Wyoming Gray Wolf Monitoring and Management: 2022 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, 2022 through December 31, 2022.

EXECUTIVE SUMMARY

At the end of 2022, the gray wolf (wolf) population in Wyoming remained above minimum recovery criteria, making 2022 the 21st consecutive year Wyoming has exceeded the numerical, distributional, and temporal recovery criteria established for wolves by the U.S. Fish and Wildlife Service. At least 338 wolves in ≥41 packs (including ≥23 breeding pairs) inhabited Wyoming statewide on December 31, 2022. Of the total, there were ≥163 wolves and ≥23 packs (including ≥12 breeding pairs) in the Wolf Trophy Game Management Area (WTGMA), ≥108 wolves and ≥10 packs (including ≥7 breeding pairs) in Yellowstone National Park, ≥18 wolves and ≥3 packs (including ≥2 breeding pairs) in the Wind River Reservation, and ≥49 wolves and ≥5 packs (including ≥2 breeding pairs) resided in areas where wolves are designated primarily as predatory animals in Wyoming. A total of 95 wolf mortalities were documented statewide in Wyoming in 2022: 53 in the WTGMA, 33 in areas where wolves are primarily designated as predatory animals, 7 in Yellowstone National Park, and 2 in the Wind River Reservation. Mortality was from both human causes = 85 (89% of mortalities) and natural causes = 10 (11%). Fifty wolves were captured and radio-collared for monitoring and research in 2022.

In 2022, 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 47 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 to December 31, 2022 with the exception of hunt area 12 (opened on October 15, 2022) and hunt area 13 (closed March 31, 2023). 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 2022 wolf hunting season. In addition, the 2021 wolf hunting season extended from January 1 to March 31, 2022 in hunt area 13, during which 2 wolves were taken.

Wolves were confirmed to have killed or injured 97 head of livestock (46 cattle, 46 sheep, and 5 horses) statewide in Wyoming in 2022. Wolf-livestock conflicts in the WTGMA remained similar from 2021-2022. Twenty-one wolves were lethally and legally removed by agencies or the public in an effort to reduce livestock losses to wolves (15 in the WTGMA, 6 in predatory animal areas in WYO).

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Available for download at:
https://wgfd.wyo.gov/WGFD/media/content/PDF/Wildlife/Large%20Carnivore/WYWOLF_ANNUALREPORT_2022.pdf

COVER PHOTO: 1259M, breeding male of the Togwotee pack, observed during a big game survey flight on February 9, 2023. Credit: Mark Gocke.

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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 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/species/gray-wolf-canis-lupus
https://wgfd.wyo.gov/Wildlife-in-Wyoming/Large-Carnivore/Wolves-in-Wyoming

Endangered Species Act protections were removed for wolves (i.e., "delisting") 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 boundary 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://fws.gov/media/wind-river-wolf-plan

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 into the foreseeable future 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 additional recovery 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 qualify for delisting and 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 was 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. The 5-year post-delisting monitoring period concluded at the publication of the 2021 annual report in April 2022. However, the agencies in Wyoming charged with wolf monitoring and management responsibility have continued to work cooperatively and have generated this report to provide a consistent and transparent annual presentation of statewide wolf population data.

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 them 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: 2022 ANNUAL REPORT

WOLF POPULATION MONITORING

SUMMARY OF WOLF POPULATION MONITORING STATEWIDE

At the end of 2022, the wolf population in Wyoming remained above minimum recovery criteria, making 2022 the 21st consecutive year Wyoming has exceeded the numerical, distributional, and temporal recovery criteria established for wolves by the U.S. Fish and Wildlife Service. At least 338 wolves in ≥41 packs (including ≥23 breeding pairs) inhabited Wyoming statewide on December 31, 2022. Of the total, there were ≥163 wolves and ≥23 packs (including ≥12 breeding pairs) in the Wolf Trophy Game Management Area (WTGMA), ≥108 wolves and ≥10 packs (including ≥7 breeding pairs) in Yellowstone National Park, ≥18 wolves and ≥3 packs (including ≥2 breeding pairs) in the Wind River Reservation, and ≥49 wolves and ≥5 packs (including ≥2 breeding pairs) resided in areas where wolves are designated primarily as predatory animals in Wyoming. A total of 95 wolf mortalities were documented statewide in Wyoming in 2022: 53 in the WTGMA, 33 in areas where wolves are primarily designated as predatory animals, 7 in Yellowstone National Park, and 2 in the Wind River Reservation. Mortality was from both human causes = 85 (89% of mortalities) and natural causes = 10 (11%). Fifty wolves were captured and radio-collared for monitoring and research in 2022.

Wolf Population Monitoring in the WTGMA

Population and Breeding Pair Status

The minimum number of wolves in the Wolf Trophy Game Management Area (WTGMA; see map in Figure 1) on December 31, 2022 was determined using standard wolf monitoring methods. The number of wolves in individual packs and the number of lone, dispersing wolves 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 observations obtained by agency personnel from December 2022 through March 2023 were included to ensure they were reflective of the minimum number of wolves present on December 31, 2022. Miscellaneous, mostly solitary, wolves were included in the estimate only if the animal was documented as described above and was not a known member of an identified wolf pack. Packs that formed in late 2022 and early 2023 are included in the "miscellaneous" wolf category 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 2022. The final minimum population census was the sum of all pack counts and miscellaneous wolves known to be present on December 31, 2022 (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.

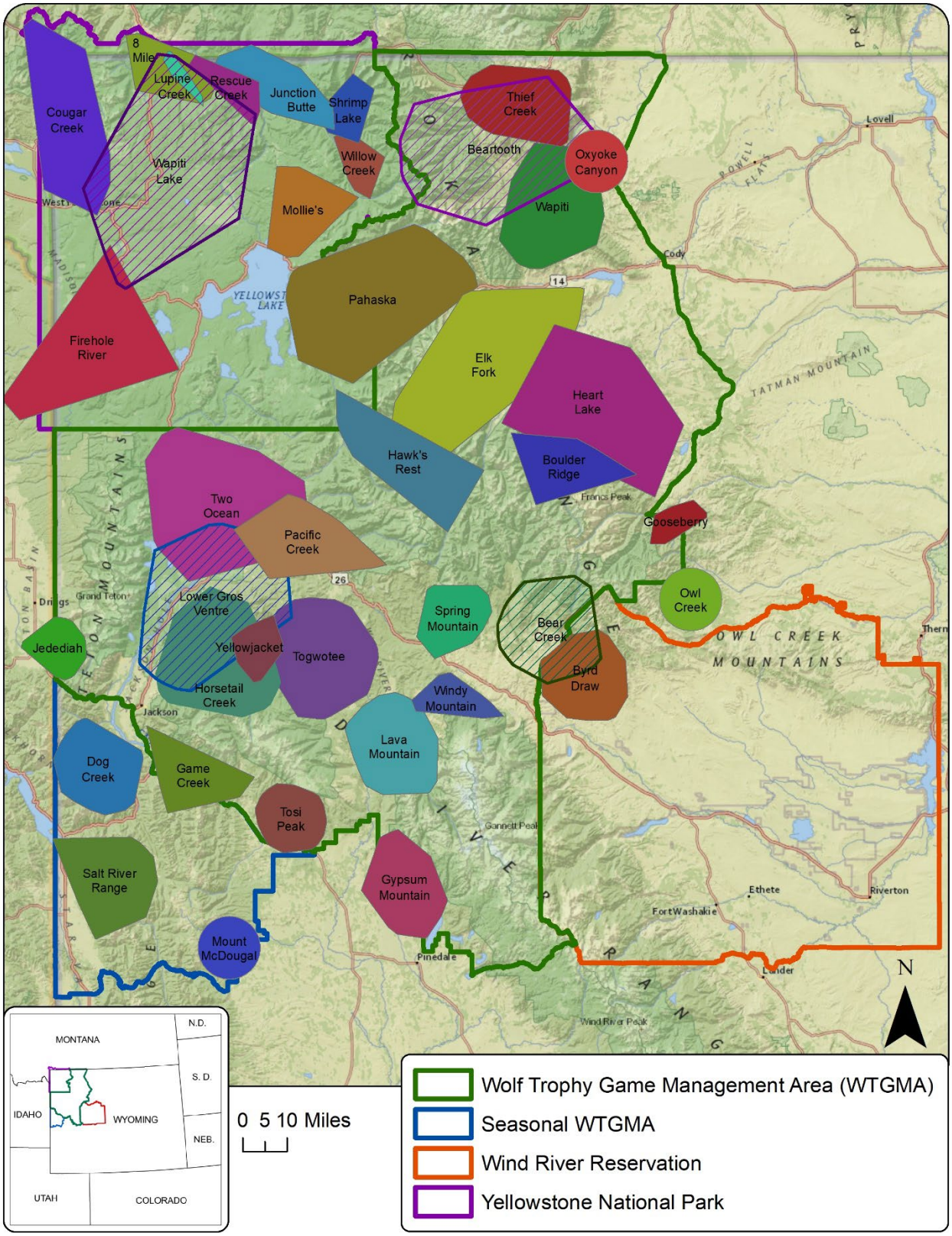

Figure 1. Wolf management areas and home ranges of wolf packs in Wyoming in 2022.

Table 1. Wolf packs, minimum pack size at the end of the calendar year, wolf mortality, and wolf-livestock conflicts in Wyoming in 2022.

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^	10				2	1		2					
Beartooth	5		1		3			1		3			
Boulder Ridge	4				1			1					
Elk Fork Creek	6	1			1					1			
Game Creek	3					1							
Gypsum Mountain*	10									1			
Hawk's Rest^	14				1								
Heart Lake	5		1		3		5	3		3			
~~Hoodoo~~													
Horsetail Creek	9				2		4			2			5
Jedediah	2												
Lava Mountain	2						3			9			
~~Long Hollow~~		1						1					
Lower Gros Ventre	11	1						1	1				
Oxyoke Canyon	5				1					3			
Pacific Creek	12				1			8					
Pahaska^	5							1					
Spring Mountain	3				1			2		6			
Thief Creek	6				1								
Togwotee	10				1					1			
Tosi Peak	3									1			
Two Ocean	8				2			1					
Wapiti	6				3								
~~Wildcat Ridge~~		1					2	3					
Windy Mountain	7				4					1			
Yellowjacket	11				1								
Misc. wolves	10		1		3		1			8			
WTGMA TOTAL	**163**	4	3	0	31	-	15	24	1	39	0	0	5
PREDATORY ANIMAL AREAS													
Seasonal Wolf Trophy Game Management Area													
Dog Creek^	14						1				35		
Mount McDougal	4					2							
Salt River Range	3		2										
Misc. wolves	2						1				7		
Year-round Predatory Animal Area													
Gooseberry	8					5							
~~Prospect~~							4			3			
Owl Creek^	7					1							
~~Willow Creek~~						1							
Misc. wolves	7		1			13				4	4		
PRED. AREAS TOTAL	**49**	0	3	0	0	24	6	0	0	7	46	0	0
WYO Total	**212**	**4**	**6**	**0**	**31**	**24**	**21**	**24**	**1**	**46**	**46**	**0**	**5**
YNP Total	108	6	1	0	0	0	0	13	3	0	0	0	0
WRR Total	18	0	1	0	1	0	0	1	1	0	0	0	0
WYOMING TOTAL	**338**	**10**	**8**	**0**	**32**	**24**	**21**	**38**	**5**	**46**	**46**	**0**	**5**

1 Underlined packs are counted as breeding pairs on December 31, 2022.
2 Strikethough packs were not documented during 2022 and/or did not exist on Dec. 31, 2022 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. Excludes wolves taken illegally that applied to the mortality limit.
6 Number of wolves taken by the public as predatory animals. Wolves killed from packs assigned to the WTGMA are counted in the Predatory animal area total.
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 2 killed/3 injured colts by the Horsetail Creek pack.
^ Border pack shared with Idaho, Yellowstone National Park or the Wind River Reservation; assigned to WYO.
* Border pack with the year-round predatory animal area; 6 wolves assigned to the WTGMA, 4 wolves assigned to the predatory animal area

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 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, 2022, ≥163 wolves in ≥23 packs, including ≥12 breeding pairs, were documented in the WTGMA (Figures 1, 2, and 3; Table 1). Pack size ranged from 2 to 14 and averaged 6.8 wolves per pack (Figure 4; Table 1). Wolf packs were distributed in largely exclusive territories across suitable habitat in the WTGMA similar to previous years (Figure 1).

