27.9% wolf hunting mortality rate, which equaled a total mortality limit of 49 wolves when applied to the minimum wolf population estimate of ≥ 175 wolves present in the WTGMA at the beginning of 2020 (i.e., the end of 2019 minimum wolf population). The total mortality limit of 49 wolves was sub-divided among 13 hunt areas in the WTGMA (Table 4). An additional 2 wolves were included in the total mortality limit to be applied to hunt area 12 (the Seasonal WTGMA), for a total mortality limit of 51 wolves (Table 4).

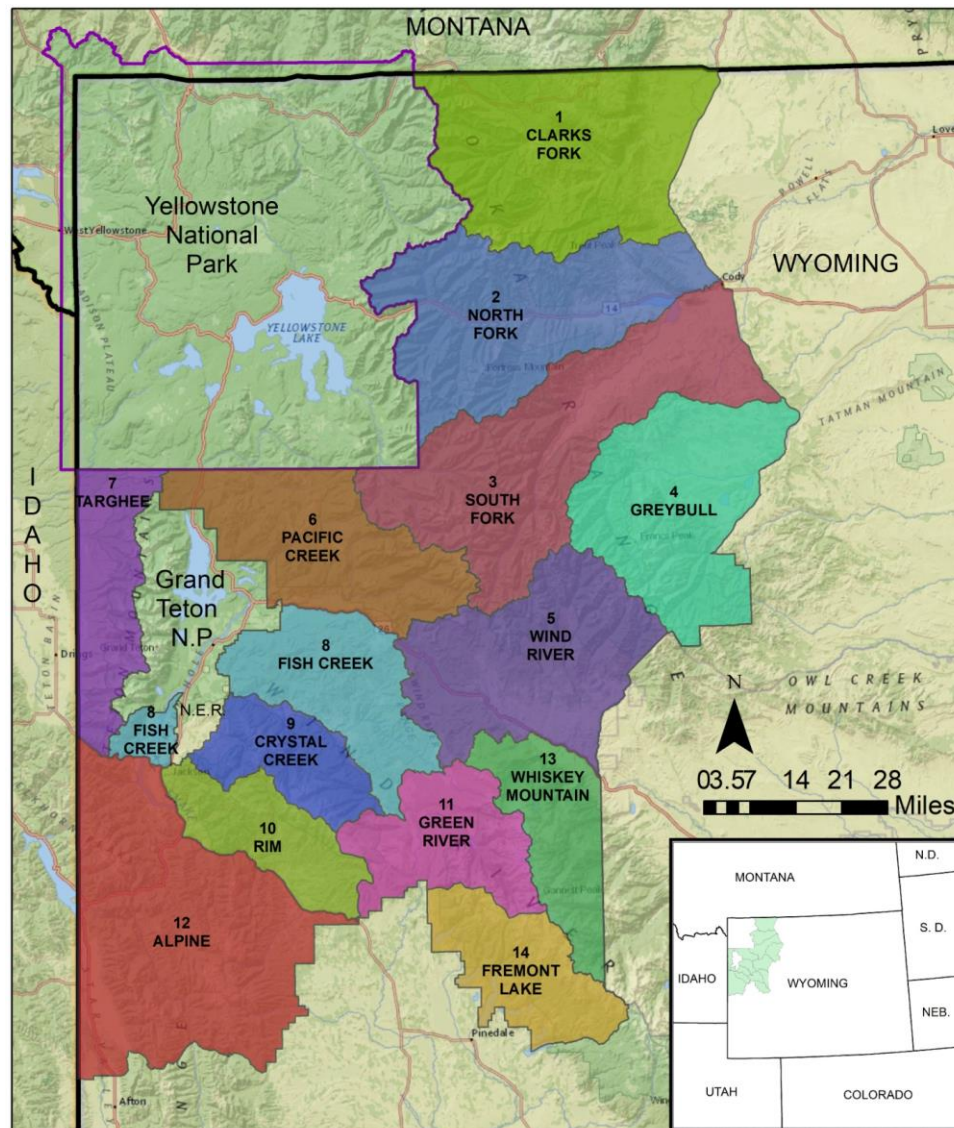


Figure 10. Wolf hunt areas for the 2020 wolf hunting season in northwest Wyoming.

Wolf Hunting in the WTGMA and Seasonal WTGMA: A total of 2,221 wolf hunting licenses were sold to 2,077 individuals (1,848 residents and 229 nonresidents) for the 2020 wolf hunting season, more than in 2019 (1,885 licenses) and slightly below hunting seasons in 2017-2018 (average of 2,590 licenses). One hundred forty-four individuals purchased 2 wolf hunting licenses. A total of 31 wolves out of the 51 wolf mortality limit were taken during open wolf hunting seasons in the 14 hunt areas in 2020 (Table 4). Two additional wolves were taken in early January 2021 in Hunt Area 13. One of the 14 hunt areas closed prior to the established December 31, 2020 closing date due to the mortality limit being met (Table 4). All hunters who legally killed a wolf complied with reporting and registration requirements.

Table 4. Summary of the wolf hunting season in the WTGMA and Seasonal WTGMA (hunt area 12) in 2020.