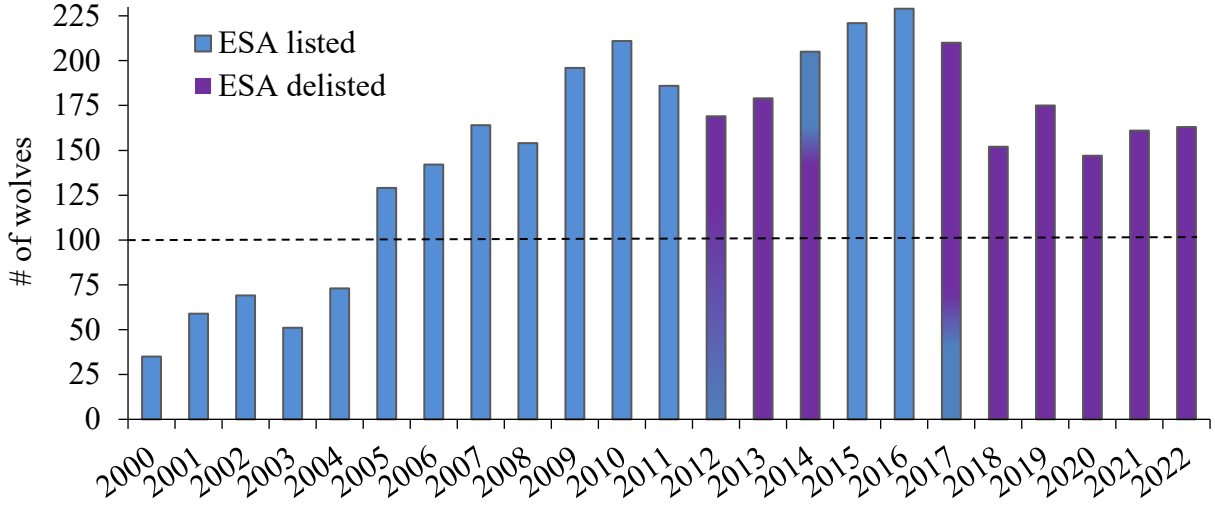

Figure 2. Minimum number of wolves in the WTGMA at the end of the calendar year. (The dashed line indicates the ≥100 wolf minimum recovery criterion)

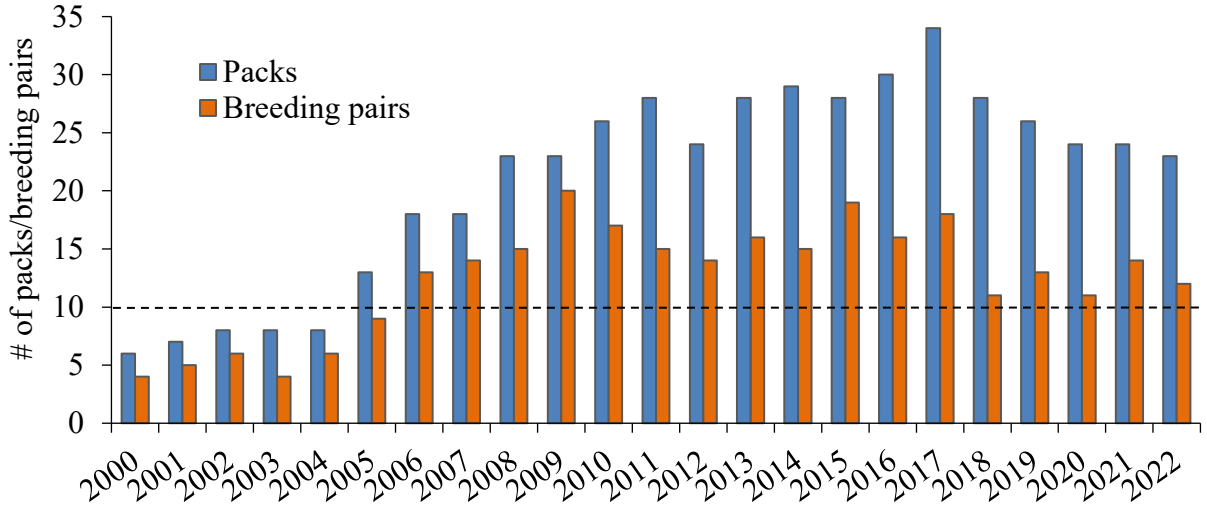

Figure 3. Minimum number of wolf packs and breeding pairs in the WTGMA at the end of the calendar year. (The dashed line indicates the ≥10 breeding pair minimum recovery criterion)

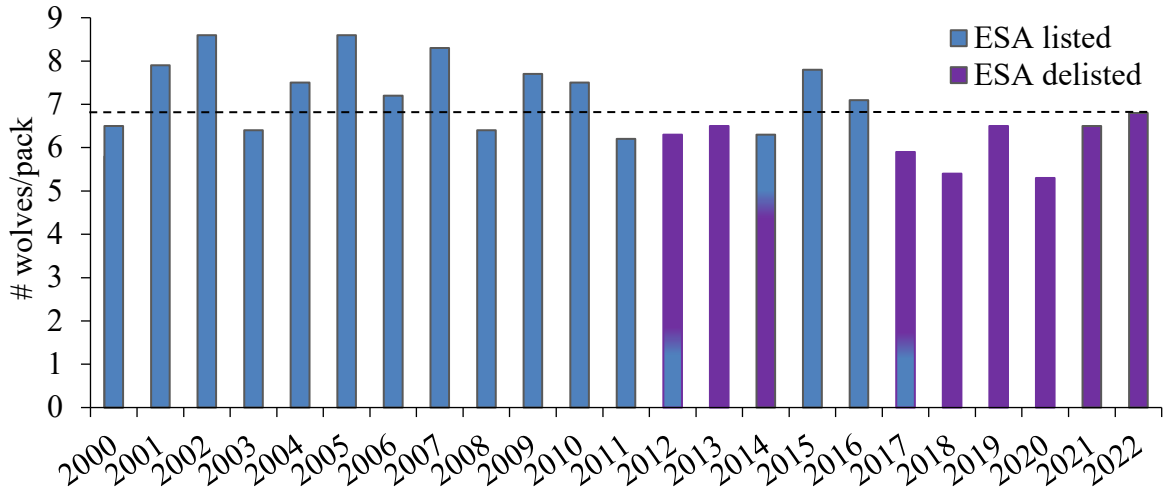

Figure 4. Average pack size for wolf packs in the WTGMA at the end of the calendar year. (The dashed line indicates the average pack size [6.9 wolves per pack] from 2000-2022)

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 WTMGA was monitored via mandatory reporting and registration by successful hunters as required in the 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 wolves taken during the hunt, 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 2022, 53 wolves were known to have died in the WTGMA (Figure 5; Tables 1 and 2). Causes of mortality included: hunting = 31; conflict control = 15; other human causes = 3; and natural causes = 4 (Figure 5; Tables 1 and 2). Of the 31 wolves taken during hunting seasons, 2 were taken during the extended 2021 wolf hunting season in March 2022 in hunt area 13 and 29 were legally taken during the normal wolf hunting season in autumn 2022. Conflict control mortalities included 10 wolves from agency-directed lethal control actions and 5 wolves taken under the authority of a lethal take permit as authorized by the Wyoming Game and Fish Commission Chapter 21 regulation. The 3 wolf deaths from other human causes included 1 illegal kill (1 case of mistaken identity which counted toward the wolf hunt mortality limit), 1 capture related mortality (the wolf was killed by a mountain lion within a few days after capture), and 1 wounding loss during the hunting season. Natural mortalities included 2 wolves killed by other wolves, 1 wolf that died in an avalanche, and 1 that died of other natural, but not specifically identified, causes. The number of wolves that died in the WTGMA in 2022 (53 wolves; Figure 5)

was less than the average number of mortalities from 2012-2022 (average = 71 wolves). Human-caused mortality accounted for 92.5% of all wolf mortalities in 2022 (Table 2). The overall mortality rate was 24.5% of all wolves known to be alive in the WTGMA in 2022 and was slightly below the overall mortality rate for 2021 (27.8%; Table 2).

Table 2. Summary of wolf mortality by cause of death in the WTGMA in 2022.

Cause of death	Total	% of mortality	% of wolves
Hunting	31	58.5	14.4
Conflict control	15	28.3	6.9
Other human causes	3	5.7	1.4
All Human Causes	49	92.5	22.7
Natural	4	7.5	1.9
Unknown	0	0.0	0.0
Total Mortality	53	100.0	24.5

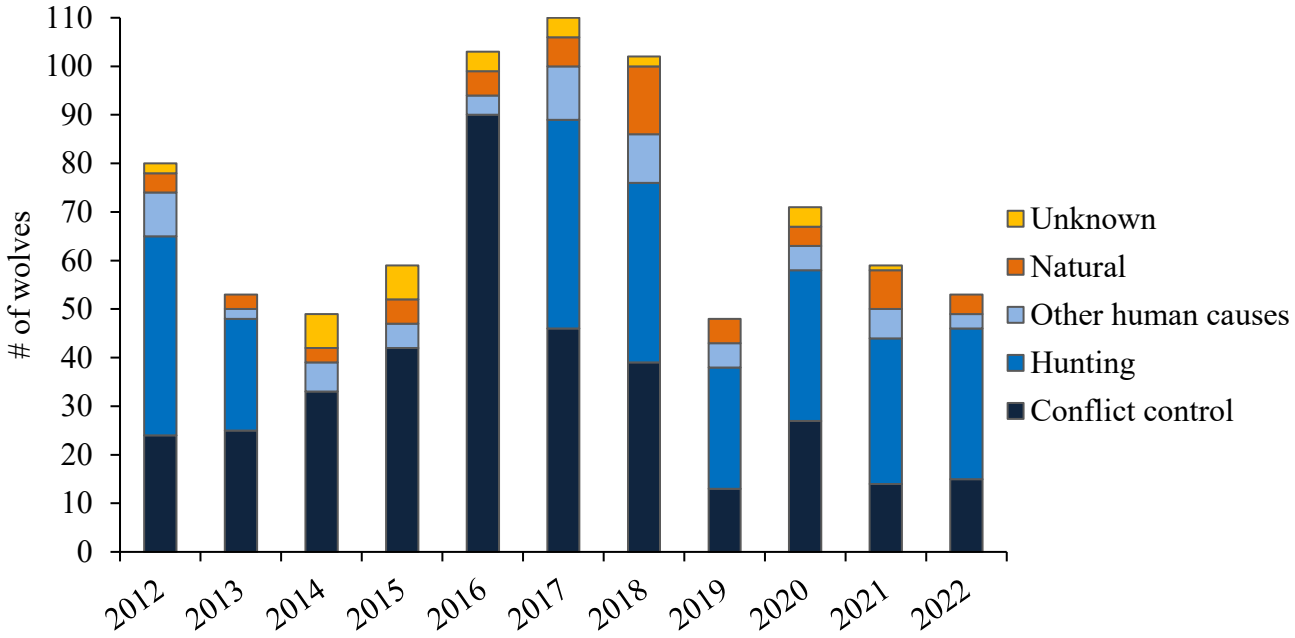

Figure 5. Number of wolf mortalities by cause of death in the WTGMA during the calendar year. (Wolves were listed under the Endangered Species Act in portions of 2014-2017)

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 sarcoptic mange (*Sarcoptes scabiei*: mange) and canine distemper virus (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 in most years 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 wolf population below the threshold where disease outbreaks are more probable, 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 distemper (Figure 6) and mange in the wolf population through 2018. Documentation of disease in the WTGMA wolf population declined and has remained low since 2018 when wolf density in the WTGMA was reduced following Endangered Species Act delisting and return to state management in 2017 (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.