WGFD WOLF HUNTER HARVEST SUMMARY 2020						12/31/2020
HUNT AREA(s)	MORTALITY LIMIT FROM REGULATIONS	SEASON DATES	HARVEST COUNTED TOWARDS LIMIT*	AREA STATUS	DATE/TIME AREA CLOSED	
		GENERAL				
1	7	Sep. 15 - Dec. 31	6	CLOSED	12/31 per Regulation	
2	7		4	CLOSED	12/31 per Regulation	
3,4	5		1	CLOSED	12/31 per Regulation	
5	4		3	CLOSED	12/31 per Regulation	
6, 7	6		2	CLOSED	12/31 per Regulation	
8, 9, 11	10		8	CLOSED	12/31 per Regulation	
10	6		6	CLOSED	10/26 @ 8:45 PM	
12	2	Oct. 15 - Dec. 31	0	CLOSED	12/31 per Regulation	
13	3	Sep.15 - Mar. 31	1	OPEN		
14	1	Sep. 15 - Dec. 31	0	CLOSED	12/31 per Regulation	
Total 2020 Mortality Limit	51	Total 2020 Trophy Harvest	31			

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

Hunting mortality was recorded in 16 of 26 packs (62%) that regularly used the WTGMA (Table 1). Six additional wolves were taken that did not belong to established packs (Table 1). Hunting mortality occurred during each month of the season, with most occurring in September and October (Figure 11). Slightly more females than males (17 females:14 males) and nearly twice as many black than gray colored wolves were taken in the hunt (11gray:20 black). Wolves taken during the hunting season in 2020 were primarily adults and subadults (4 juveniles:14 subadults:13 adults). For all wolf hunting seasons combined, more juveniles and fewer adults have been taken in earlier months with the ratio shifting toward adults through the end of the hunting season in December (Figure 12).

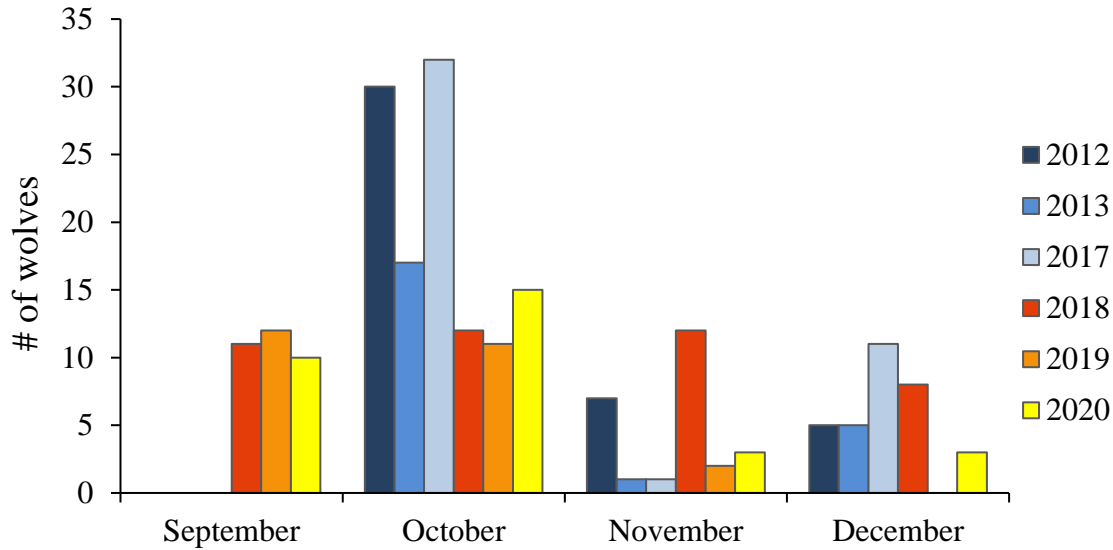


Figure 11. Number of wolves taken during wolf hunting seasons by month and year in the WTGMA and Seasonal WTGMA in northwest Wyoming. (2012-2017 had Oct. 1st openers; 2018-2019 had Sept. 1st openers; 2020 had a Sept. 15th opener)