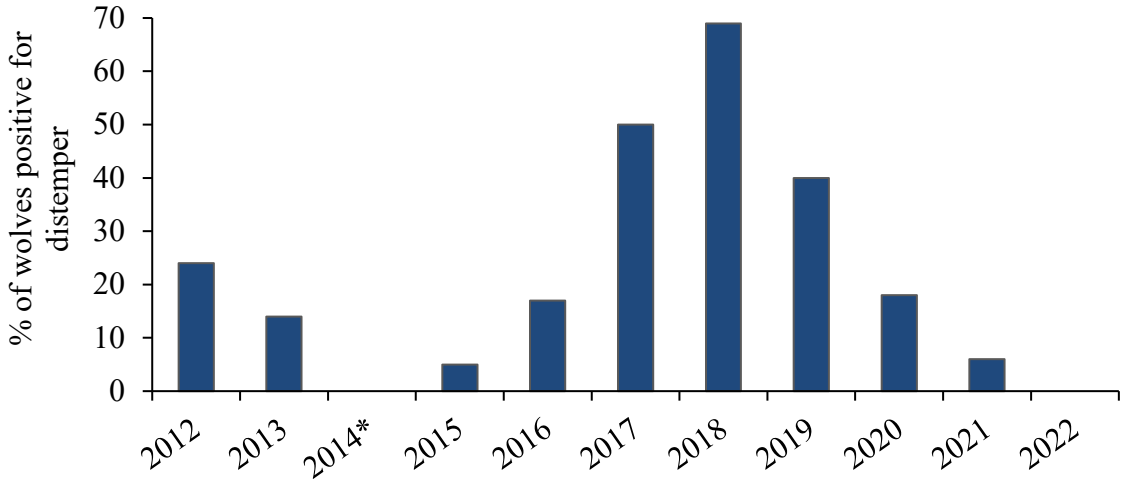

Figure 6. Proportion (%) of wolves captured in winter (November through March) that tested positive for canine distemper virus in the WTGMA. (*Too few wolves were captured following Endangered Species Act relisting of the wolf population in 2014 to allow for an adequate sample)

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 2022. During winter capture efforts, individuals from two packs showed evidence of mange infection (Game Creek and Beartooth), but no mortality due to mange was documented in 2022. Mange was not a factor affecting broader wolf survival or population dynamics in the WTGMA in 2022.

Distemper: Distemper is a highly contagious viral 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 juveniles. 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 and wolf pack density in the WTGMA (Figures 2 and 3). Decreasing prevalence of distemper has been correlated with a reduction in wolf population and wolf pack density in the WTGMA and subsequent stability around the population objective from 2018-2022 (Figures 2, 3 and 6). The trend continued during winter 2022, when none of the 21 wolves (0%) captured tested positive for distemper exposure (Figure 6). (It should be noted that additional samples from wolves captured in March 2023 are yet to be tested, therefore subsequent analyses will be updated if necessary once these results are available.)

Canine Parvovirus: Canine parvovirus is a highly contagious disease that has 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 determined to have the suitable habitat required for long-term viability of a wolf population in Wyoming outside Yellowstone National Park 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 2011). Wolf population dynamics were similar to long-term trends in the WTGMA in 2022 (Figures 7 and 8; see also Figures 14 and 15). The WTGMA end of year wolf population remained stable above the management objective of 160 wolves in 2021 (≥161 wolves) and 2022 (≥163 wolves) and above the minimum population commitment of ≥100 wolves (Figure 2; Table 1). Wyoming Game and Fish Department management has yielded a wolf population within 10% of the 160 wolf population objective for 5 consecutive years (Figure 2), which has stabilized the wolf population, reduced the likelihood of significant disease outbreak (Figure 6), and reduced wolf-livestock conflict (see the "*Wolf-Livestock conflict*" section below).

Breeding pairs decreased from ≥14 in 2021 to ≥12 in 2022 (14%) and remained above the minimum breeding pair commitment of ≥10 breeding pairs (Figure 3; Table 1). Recruitment, as measured by the proportion of packs that qualified as a breeding pair, was slightly below the long-term average (Figure 7), and was similar to lower recruitment levels in 4 of the last 5 years (Figure 8). Litter sizes (4.5 pups per pack in 2022) were lower than the previous 3 years (5.4 pups per pack from 2019-2021) and were closer to the long term average (4.6 pups per pack from 2012-2021). Disease outbreaks primarily affect juvenile survival and recruitment in wolf populations as described above. However, evidence of disease has declined in the WTGMA as wolf population density declined and stabilized around the population objective and is not likely to affect the wolf population dynamics in the foreseeable future (Figure 6).

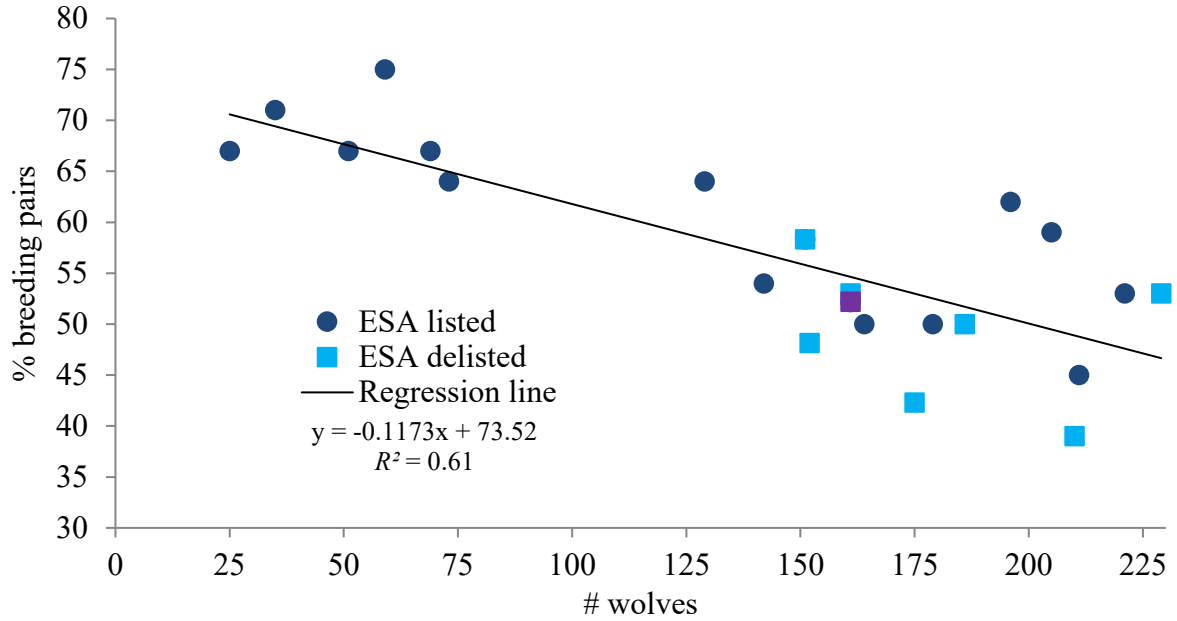

Figure 7. Minimum number of wolves present in the WTGMA at the beginning of the calendar year compared to the proportion (%) of packs that qualified as a breeding pair in the WTGMA at the end of the calendar year from 2000-2022. ("■" indicates the 2022 data point)

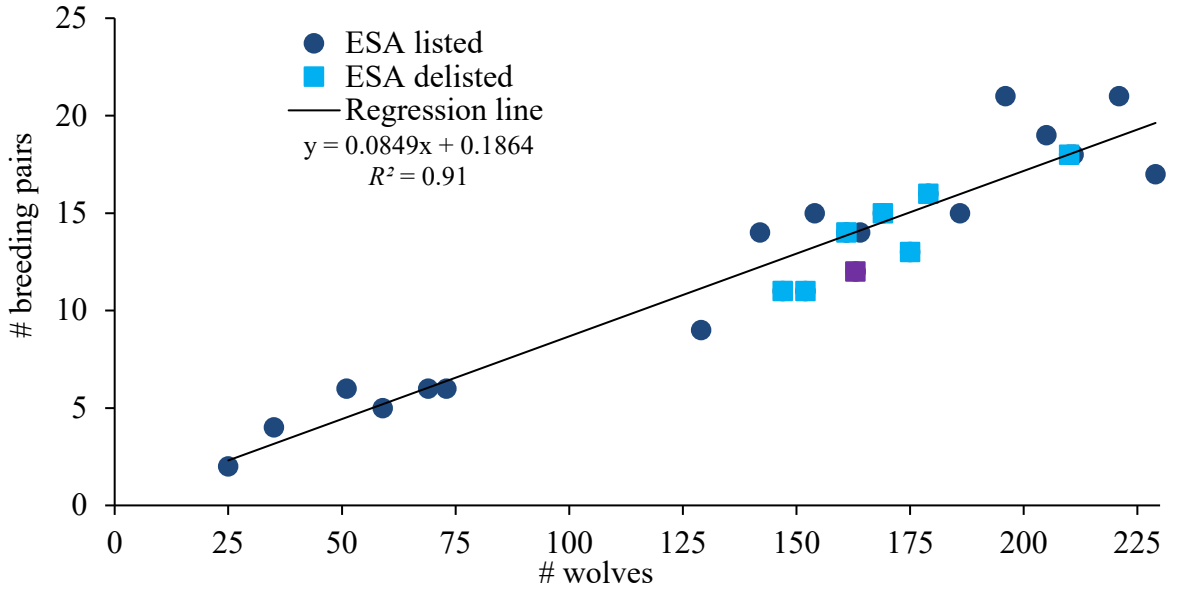

Figure 8. Minimum number of wolves and breeding pairs in the WTGMA at the end of the calendar year from 1999-2022. ("■" indicates the 2022 data point)

As highly social carnivores, wolf packs constitute the primary functioning unit of any given wolf population. Thus, it is necessary to also monitor and evaluate elements of wolf pack demography in the WTGMA in addition to the population objectives outlined above to ensure the wolf population is robust to management actions and meets objectives in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011). The number of wolf packs in the WTGMA decreased from ≥24 packs in 2021 to ≥23 packs at the end of 2022 (Figure 3).

There was no evidence suggesting the presence of wolf packs in the WTGMA that were not documented. Average pack size at the end of 2022 (6.8 wolves per pack) was slightly higher than 2021 (6.5 wolves per pack), and was reflective of the slightly increased population present in fewer packs in the WTGMA (Figures 2, 3, and 4). Two packs established in 2022, including the Oxyoke Canyon pack that formed in the former Rattlesnake pack territory and the Two Ocean pack who split from the Pacific Creek pack and killed and/or displaced the members of the Wildcat Ridge pack (Figure 1; Table 1). Three packs documented at the end of 2021 did not exist on December 31, 2022 (Hoodoo, Long Hollow and Wildcat Ridge: Table 1). As mentioned above, maintaining stable wolf packs in the WTGMA is important to ensure a robust wolf population that meets management objectives. Therefore, to further evaluate pack dynamics, we reconstructed pack tenures (i.e., the duration an individual pack persisted on the landscape) for 98 packs documented in the WTGMA from 1997-2022 using published annual wolf reports (Appendix A). Pack formation and dissolution in the WTGMA in 2022 were both below the 10-year average (average 4.4 packs formed and 4.6 packs dissolved per year; Appendix A). Average tenure of wolf packs established in the WTGMA has increased through time, and has remained high after the implementation of wolf hunting seasons in 2017 (Figure 9, Appendix A). The relatively long tenures documented for wolf packs from 2017-2022 while wolves in Wyoming have been delisted demonstrate Wyoming Game and Fish Department management is resulting in a wolf population around the desired objective while allowing packs to maintain stable social structure that enables long-term persistence of packs on the landscape in the WTGMA (Figure 9, Appendix A).

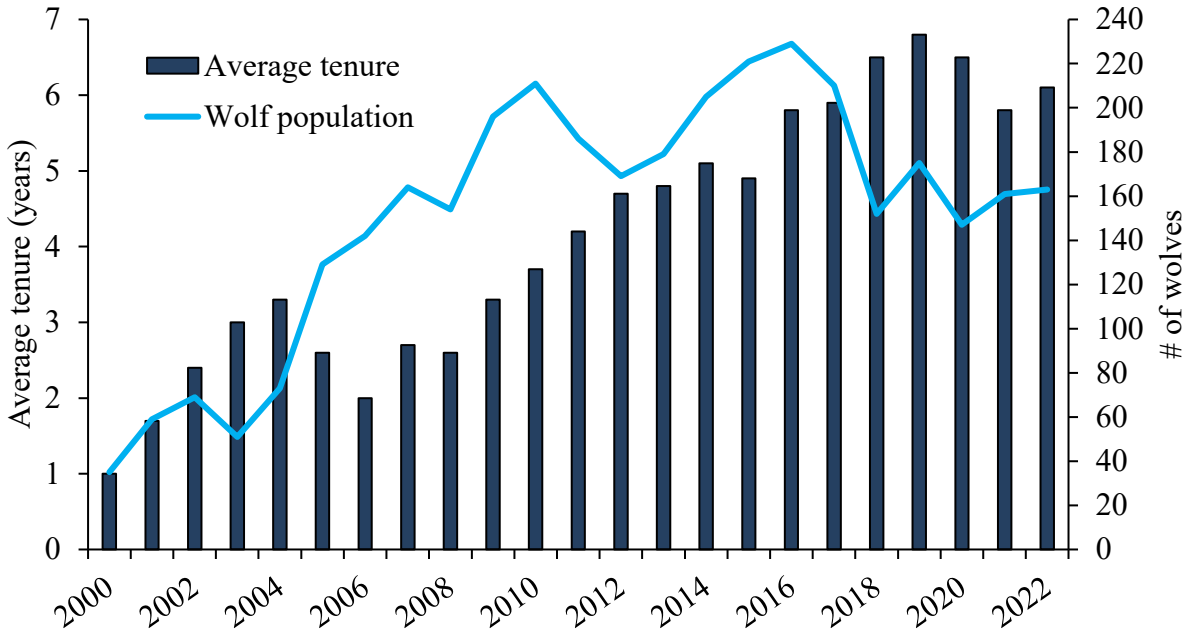

Figure 9. Wolf population trend and average tenure in years for wolf packs in the Wolf Trophy Game Management Area WTGMA from 2000-2022.

Overall, the wolf population in the WTGMA has largely followed the basic precepts of population theory over the course of recolonization and transfer to state management (e.g., density-dependence as seen in Figure 7 and Figure 14 in the *"Development of 2023 Wolf Hunting Seasons"* below). Predictable population responses to natural and human-caused

perturbations allow for more precise estimation of the impact of management decisions, allowing for responsive adaptive management as population conditions shift through time. 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 seasons, may impact both population and breeding pair numbers (Figure 8). The Wyoming Game and Fish Department continues rigorous monitoring and data analysis to aid in making robust management decisions for the wolf population in the WTGMA.

Genetic Monitoring

Genetic monitoring is an essential component of wolf management in the northern Rocky Mountain wolf metapopulation. The U.S. Fish and Wildlife Service determined that, in addition to minimum population criteria, genetic interchange must also occur between the three 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 2022, genetic samples were collected from 75 wolves in the WTGMA that will be used in analysis of genetic interchange. Genetic samples were collected from 43 wolves that died and 32 wolves captured for monitoring purposes. As required by Chapter 47, 30 samples were acquired from wolves taken during authorized wolf hunting seasons in the WTGMA in 2022.

The biological samples obtained will be retained for future analyses regarding genetic interchange between wolf subpopulations in the northern Rocky Mountains as outlined in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011). Such an analysis was conducted in 2021 using samples from 2010-2018 (Wildlife Genetics International, in preparation); this analysis concluded a high level of genetic diversity continues to within each wolf recovery area in the northern Rocky Mountains. In addition, individuals with ancestry representing each recovery area were present in each wolf recovery area in the northern Rocky Mountains, indicating sufficient genetic interchange to maintain genetic diversity into the foreseeable future.

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 and collars were affixed to captured wolves. During capture processes 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.

Thirty-two wolves from 17 packs in the WTGMA were collared through aerial capture techniques in 2022, including 5 recaptures. At the end of 2022, there were 45 wolves in 21 packs, 3 wolves in newly formed pairs or trios, and 2 single wolves being monitored with telemetry collars in the WTGMA (50 wolves total; 31% of the year-end population). Winter wolf capture efforts continued through March 2023 in conjunction with the year-end population census, at which point a total of 78 wolves in 24 packs were being monitored via telemetry collars in the WTGMA (approximately 48% of the WTGMA population in March 2023). 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, 2022, there were ≥49 wolves in ≥5 packs, including ≥2 breeding pairs, in the predatory animal areas (including the Seasonal WTGMA) in Wyoming (Figure 1; Table 1). Thirty-three wolf mortalities were documented in predatory animal areas in 2022, including: 24 taken by the public as predatory animals, 6 taken by USDA Wildlife Services, and 3 taken illegally (one failure-to-report as required by state statute, 1 trap-check violation, and 1 claimed self-defense during the open wolf hunting season in the Seasonal WTGMA: Table 1). Wolf captures included 1 wolf from 1 pack in the Seasonal WTGMA and 2 wolves from 2 packs in the predatory animal area. At the end of 2022, 5 wolves from 2 packs and 3 single wolves were marked via telemetry collars in predatory animal areas in Wyoming. Twenty genetic samples were collected from wolves that died in predatory animal areas 2022.

Wolf Population Monitoring in the Wind River Reservation

Population and Breeding Pair Status

The Wind River Reservation minimum wolf population and breeding pair estimates were determined 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 10). 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, 2022, ≥18 wolves in ≥3 packs, including ≥2 breeding pairs, were documented on the Wind River Reservation (Figures 1 and 10; Table 3). Historically, most confirmed packs existed along the eastern front of the Wind River Range (Figure 1). However, a new pack formed north of the Wind River in 2022 and successfully reproduced (Byrd Draw; Figure 1). The telemetry collars present on wolves in the Sage Creek pack either failed or released as scheduled, leaving no collared individuals in the pack, which made documentation difficult at the end of 2022. In 2022, 2 wolves were observed in the old St. Lawrence Pack

territory near Blue Trail. Three wolves were observed again in the area in January 2023 and were named the Blue Trail pack (Table 3). The 3 wolves reported in the miscellaneous wolf category were observed in February 2023 along the northwest boundary of the Wind River Reservation.

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 2022.

WOLF PACK[1,2]	MINIMUM PACK SIZE	DOCUMENTED MORTALITY[3] NATURAL	HUMAN[4]	UNKN	HUNTING	CONTROL	KNOWN DISPERSED	MISSING[5]	CONFIRMED CONFLICTS[6] CATTLE	SHEEP	DOGS	OTHER
Yellowstone National Park northern range												
8 Mile^	11						2	1				
Junction Butte	25						2					
Lupine Creek	8											
~~Phantom Lake^~~												
Rescue Creek	12	1					1	1				
Shrimp Lake	4											
Misc. wolves							1					
Yellowstone National Park non-northern range												
~~Bechler~~ %		1										
Cougar Creek^	15	1										
Firehole River	5											
Mollie's	9						2	1				
Wapiti Lake	10	3	1				5					
Willow Creek	8											
Misc. wolves	1											
YELLOWSTONE NATIONAL PARK TOTAL[7]	**108**	**6**	**1**	**0**	**0**	**0**	**13**	**3**	**0**	**0**	**0**	**0**
Wind River Reservation												
Arrow Mountain*	7						1					
Blue Trail*	3				1							
Byrd Draw *	5											
~~Sage Creek~~								1				
~~St. Lawrence~~												
Misc. wolves	3		1									
WIND RIVER RESERVATION TOTAL[8]	**18**	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**0**
TOTAL in YNP and WRR	**126**	**6**	**2**	**0**	**1**	**0**	**14**	**4**	**0**	**0**	**0**	**0**

1 Underlined packs qualified as breeding pairs on December 31, 2022.
2 Strikethough packs were not documented during 2022 and/or did not exist on Dec. 31, 2022 and are not displayed in Figure 1.
3 Includes hunting and trapping mortality. 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 2022.
6 Includeslivestock and domestic animals confirmed killed or injured by wolves.
7 Mortality and confirmed livestock conflicts by wolf packs assigned to Yellowstone National Park that occured in WYO are reported in Table 1.
8 Mortality and conflicts with livestock by wolf packs assigned to the Wind River Reservation that occured 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

Two wolves from the Byrd Draw pack were captured and telemetry-collared in the Wind River Reservation in 2022.

Mortality

One dispersing wolf was electrocuted by a downed electric line and 1 wolf was trapped during the regulated wolf hunting season in the Wind River Reservation in 2022 (Table 3).