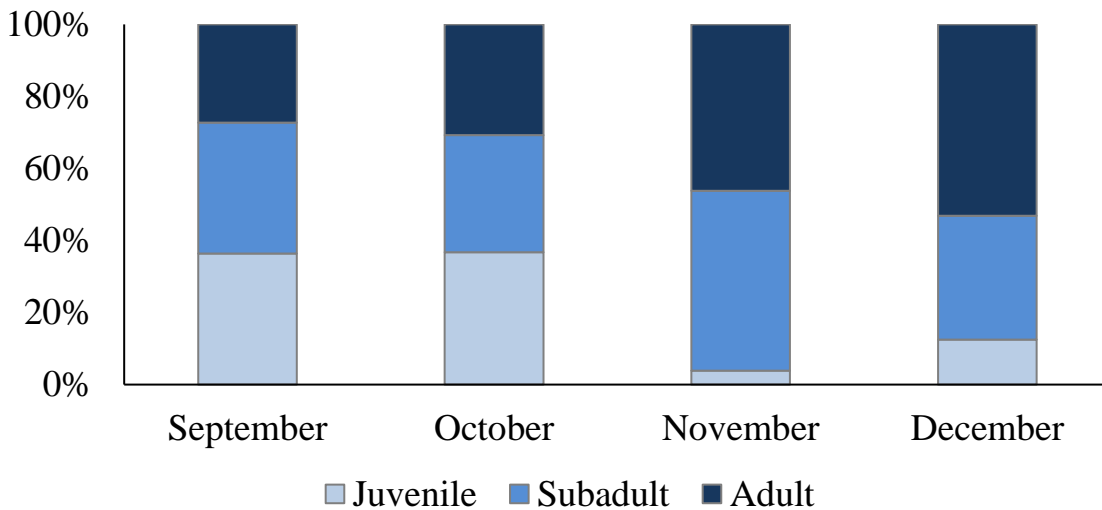


Figure 12. Proportion of adult (>2 years of age), subadult (1-2 years of age), and juvenile (<1 year of age) wolves taken during wolf hunting seasons by month in the WTGMA and Seasonal WTGMA in northwest Wyoming during all wolf hunting seasons: 2012, 2013, 2017-2020. (Seasons started October 1st in 2012, 2013 and 2017, September 1st in 2018-2019, and September 15th in 2020)

Development of 2020 Wolf Hunting Seasons: The 2020 end of year wolf population in the WTGMA was 8% lower than the population objective set during the wolf hunting season setting process (147 wolves vs. the 160 wolf population objective). Wyoming Game and Fish Department wolf management has consistently produced an end of year wolf population within 10% of the population objective since 2018 (+9% in 2019 and -5% in 2018). The efficacy of the

season-setting process employed is dependent on analysis of long-term wolf population trend data for the WTGMA, including recruitment (i.e., breeding pairs: Figures 7 and 8) and mortality (Figures 13 and 14). The Department will continue to take an adaptive management approach for setting 2021 wolf hunting seasons as outlined in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011).

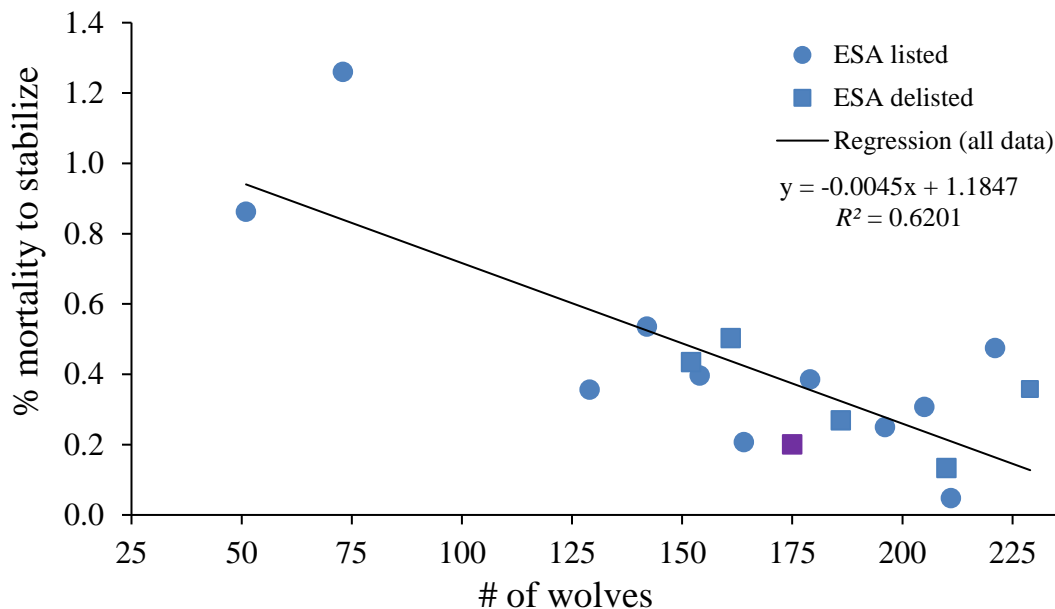


Figure 13. Minimum number of wolves at the beginning of the calendar year and the percent human-caused mortality required to stabilize wolf population growth during the calendar year in the WTGMA from 2004-2020. (“■” indicates the 2020 data point)