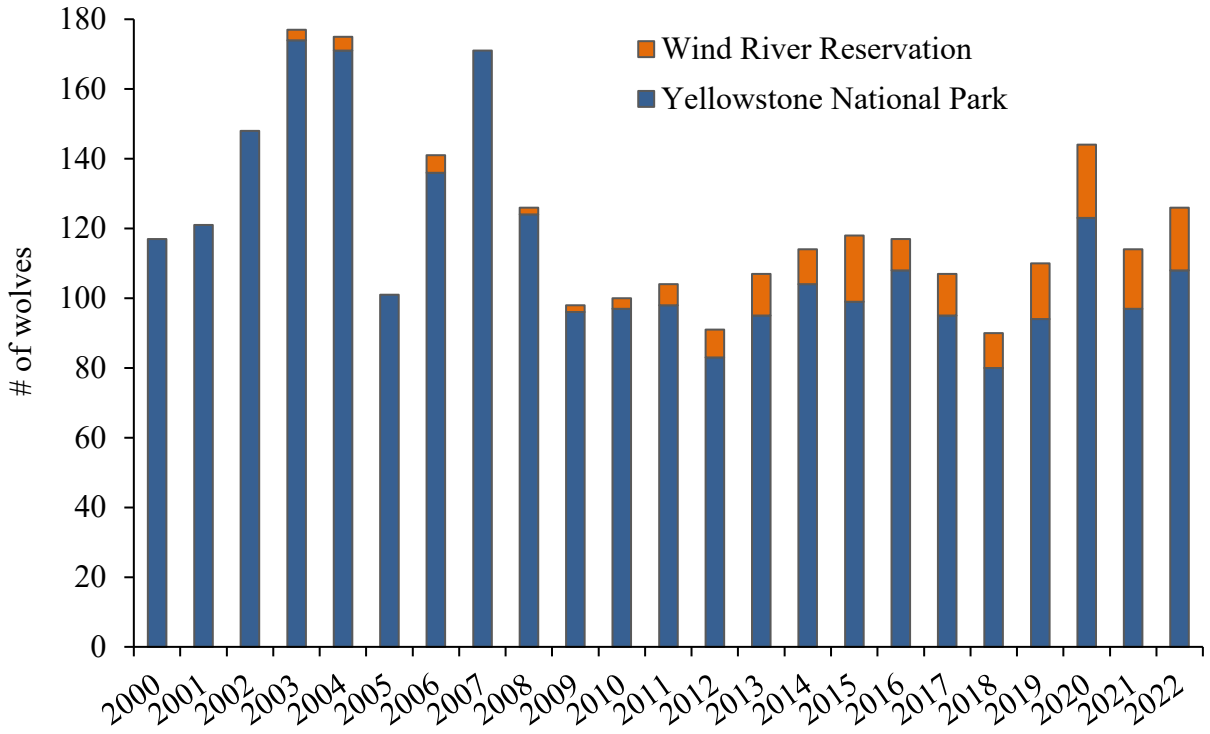

Figure 10. Minimum number of wolves in Yellowstone National Park and the Wind River Reservation at the end of the calendar year.

Wolf Population Monitoring in Yellowstone National Park

Population and Breeding Pair Status

At the end of December 2022 there were ≥108 wolves in ≥10 packs, including ≥7 breeding pairs, living primarily in Yellowstone National Park (Figures 1 and 10; Table 3). Pack size ranged from 4 to 25, averaging 10.7 members (Table 3). Throughout Yellowstone, at least 58 pups were produced, with an additional 3 or more litters that were born but died before they could be counted. Forty pups survived (69%) to the end of the year with 28 in the 5 northern Yellowstone packs and 12 in the 5 interior packs. At the end of 2022, pups comprised 37% of the wolves living in Yellowstone.

Two packs dissolved (Phantom Lake and Bechler) and 4 new packs formed this year (Shrimp Lake, Firehole River, Willow Creek, and Lupine Creek; Table 3). On average, about 1 pack dissolves and 1 new pack forms in Yellowstone each year. The explanation for this year's shift in population and pack dynamics may be related to multiple factors: several years of successful pup production; the large 2019 and 2020 cohorts reaching dispersal age; shifting prey dynamics with elk and bison; and other factors.

Prior to the 2022 pups being born, there were approximately 80 adult wolves alive in April in Yellowstone. At least 58 pups were born to 9 packs. Three packs produced multiple litters this year: Rescue Creek (6 pups in 1 litter and an unknown number in another); Firehole River (an

unknown number of pups from 2 litters all died by late May); and the Junction Butte pack (21 pups from 4 litters). The 8 Mile, Lupine Creek, Shrimp Lake, Willow Creek, Mollie's, and Cougar Creek packs had 1 litter each. The Wapiti Lake pack had at least 1 litter but may have had another that died early. Of the minimum 58 pups produced in all packs, 40 (69%) survived to the end of the year.

Capture and Telemetry collaring

Fourteen wolves from 4 packs were captured and collared in 2022. New collars were deployed on 2 pups, 6 yearlings, and 1 older adult. Older collars were replaced on 5 adult or elderly wolves. In addition to fitting the radio collar, staff took blood samples for disease screening, a whisker for isotopic diet analysis, body and tooth measurements, and weights. A uniquely-identifying pit-tag was inserted under the skin near the shoulder in case a collar is dropped or chewed off and the wolf is recaptured in the future. Seven of the collars were GPS (Global Positioning System) which send data and can be programmed remotely, and are used to evaluate habitat selection, movement patterns, prey selection, biomass consumption, and multi-species interactions during specific seasons. These collars typically last for 2 years and are programmed to record locations every 30 minutes or up to 6 hours, depending on the time of year and study objectives. The other 7 collars were VHF which only emit a tracking radio beacon but are less expensive than GPS collars and have a battery life lasting over 5 years in some cases. At the end of 2022, there were 25 collars on 108 wolves (23%).

Mortality

Seven wolves died in Yellowstone in 2022, including 2 telemetry collared wolves and 5 uncollared wolves (Table 3). Causes of mortality included 4 wolves killed by other wolves, 1 wolf killed by a bear, 1 habituated wolf killed by a vehicle and 1 wolf that died of unknown, natural causes (Table 3). An additional 9 wolves assigned to the Yellowstone subpopulation were killed by hunters outside the Park in 2022, including 7 in Montana, 1 in Idaho, and 1 in Wyoming.

Disease Monitoring

There was no indication of widespread disease outbreak in Yellowstone in 2022. Both litters of pups produced by the Firehole Lake pack died prior to den emergence and it was unknown if the mortalities were related to disease or some other cause. The pups may have been killed by a predator or died while being moved to a different den by the adults. Most of the other packs had typical pup production and survival rates.

Several members of the Junction Butte, Rescue Creek, and 8 Mile packs have been recorded for the last year or more with slightly discolored, thinning fur in the belly and groin area. After examining a few of these wolves during capture, it seems likely that the wolves had very mild cases of mange infection. After widespread, sometimes severe, infection in most packs from 2009 to about 2013, mange seems to be rare and only causing minor infection in the wolves currently living in Yellowstone.

WOLF MANAGEMENT

SUMMARY OF WOLF MANAGEMENT STATEWIDE

In 2022, 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 47 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 to December 31, 2022 with the exception of hunt area 12 (opened on October 15, 2022) and hunt area 13 (closed March 31, 2023). 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 2022 wolf hunting season. In addition, the 2021 wolf hunting season extended from January 1 to March 31, 2022 in hunt area 13, during which 2 wolves were taken.

Wolves were confirmed to have killed or injured 97 head of livestock (46 cattle, 46 sheep, and 5 horses) statewide in Wyoming in 2022. Wolf-livestock conflicts in the WTGMA were relatively low from 2021-2022. Twenty-one wolves were lethally and legally removed by agencies or the public in an effort to reduce livestock losses to wolves (15 in the WTGMA, 6 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 2021 and 2022 were authorized 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. As reported in the 2021 annual wolf report, the 2021 wolf hunting season included season dates for hunt area 13 that extended from January 1 to March 31, 2022. Take occurring during this extended season is included in this report. For the 2022 wolf hunting season, the Wyoming Game and Fish Department delineated 14 wolf hunt areas in the WTGMA and Seasonal WTGMA (Figure 11). 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; Wyoming Game and Fish Commission 2011). The wolf hunting season opening date was shifted from September 1st in 2018-2019 to September 15th in 2020-2022 to reduce the proportion of juveniles taken in the hunt. 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 11; 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, 2022 (Figure 11; Table 4). December 31 was chosen as the closure date

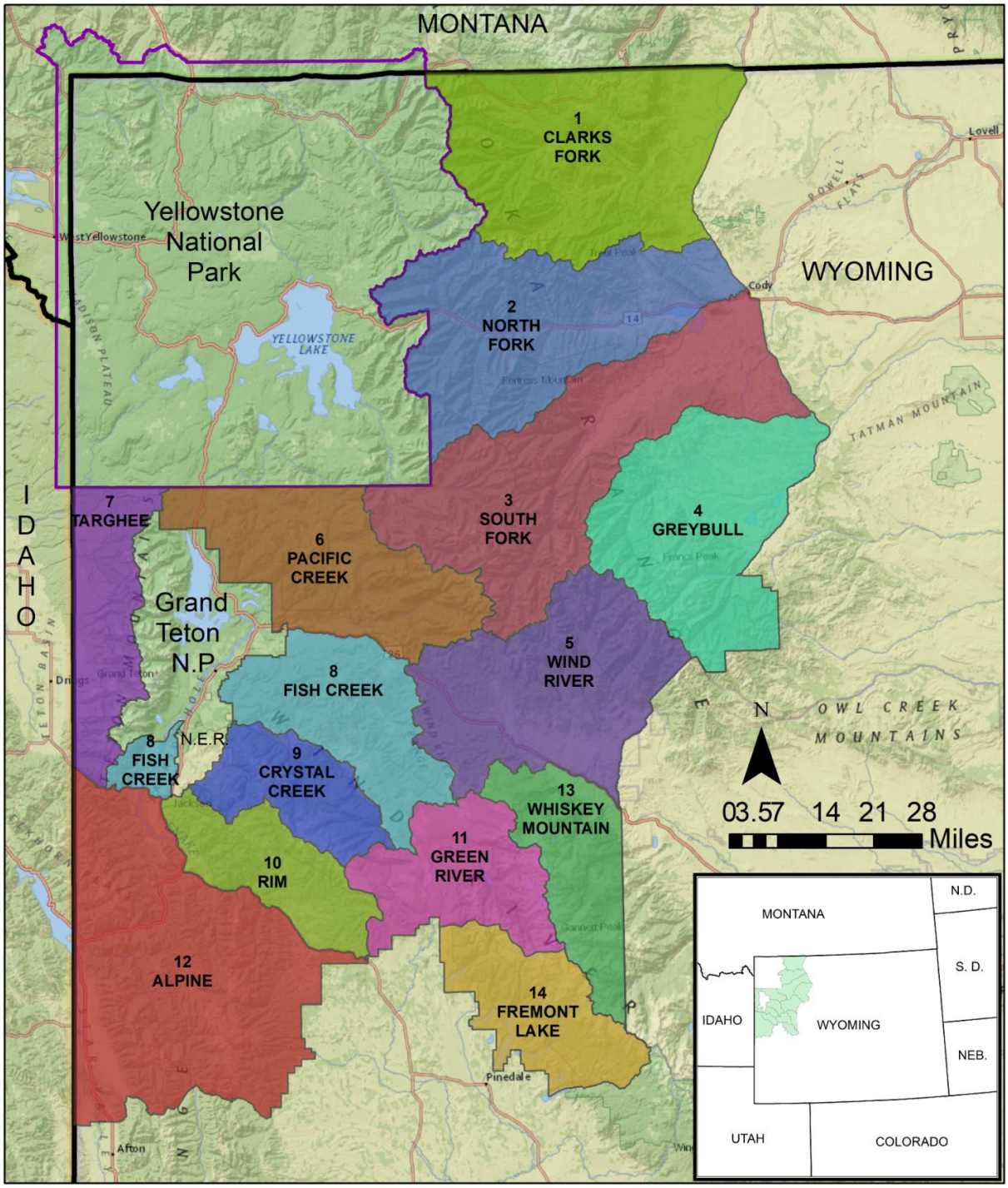

Figure 11. Wolf hunt areas for the 2022 wolf hunting season in northwest Wyoming.

for wolf hunting seasons to avoid disproportionate take of breeding individuals, who are more vulnerable to wolf hunting in January-March (Rebholz 2022). Closing seasons at the end of December also allows time for packs to replace breeders who were taken during the wolf hunting season before the wolf breeding season that occurs the second fortnight of February. 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 2022

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 stabilized around 160 wolves at the end of 2022 in the WTGMA if 44.6% of the wolves present at the beginning of 2022 died from all human-caused mortality. The predicted non-hunting human-caused mortality rate (15.7%) was then subtracted from 44.6% to obtain a 28.9% wolf hunting mortality rate, which equaled a total mortality limit of 45 wolves when applied to the minimum wolf population estimate of ≥159 wolves present in the WTGMA at the beginning of 2022 (i.e., the end of 2021 minimum wolf population [161 wolves] – 2 wolves taken in hunt area 13 in March 2022). The total mortality limit of 45 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 47 wolves (Table 4).

Wolf Hunting in the WTGMA and Seasonal WTGMA: The 2021 wolf hunting season in hunt area 13 extended from January 1 through March 31, 2022, during which time 2 wolves were taken from the Windy Mountain pack in March (Table 1). For the 2022 wolf hunting season, a total of 2,323 wolf hunting licenses were sold to 2,150 individuals (1,911 residents and 239 nonresidents), equal to the average sold from 2017-2020 (average = 2,323 licenses). Two wolf hunting licenses were purchased by 173 individuals. A total of 31 wolves (29 legal, 2 illegal) were taken during open wolf hunting seasons in the 14 hunt areas during the wolf hunting season in autumn 2022 (Tables 1, 2 and 4). Three of the 10 hunt areas/hunt area combinations closed prior to the established December 31, 2022 closing date due to the mortality limit being met (Table 4). The mortality limit for combined hunt areas 3 and 4 was exceeded by 1 wolf because 2 wolves were killed the same day when only 1 wolf remained on the mortality limit (Table 4). All hunters who legally killed a wolf complied with reporting and registration requirements. The two wolves illegally killed included 1 case of mistaken identity and 1 case of claimed self-defense.

Hunting mortality during the wolf hunting season in autumn 2022 was recorded in 17 of 29 packs (59%) that regularly used the WTGMA (includes Arrow Mountain assigned to the Wind River Reservation, Coyote Meadows assigned to Idaho, and Shrimp Lake assigned to Yellowstone National Park; Table 1). Two additional wolves were taken that did not belong to established packs, both of which had dispersed from Yellowstone National Park in summer 2022 (Table 1). Hunting mortality occurred during each month of the season, with most occurring in October and November (Figure 12). More males than females (17 females:12 females) and equal proportions of black and gray colored wolves were legally taken during the hunt (14 gray:15 black). More adults and equal proportions of subabults and juveniles were legally taken during the hunting season in autumn 2022 (8 juveniles:9 subadults:12 adults). For all wolf hunting seasons combined, a higher proportion of young wolves (juveniles and subadults) have been taken in earlier months with the ratio shifting toward adults through the end of the hunting season in December (Figure 13). The Department will continue to monitor the results of wolf

hunting seasons to determine the impact of hunting on wolf population dynamics and to assist in making management decisions in the future.

Table 4. Summary of the 2022 wolf hunting season in the WTGMA and Seasonal WTGMA (i.e., hunt area 12).

WGFD WOLF HUNTER HARVEST SUMMARY 2022				1/1/2023	
HUNT AREA(s)	LIMIT FROM REGULATIONS	SEASON DATES GENERAL	COUNTED TOWARDS LIMIT*	AREA STATUS	DATE/TIME AREA CLOSED
1	8	Sep. 15 - Dec. 31	7	CLOSED	1/1 per Regulation
2	5		5	CLOSED	12/24 @ 840 AM
3,4	4		5	CLOSED	10/14 @ 7:50 AM
5	5		3	CLOSED	1/1 per Regulation
6, 7	5		4	CLOSED	1/1 per Regulation
8, 9, 11	12		4	CLOSED	1/1 per Regulation
10	3		0	CLOSED	1/1 per Regulation
12	2	Oct. 15 - Dec. 31	1	CLOSED	1/1 per Regulation
13	2	Sep.15 - Mar. 31	2	CLOSED	11/16 @ 3:10 PM
14	1	Sep. 15 - Dec. 31	0	CLOSED	1/1 per Regulation
Total 2022 Mortality Limit	47	Total 2022 Harvest	31		

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

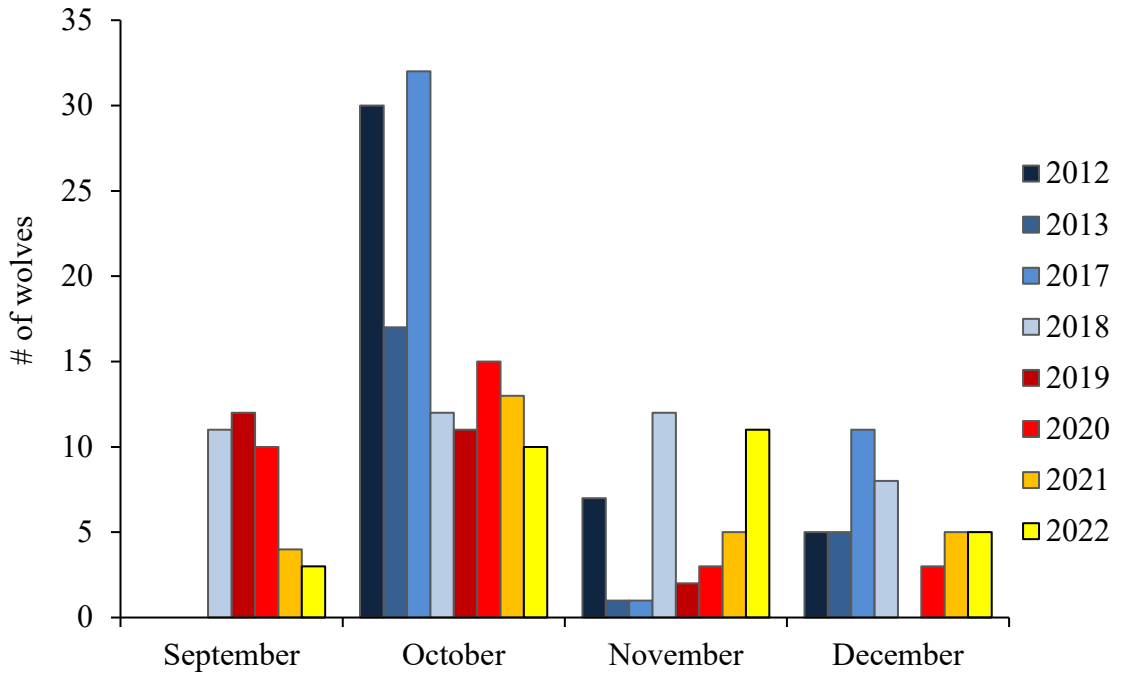

Figure 12. Number of wolves harvested during wolf hunting seasons by month and year in the WTGMA and Seasonal WTGMA in northwest Wyoming. (2012, 2013 and 2017 had Oct. 1st openers; 2018-2019 had Sept. 1st openers; 2020-2022 had Sept. 15th openers)

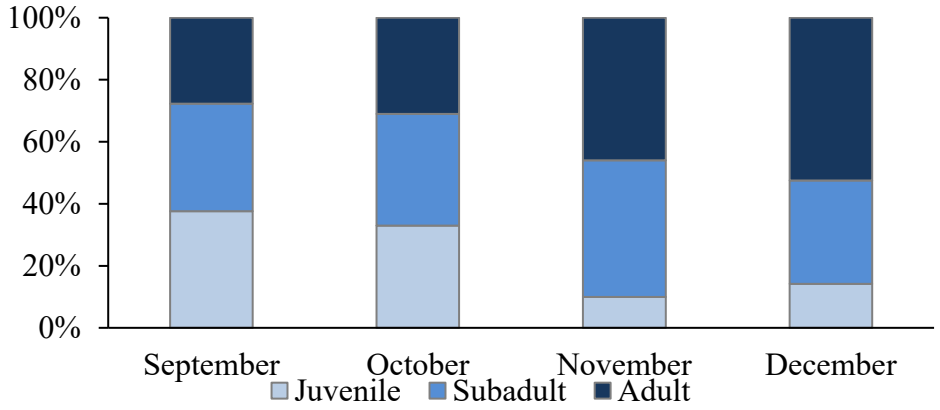

Figure 13. Proportion (%) of adult (>2 years of age), subadult (1-2 years of age), and juvenile (<1 year of age) wolves taken during wolf hunting seasons by month in the WTGMA and Seasonal WTGMA in northwest Wyoming during all wolf hunting seasons: 2012, 2013, 2017-2022. (Seasons started October 1st in 2012, 2013 and 2017, September 1st in 2018-2019, and September 15th in 2020-2022)

Development of 2023 Wolf Hunting Seasons: The 2022 end of year wolf population in the WTGMA was 3 wolves above the population objective of 160 wolves and was 2 breeding pairs below the corresponding objective of 14 breeding pairs set during the wolf hunting season setting process (Figures 2 and 3; Table 1). Wyoming Game and Fish Department wolf management has consistently produced an end of year wolf population within 10% of the population objective since 2018 (2% above in 2022, 1% above in 2021, 8% below in 2020, 9% above in 2019 and 5% below 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 14 and 15). The Department will continue to take an adaptive management approach for setting 2023 wolf hunting seasons as outlined in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011).

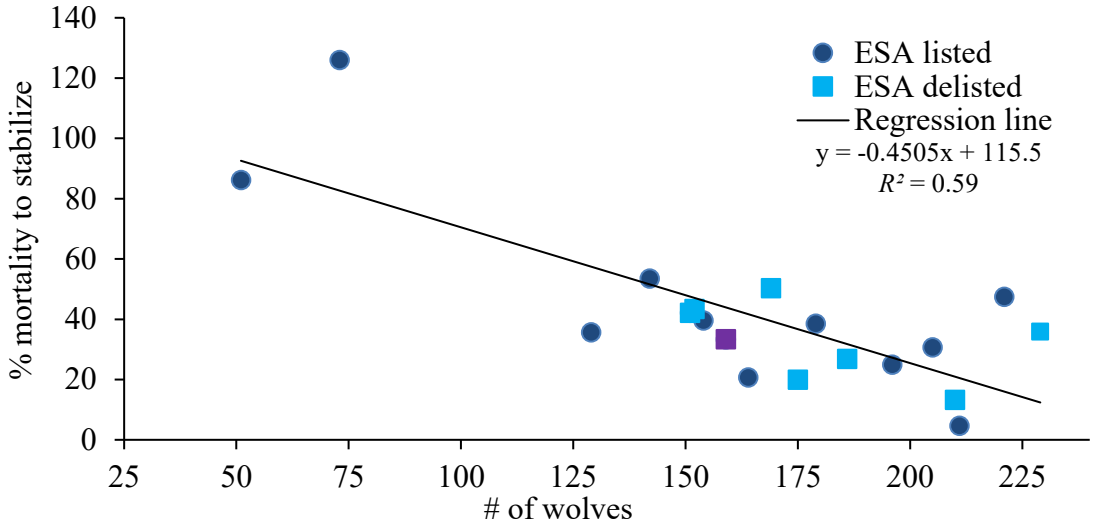

Figure 14. Minimum number of wolves at the beginning of the calendar year and the proportion (%) human-caused mortality that would have been required to stabilize wolf population growth during the calendar year in the WTGMA from 2004-2022. ("■" indicates the 2022 data point)