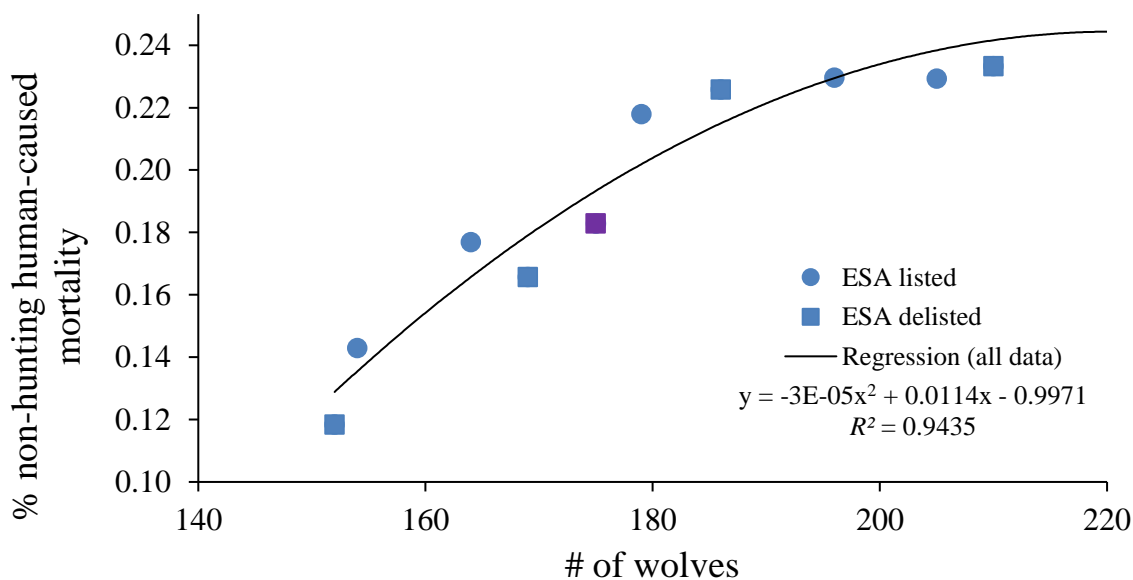


Figure 14. Proportion of wolves present in the WTGMA at the beginning of the calendar year that were killed by non-hunting human-causes during the calendar year from 2008-2020. (Statistical outliers from 2011 and 2016 are excluded; “■” indicates the 2020 data point)

Wolf-Livestock Conflicts

During 2020, reported livestock that were killed or injured by wolves (i.e., conflicts) in the WTGMA and Seasonal WTGMA were investigated by the Wyoming Game and Fish Department. 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 suspected conflicts between livestock and wolves are expected to be reported in the WTGMA and Seasonal WTGMA because verification is required to qualify for damage compensation and/or for wolf management actions to be initiated.

In 2020, wolves were responsible for killing or injuring 74 head of livestock in the WTGMA and Seasonal WTGMA (Figure 15; Tables 1 and 5). Livestock confirmed to have been killed or injured by wolves included 51 cattle (41 calves and 10 cows/yearlings), 12 sheep, 1 dog, and 10 chickens (Figure 15; Tables 1 and 5). The total number of wolf-livestock conflicts in 2020 was higher compared to 2019 largely due to increased sheep and chicken depredations. The number of cattle killed by wolves was similar to the two previous years (Figure 15; Table 5). Management actions included collaring wolves, intensive monitoring, lethal removal, non-lethal depredation prevention measures, and issuance of 21 lethal take permits to livestock producers (19 initial permits, 2 of which were renewed due to continued livestock conflict). Twenty-seven wolves were killed in response to livestock conflicts; 13 in agency-directed lethal control actions, 13 under authority of lethal take permits, and 1 in defense of private property (Figure 5 and 15; Tables 1, 2 and 5).

Table 5. Confirmed wolf-livestock conflicts and wolves killed in conflict control actions in the WTGMA and Seasonal WTGMA by calendar year.

Livestock	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cattle	38	15	26	41	46	44	60	81	141	87	55	48	51
Sheep	16	40	1	0	69	19	3	36	47	22	7	0	12
Dogs	0	0	0	0	4	1	0	0	0	1	0	0	1
Horses/Other	0	1	1	0	0	2	0	1	0	0	2	2	10
Livestock killed/injured	54	56	28	41	119	66	63	118	188	110	64	50	74
Wolves killed	32	26	32	32	26	25	29	25	89	46	39	12	27

Number of Packs Involved in Confirmed Livestock Conflicts: Thirteen packs (36% of 36 packs that existed in 2020) in the WTGMA and Seasonal WTGMA were involved in ≥ 1 livestock conflict in 2020 (Figure 16; Table 1). All 10 packs involved in >1 conflict were verified to have killed or injured ≥ 3 livestock (77% of conflict packs; 28% of packs; Table 1).