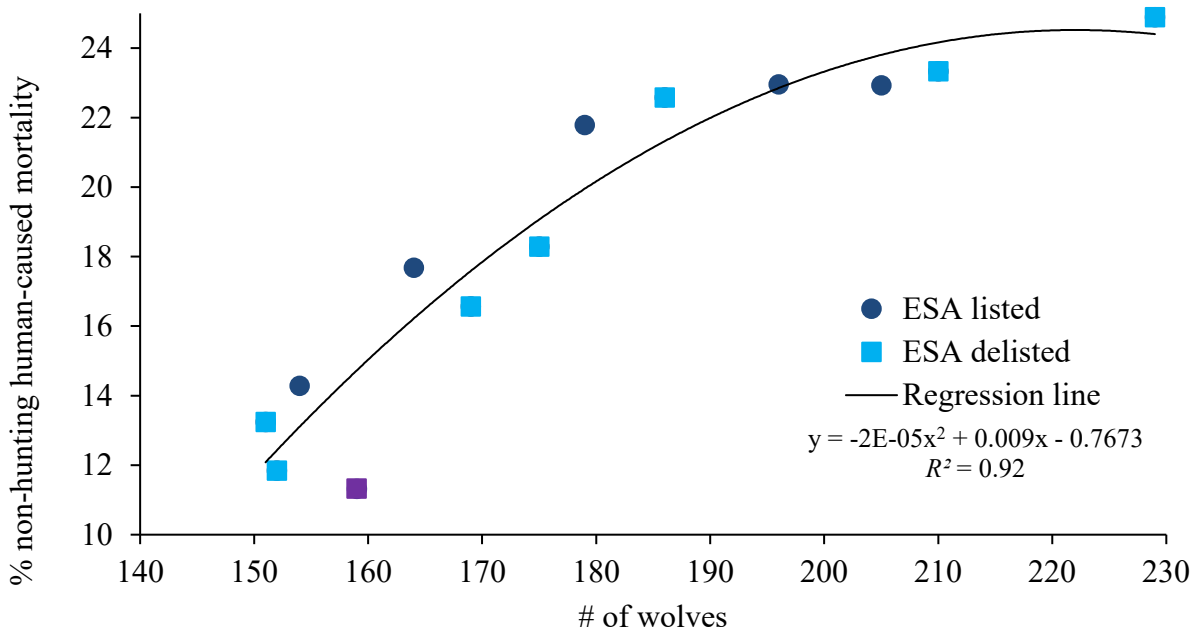

Figure 15. Minimum number of wolves at the beginning of the calendar year and proportion (%) of wolves present in the WTGMA at the beginning of the calendar year that were killed by non-hunting human-causes during the calendar year from 2008-2022. (Statistical outliers from 2011 and 2016 are excluded; "■" indicates the 2022 data point)

Wolf-Livestock Conflicts

As in previous years, livestock that were reported as damaged by wolves (i.e., conflicts) in the WTGMA were investigated by the Wyoming Game and Fish Department (Figure 1). 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 because verification is required to qualify for damage compensation and/or for wolf management actions to be initiated.

In 2022, wolves were responsible for killing or injuring 44 head of livestock in the WTGMA (Figure 16; Tables 1 and 5). Livestock confirmed to have been killed or injured by wolves included 39 cattle (28 calves and 11 cows/yearlings) and 5 horses (all colts: Figure 16; Tables 1, 5 and 6). The number of wolf-livestock conflicts remained relatively similar from 2021 to 2022 (Figure 16; Tables 5 and 6). Management actions included collaring wolves, intensive monitoring, lethal removal, non-lethal depredation prevention measures, and issuance of 17 lethal take permits to livestock producers (12 initial permits and 5 permits that were renewed due to continued livestock conflict). Fifteen wolves were killed in response to livestock conflicts in the WTGMA; 10 in agency-directed lethal control actions and 5 under authority of lethal take permits (Figures 5 and 16; Tables 1, 2 and 5).

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

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Cattle	38	15	26	41	46	44	60	81	141	87	55	48	51	38	39
Sheep	14	37	0	0	1	19	3	19	0	0	0	0	0	0	0
Dogs	0	0	0	0	4	1	0	0	0	1	0	0	1	5	0
Horses/other	0	1	1	0	0	2	0	1	0	0	2	2	10	1	5
Total livestock killed/injured	52	53	27	41	51	66	63	118	141	110	57	50	62	44	44
Wolves killed	32	21	32	28	19	24	29	25	90	46	39	12	27	14	15

Number of Packs Involved in Confirmed Livestock Conflicts: Eleven packs (38% of 29 packs that existed in 2022) that use the WTGMA were involved in ≥1 livestock conflict in 2022 (includes Arrow Mountain assigned to the Wind River Reservation, Coyote Meadows assigned to Idaho, and Shrimp Lake assigned to Yellowstone National Park: Figure 17; Table 1). Four packs were responsible for 1 confirmed conflict with livestock (36% of conflict packs; 14% of all packs), 1 pack was responsible for 2 confirmed conflicts with livestock (9% of conflict packs; 3% of all packs), and 6 packs were responsible for ≥3 confirmed conflicts with livestock (55% of conflict packs; 21% of packs; Table 1).

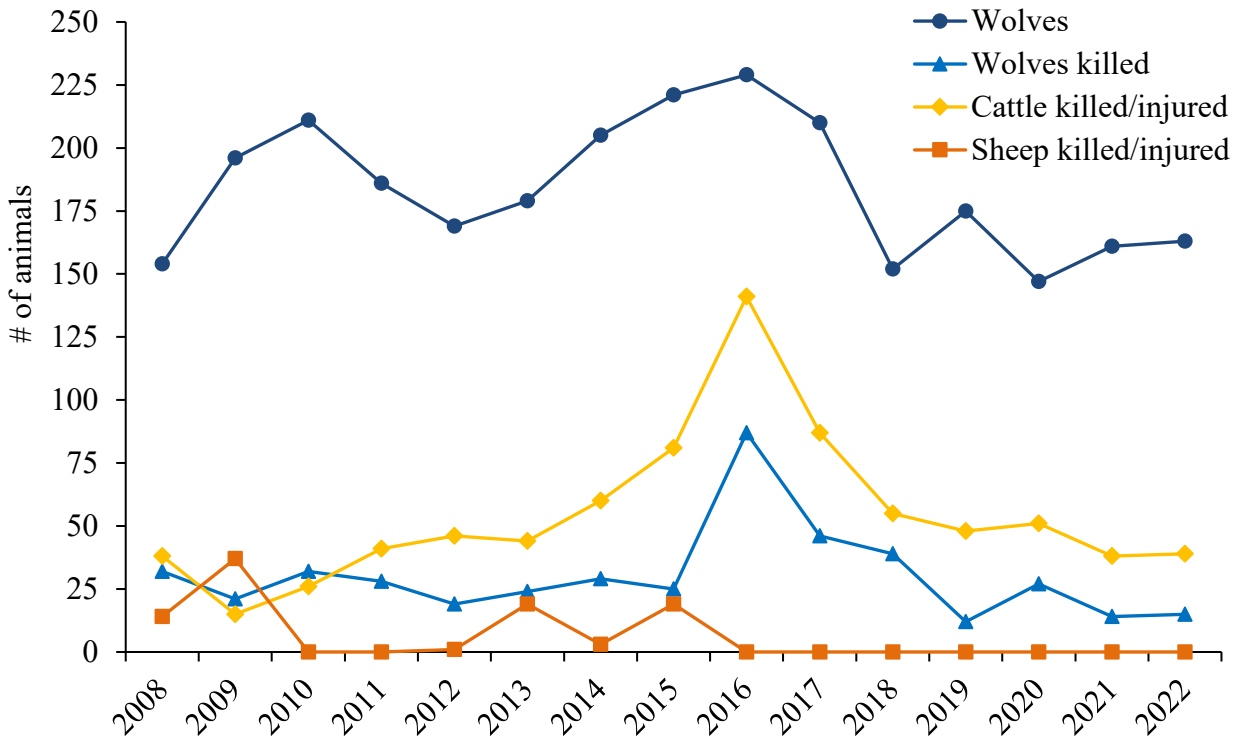

Figure 16. Number of wolves in the, confirmed wolf-livestock conflicts and wolves killed in conflict control actions in the WTGMA by calendar year.

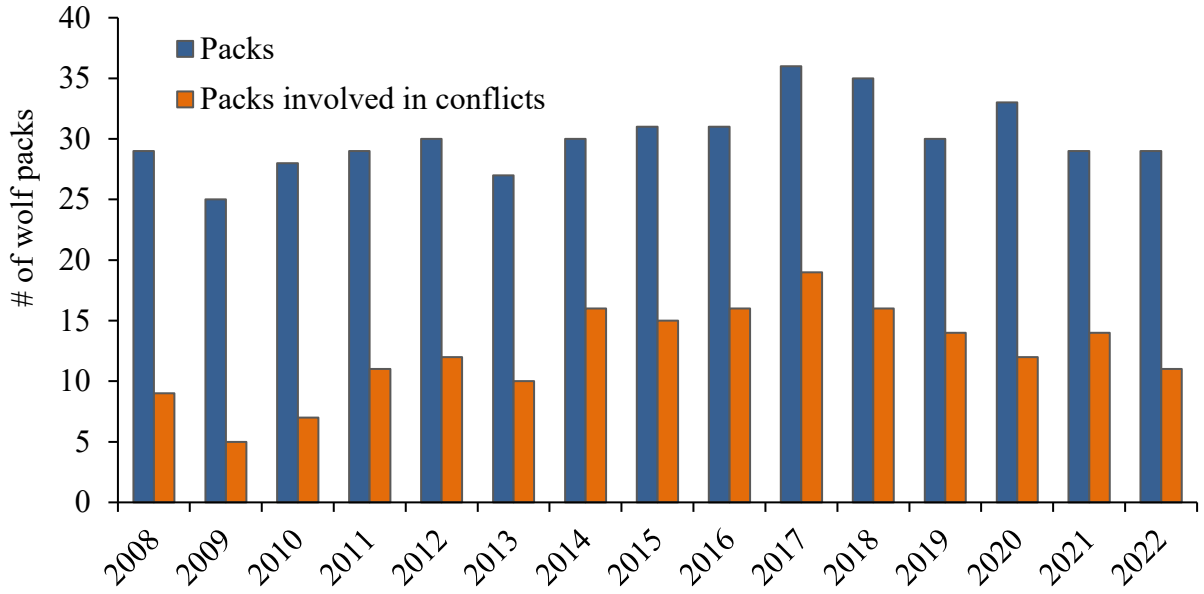

Figure 17. Minimum number of wolf packs present during the calendar year and number of wolf packs that were involved in ≥1 confirmed wolf-livestock conflict in the by calendar year.

Location of Livestock Conflicts: Land ownership is recorded for all instances of confirmed wolf-livestock conflict in the WTGMA as part of routine investigation of reported conflicts. Of 44 wolf-livestock conflicts in the WTGMA in 2022, 50% were on public land (22 cattle) and 50% were on private land (17 cattle and 5 horses: Table 6). There were slightly more wolf-cattle conflicts on public lands than private (Table 6). In addition, 2 colt horses were killed and 3 colt horses were injured on private lands (Table 1). Hunt areas 5 and 11 had the highest confirmed wolf-cattle conflicts (Table 7).

Table 6. Proportion (%) of wolf-cattle conflicts that occurred on private or public lands in the WTGMA from 2017-2022.

Year	2017	2018	2019	2020	2021	2022	Average
Public	49%	45%	71%	63%	47%	56%	55%
Private	51%	55%	29%	37%	53%	44%	45%

Table 7. Confirmed wolf-livestock conflicts in the WTGMA (Hunt areas 1-11, 13 & 14) by wolf hunt area in 2022.

Hunt area	1	2	3	4	5	6	7	8	9	10	11	13	14	Total
Cattle	6	0	5	3	8	0	2	1	2	2	9	0	1	39
Sheep	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	5	0	0	0	0	0	5
Total	6	0	5	3	8	0	2	6	2	2	9	0	1	44

Seasonal Trend in Livestock Conflicts: Wolf-cattle conflict patterns in 2022 were similar to previous years but were less frequent except for August (Figure 18). Confirmed wolf-cattle conflicts began in April, peaked in August, and ceased by the end of October (Figure 18).