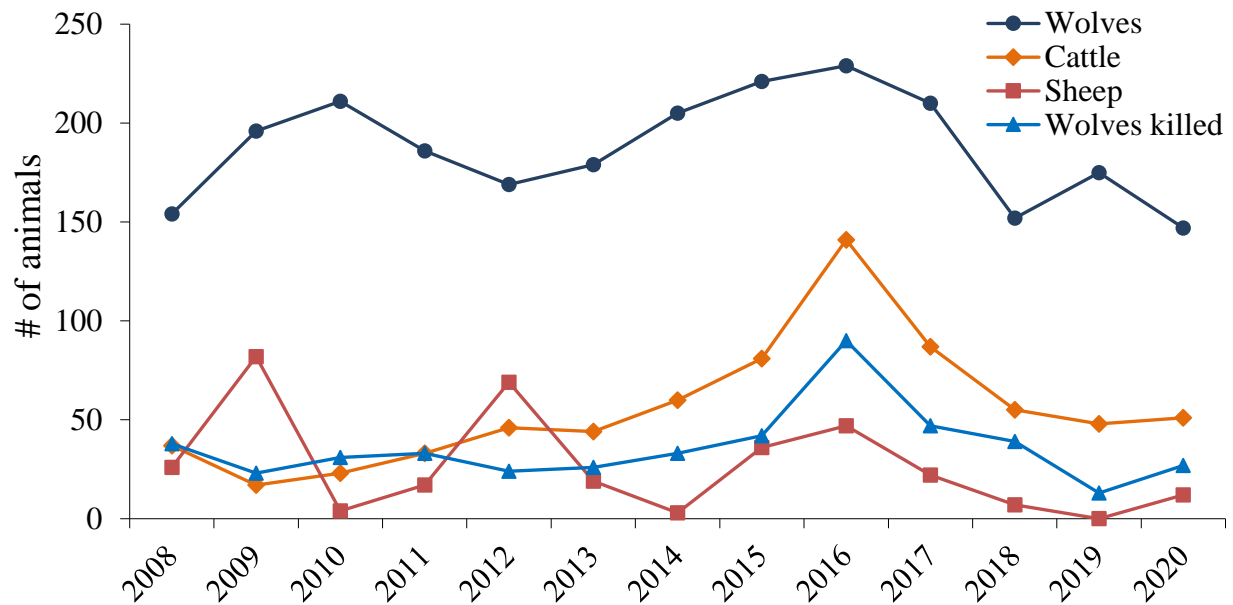


Figure 15. Confirmed wolf-livestock conflicts and wolves killed in conflict control actions in the WTGMA and Seasonal WTGMA by calendar year.

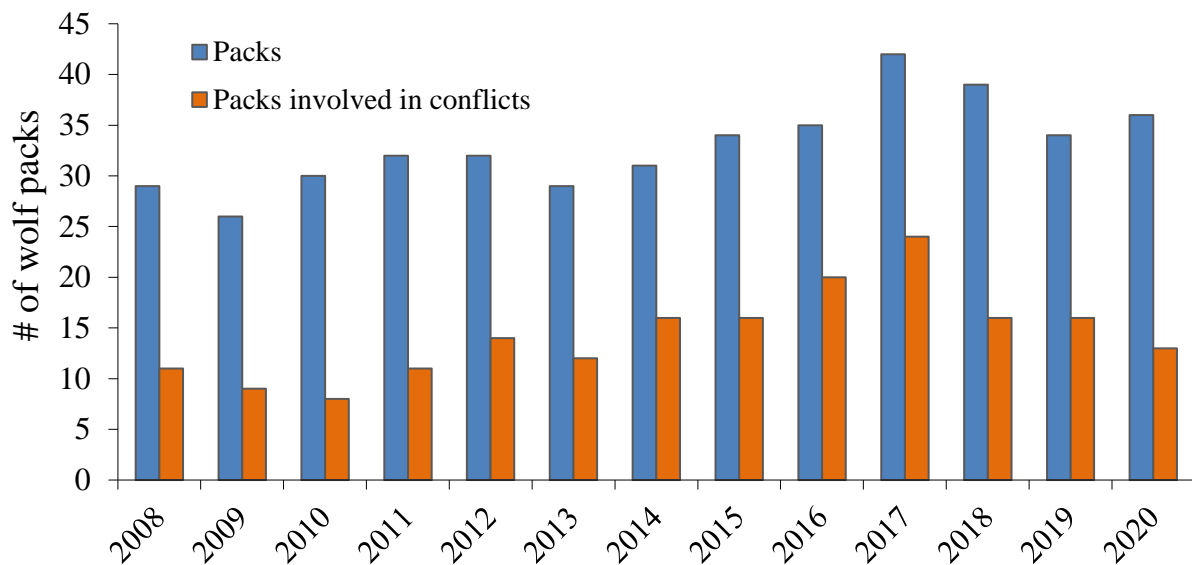


Figure 16. Minimum number of wolf packs present during the calendar year and number of wolf packs that were involved in ≥ 1 confirmed wolf-livestock conflict in the WTGMA and Seasonal WTGMA by calendar year.

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. In 2020, 59% (32 cattle and 12 sheep) of all confirmed wolf-livestock conflicts in the WTMGA and Seasonal WTGMA were on public land and 41% (19 cattle, 10 chickens, and 1 dog) were on private land (Figure 17).

In 2020, hunt areas 1 and 11 had the highest confirmed wolf-cattle conflicts while hunt area 12 (the Seasonal WTGMA) was the only area with wolf-sheep conflicts (Table 6).

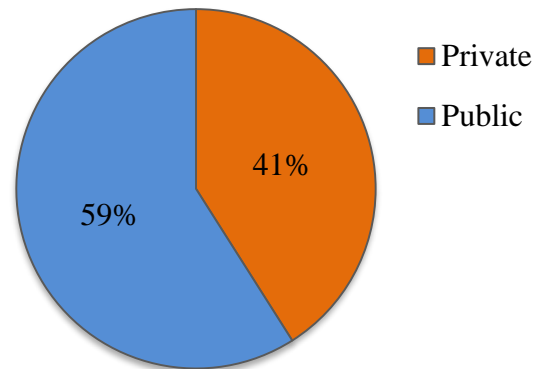


Figure 17. Land status where confirmed wolf-livestock conflicts occurred in the WTGMA and Seasonal WTGMA in 2020.

Table 6. Confirmed wolf-livestock conflicts in the WTGMA and Seasonal WTGMA by wolf hunt area (WHA) in 2020.

WHA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Cattle	10	3	4	5	4	0	0	2	3	5	15	0	0	0	51
Sheep	0	0	0	0	0	0	0	0	0	0	0	12	0	0	12
Other	10	0	0	0	1	0	0	0	0	0	0	0	0	0	11
Total	10	3	4	5	4	0	0	2	3	5	15	12	0	1	74

Seasonal Trend in Livestock Conflicts: Wolf-livestock conflict patterns in 2020 were similar to previous years. Confirmed conflicts began in January, peaked in late summer, and then declined toward the end of the calendar year (Figure 18).

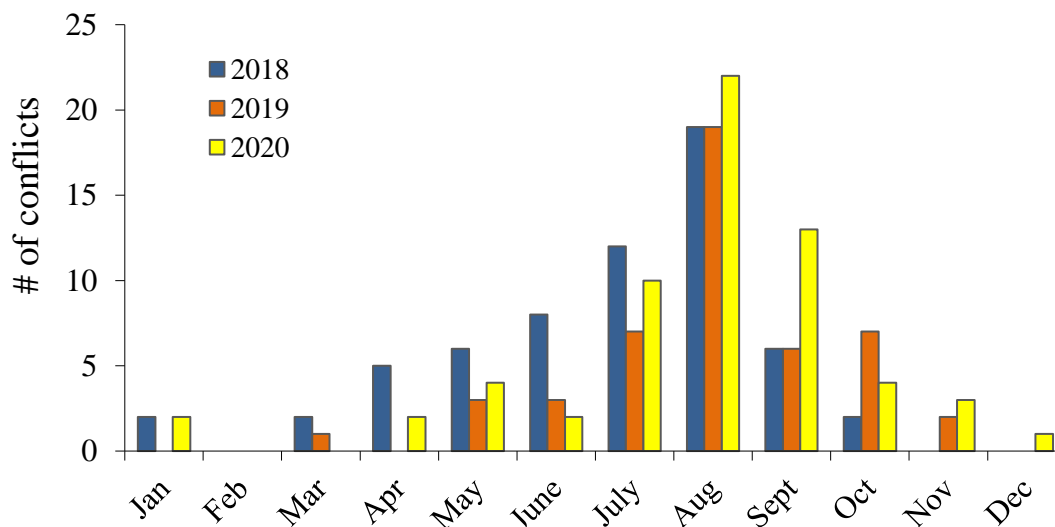


Figure 18. Number of wolf conflicts with cattle and sheep per month in the WTGMA and Seasonal WTGMA from 2018-2020.

Compensation for Livestock Damage Caused by Wolves: In 2020, the Wyoming Game and Fish Department paid \$152,860 to compensate 20 livestock producers for livestock killed or injured by wolves in the WTGMA and Seasonal WTGMA (Figure 19). Compensation payments declined from >\$300,000 from 2014-2017 to <\$170,000 from 2018-2020, mirroring synchronous declines in conflict between wolves and livestock following removal of Endangered Species Act protections in 2017 (Figures 15 and 19). Compensation payments have consistently remained lower under Wyoming Game and Fish Department management from 2018-2020 (Figures 2, 15 and 19; Table 5).

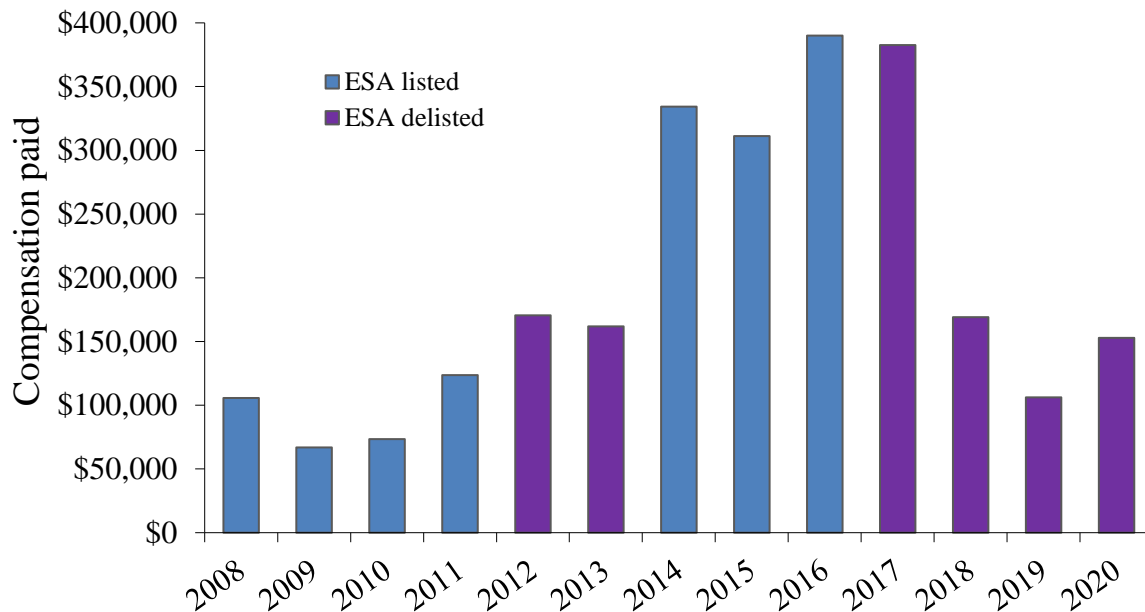


Figure 19. Compensation paid for confirmed livestock damage caused by wolves in the WTGMA (all years) and Seasonal WTGMA (from 2012-2020) by calendar year.

Unacceptable Impacts to Ungulates or Elk Feedgrounds

Under the Wyoming Gray Wolf Management Plan, Wyoming Statute 23-1-304(j), and 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” (Wyoming Game and Fish Commission 2011). 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 2020 as there was no definitive 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 the WTGMA.

Predatory animal areas

A total of 22 wolves were taken by the public under predatory animal designation and an additional 16 wolves were taken by USDA Wildlife Services to prevent conflicts with livestock in predatory animal areas in 2020 (Table 1). Wolves caused 3 conflicts with cattle and 1 conflict with sheep in the year-round predatory animal area (Table 1).

Wolf Management on the Wind River Reservation

In 2020, wolves were classed as a trophy game animal on the Wind River Reservation. Legal take could occur for wolves during a regulated hunting season and for defense of life and property. Reported livestock conflicts with wolves on the Wind River Reservation are 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.

No conflicts were reported or investigated in 2020 (Table 3). A wolf hunting season was implemented from December 1, 2020 through February 28, 2021 on the Wind River Reservation. Season dates were chosen to correspond with the period of the year when wolf pelts are prime. A total quota of 6 wolves was split evenly between 2 hunt areas in the Owl Creek and Wind River Mountains. Mandatory reporting was required within 48 hours to allow for seasons to be closed once the quota was met. No wolves were taken during the hunt (Table 3).

Wolf Management in Yellowstone National Park

Wolf management in Yellowstone National Park in 2020 was primarily focused on reducing habituated behavior from some individuals in both the Junction Butte and Wapiti Lake packs. Staff hazed at least 5 wolves from the Junction Butte pack and 3 from the Wapiti Lake pack and continue to monitor their behavior.

Yellowstone National Park staff closed the areas around the Junction Butte, Carnelian Creek, and Wapiti Lake pack’s dens to protect the young pups from disturbance. The Junction Butte pack was visible nearly every day of the summer and fall, using Slough Creek and later Lamar Valley to raise their pups. In Hayden Valley, management closures and signage near the Wapiti Lake

pack homesite were required to reduce resource damage. Large numbers of visitors hoping to see wolves were creating eroded, braided social trails and flattening vegetation in some high-use areas.

OUTREACH IN WYO

In person presentations were limited in 2020 due to COVID restrictions, however, Wyoming Game and Fish Department personnel were able to provide presentations to some school groups and engaged the public virtually during the wolf hunting season setting process. Personnel continued to provide interviews for numerous magazine, newspaper, and television feature stories. As part of normal wolf monitoring and management activities, Wyoming Game and Fish Department personnel interacted with members of the public 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.

EXPENDITURES

WYO

During the 2020 calendar year, the Department conducted annual population monitoring, responsive conflict management, internal and external education and information, and other statutory and regulatory obligations in regards to damage compensation and law enforcement for wolves. The Department directed approximately \$543,435 of wolf program funds toward wolf management in 2020. Program expenditures are reported by primary work activities conducted below, but do not represent all Department expenses incurred:

- Monitoring and management program: \$337,289
- Conflict prevention and management: \$19,589
- Internal and external information and education: \$26,760
- Equipment and administration: \$6,937
- Compensation for verified wolf-livestock conflict: \$152,860

Cooperating agencies in WYO also expended funds directed toward wolf monitoring and management in 2020 as follows:

- Grand Teton National Park: \$121,000
- USDA Wildlife Services: \$41,017 (including \$4,158 for nonlethal projects)

Wind River Reservation

A total of \$7,870 was spent on wolf monitoring and management in the Wind River Reservation in 2020 (\$5,870 by the U.S. Fish and Wildlife Service Lander Fish and Wildlife Conservation Office and \$2,000 by the Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department).

Yellowstone National Park

About \$550,000 was spent on monitoring and managing wolves in Yellowstone National Park in 2020; \$250,000 from federal funding and \$300,000 from private sources.

CONTRIBUTORS

Many personnel contributed to the content of the 2020 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 drafted and edited the report. Large Carnivore Section: Clint Atkinson, Dan Bjornlie, Mike Boyce, Justin Clapp, Brian DeBolt, Luke Ellsbury, Andy Johnson, Ryan Kindermann, Dusty Lasseter, Rebecca Lyon, 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
- University of California, Berkeley: Kristin Barker, Arthur Middleton, and Avery Shawler
- Wyoming State Veterinary Laboratory: Joan Edwards
- Grand Teton National Park: Sarah Dewey and John Stephenson
- Wildlife Services: Mike Burrell, Mike Foster, Vivian Meek, Rod Merrell, and Melissa Walker

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

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

- National Park Service: Kira Cassidy, Douglas Smith, Daniel Stahler, Erin Stahler, Matthew Metz, Connor Meyer, Jeremy SunderRaj, Maddy Jackson, Wes Binder, Brenna Cassidy, Jack Rabe, and Nikki Tatton.

ACKNOWLEDGEMENTS

WYO

We appreciate safe and outstanding piloting from Mark Packila of Wildlife Air. We also thank Native Range Capture Services for their wolf capture expertise. Ron Blanchard dedicated many weeks of field effort assisting the wolf monitoring program and provided valuable data.

Numerous agencies and agency personnel also contributed to the monitoring program. We thank numerous regional Wyoming Game and Fish Department biologists and wardens who were instrumental in collecting wolf monitoring data. We also thank staff at the Wyoming Game and Fish Department Wildlife Forensic Laboratory for their assistance with wolf genetic samples. We thank personnel at the following agencies for their assistance in wolf monitoring and management: U.S. Forest Service; National Elk Refuge; Grand Teton National Park; and Bureau of Land Management. We also thank members of the public and private landowners who assisted the Wyoming Game and Fish Department wolf monitoring and management program in WYO. We recognize a successful program needs a strong base of support and to all of the above we are indebted.

Wind River Reservation

We gratefully acknowledge the following for their assistance with wolf conservation: Mike Mazur and Scott Becker (U.S. Fish and Wildlife Service); Justin Friday, Ervin Brown, Ben Snyder and Wilma Wagon (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department).

Yellowstone National Park

We thank the many interested people who come forward every year to study and support wolves in Yellowstone National Park. 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 (now through Yellowstone Forever) since 1996. We also appreciate the safe piloting from Mark Packila of Wildlife Air, Jim Pope of Leading Edge, Troy Woydziak of Baker Aviation, and Stephan Robinson of Ridgeline Aviation. 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.

Sara Madsen, a volunteer technician for the March winter study, lost her life in a tragic car accident on September 2, 2020. From Tetonia, Idaho, Sara had a diverse skill set from her past experiences as field technician, trail crew member, ski instructor, and wildland firefighter. Although Sara only worked for the Wolf Project for a short time, her warm personality, hard work, and passion for wildlife and wildlands was of tremendous value to our project and community. We are grateful to have known her.

LITERATURE CITED

- Almberg, E.S., L.D. Mech, D.W. Smith, J.W. Sheldon, and R.L. Crabtree. 2009 A serological survey of infectious disease in Yellowstone National Park's canid community. PLoS ONE 4(9): e7042. doi:10.1371/journal.pone.0007042
- Almberg, E.S., P.C. Cross, and D.W. Smith. 2010. Persistence of canine distemper virus in the Greater Yellowstone Ecosystem's carnivore community. Ecological Applications 20(7):2058-2074.
- Almberg, E.S., P.C. Cross, A.P. Dobson, D.W. Smith and P.J. Hudson. 2012. Parasite invasion following host reintroduction: a case study of Yellowstone's wolves. Phil. Trans. R. Soc. B 367:2840-2851.

- Cubaynes, S., D.R. MacNulty, D.R. Stahler, K.A. Quimby, D.W. Smith, and T. Coulson. 2014. Density-dependent intraspecific aggression regulations survival in northern Yellowstone wolves (*Canis lupus*). *Journal of Animal Ecology* 83:1344-1356.
- Jimenez, M.D., E.E. Bangs, C. Sime, and V.J. Asher. 2010. Sarcoptic mange found in wolves in the Rocky Mountains in western United States. *Journal of Wildlife Diseases*. 46:1120-1125.
- Jimenez, M.D., D.W. Smith, S.A. Becker, D.R. Stahler, E. Stahler, M. Metz, R. McIntyre, J. Irving, R. Raymond, C. Anton, R. Kindermann, N. Bowersock, and R.F. Krischke. 2012. Wyoming Wolf Recovery 2011 Annual Report. Pages WY-1 to WY-25 in U.S. Fish and Wildlife Service Rocky Mountain Wolf Program 2011 Annual Report. USFWS, Ecological Services, 585 Shepard Way, Helena, Montana, 59601
- Kreeger, T.J. 2003. The internal wolf: physiology, pathology, and pharmacology. Pages 192-217 in L.D. Mech and L. Boitani, editors. *Wolves: behavior, ecology, and conservation*. The University of Chicago Press, Chicago, IL.
- U.S. Fish and Wildlife Service. 2012. Removal of the Gray Wolf in Wyoming from the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population. *Federal Register* vol. 77, no. 175:55530-55604.
- Wyoming Game and Fish Commission. 2011. Wyoming Gray Wolf Management Plan. Wyoming Game and Fish Department, 5400 Bishop Blvd., Cheyenne, WY, 82006.