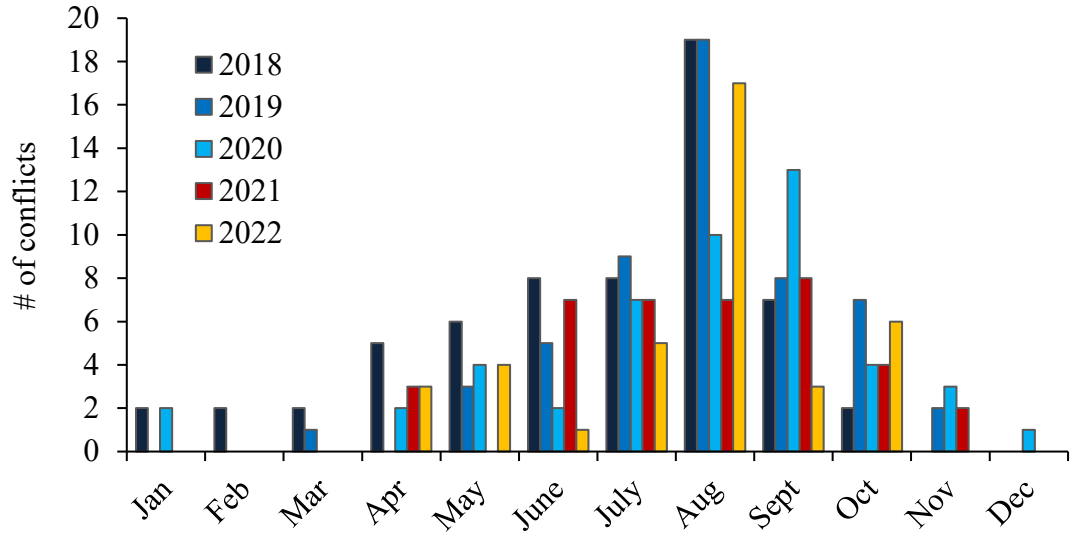

Figure 18. Number of wolf-cattle conflicts per month in the 2018-2022.

Compensation for Livestock Damage Caused by Wolves: In 2022, the Wyoming Game and Fish Department paid $187,382 to compensate 23 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 ~$200,000 or less from 2018-2022, mirroring synchronous declines in conflict between wolves and livestock following removal of Endangered Species Act protections in 2017 (Figures 16 and 19). Confirmed sheep conflicts, which are compensated using a multiplier of 7:1 (i.e., up to 7 sheep compensated for every one confirmed), increased in the Seasonal WTGMA from 2019-2022 causing overall compensation amounts to be higher during that timeframe despite stable to decreasing conflicts with cattle in the WTGMA (Figures 2, 16 and 19; Table 5). Wolf-sheep conflicts in the Seasonal WTGMA occur during the summer when sheep graze on public allotments and wolves are designated as predatory animals and are not under management jurisdiction of the Wyoming Game and Fish Department.

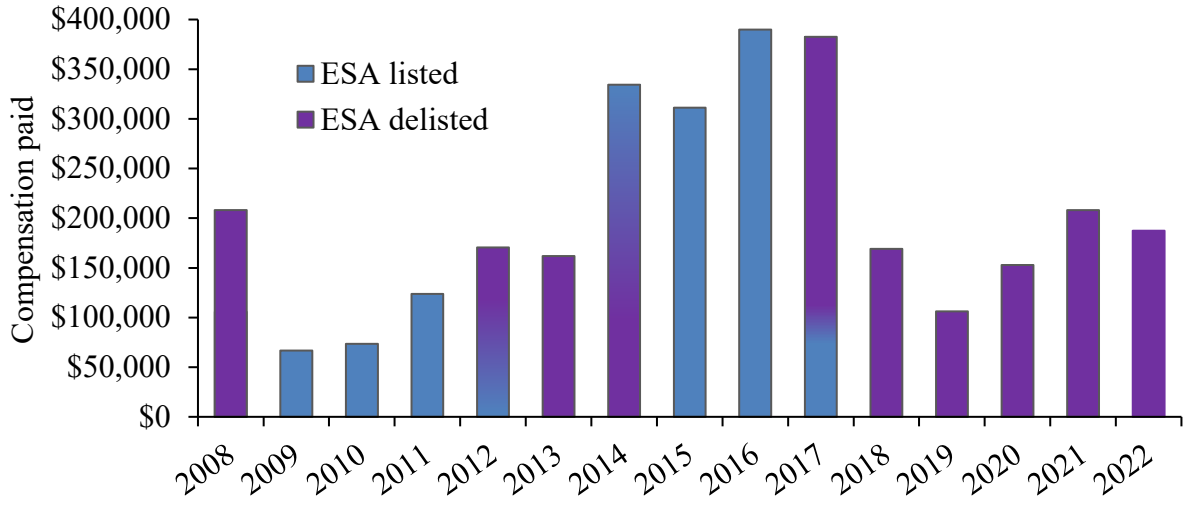

Figure 19. Compensation paid for confirmed livestock damage caused by wolves in the WTGMA (all years) and Seasonal WTGMA (from 2012-2022) by calendar year.

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.

The Wyoming Game and Fish Department did not conduct any lethal removal actions as a result of unacceptable impacts to ungulates or elk feedgrounds caused by wolves in 2022. 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 24 wolves were taken by the public under predatory animal designation and 5 wolves were taken by USDA Wildlife Services to prevent conflicts with livestock in the year-round predatory animal area and Seasonal WTGMA in 2022 (Table 1). Two additional wolves were killed illegally in the predatory animal areas in 2022, including 1 failure-to-report violation and 1 trap-check violation (Table 1). One known pack (Prospect) and other miscellaneous wolves were responsible for killing or injuring 7 cattle (4 calves, 3 yearlings) and 4 sheep (1 lamb, 3 adults) in the year-round predatory animal area in 2022 (Table 1). In addition, one known pack and other miscellaneous wolves were responsible for 42 wolf-sheep conflicts (33 lambs, 9 ewes) in the Seasonal WTGMA during the period of the year wolves were designated as predatory animals (Table 1).

Wolf Management in the Wind River Reservation

In 2022, wolves were classed as a trophy game animal on the Wind River Reservation. Legal take could occur for wolves during regulated hunting seasons 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.

Two wolf hunting seasons were implemented from December 1, 2021 through February 28, 2022 and December 1, 2022 through February 28, 2023 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 during both seasons. Mandatory reporting was required within 48 hours to allow for seasons to be closed once the quota was met. In January 2023, a trapper legally harvested 1 wolf in the Wind River hunt area within the Blue Trail pack territory. (Table 3). One credible wolf-livestock conflict was reported (loss of 2 calves), but was not verified in 2022 (Table 3).

Wolf Management in Yellowstone National Park

Wolf management actions in Yellowstone National Park generally include seasonal closures around wolf denning areas to reduce the potential for human-caused disturbance and aversive conditioning of wolves that exhibit habituated behavior around people. In 2022, wolf management actions in Yellowstone included temporary closures around the Junction Butte, Rescue Creek, and Wapiti Lake den areas to protect the young pups from disturbance and allow the adult wolves to travel to and from the den unimpeded. The Junction Butte pack denned in 2 different locations, both visible from the Slough Creek road. However, in early June the adult wolves moved all the pups to the Lamar Valley. After the park road into the Lamar Valley closed on June 13th due to extensive damage from a flood, the Junction Butte pack was generally not visible until the road reopened on October 14th. The Rescue Creek and Wapiti Lake packs both moved their pups further into the backcountry by midsummer and closures were lifted.

Several members of the Wapiti Lake and Junction Butte packs exhibited habituated behavior and, when possible, were aversively conditioned by park staff. Aversive conditioning is performed only during a teachable moment when a wolf is in proximity to humans or vehicles and showing nonchalance or interest in them. Generally, aversive conditioning can be successful in changing a wolf's behavior but can be difficult to perform unless monitoring the wolf daily for many hours.

OUTREACH

WYO

In person and virtual presentations were conducted by Wyoming Game and Fish Department personnel to multiple school and community groups in 2022. Personnel continued to provide interviews for numerous magazine, newspaper, and television feature stories for local and

national media outlets, in addition Large Carnivore Section personnel represented the Department and presented data on wolf management in Wyoming at the 2022 International Wolf Symposium, a conference focused on the science and management of wolves. The Department held a 3-day wolf depredation training session for multiple Colorado Parks and Wildlife employees to assist their agency with preparations for wolf reintroduction efforts in August 2022. As part of normal wolf monitoring and management activities, Wyoming Game and Fish Department personnel interacted with members of the public thereby increasing the public's involvement and understanding of wolf biology, monitoring, and management throughout Wyoming. The Wyoming Game and Fish Department also conducted 10 public meetings during the wolf hunting season-setting process in May 2022 as well as providing information on wolf ecology and safety at multiple Living in Large Carnivore Country Workshops held throughout Wyoming.

Yellowstone National Park

Wolf Project staff gave 155 formal talks, 99 interviews, presented 6 conference posters and 23 conference presentations, and led 16 field trips. During the summer months, staff helped educate at least 14,110 people while viewing wolves and gave 64 informal talks in the field.

EXPENDITURES

WYO

During the 2022 calendar year, the Wyoming Game and Fish 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 $538,118 of wolf program funds toward wolf management in 2022. Program expenditures are reported by primary work activities conducted below, but do not represent all Department expenses incurred:

- Monitoring and management program: $291,041
- Internal and external information and education: $30,799
- Equipment and administration: $28,896
- Compensation for verified wolf-livestock conflict: $187,382

Cooperating agencies in WYO also expended funds directed toward wolf monitoring and management in 2022 as follows:

- Grand Teton National Park: $121,000
- USDA Wildlife Services: approximately $75,000 (including funds expended for nonlethal projects and for Wyoming Animal Damage Management Board and Wyoming Department of Agriculture projects)

Wind River Reservation

A total of $4,285 was spent on wolf monitoring and management in the Wind River Reservation in 2022 ($2,285 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 2022; $250,000 from federal funding and $300,000 from private sources.

CONTRIBUTORS

Many personnel contributed to the content of the 2022 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: Large Carnivore Section: Ken Mills (corresponding author), Clint Atkinson, Dan Bjornlie, Mike Boyce, Justin Clapp, Brian DeBolt, Luke Ellsbury, Cristopher Evans, Kyle Garrett, Ryan Kindermann, Phil Quick, Sean Ryder, Scott Stingley, and Dan Thompson. Fiscal information: Kindra Brown, Tracey Kupec, Christina Malessa, and Chelsea Ramage.
- Wyoming Game and Fish Wildlife Health Laboratory: Hank Edwards, Jessica Jennings-Gaines, Maggie Johnson, Katie Luukkonen, and Kara Robbins.
- Wyoming State Veterinary Laboratory: Joan Edwards.
- Grand Teton National Park: John Stephenson and Sarah Dewey.
- Wildlife Services: Mike Burrell, Mike Foster, Vivian Meek, and Rod Merrell.
- Aerial tracking: Mark Packila.
- Volunteers: Ron Blanchard and Aylen Mills.

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, Jeremy SunderRaj, Taylor Rabe, Wes Binder, Maddy Jackson, Mark Packila, Brenna Cassidy, Jack Rabe, Nikki Tatton, Connor Meyer, Aaron Bott, Cameron Ho, Claire Lacey, and Dylan Sanborn.

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WYO

We appreciate exemplary piloting and aerial wolf monitoring from Mark Packila of Wildlife Air, without whom the Wyoming Game and Fish Department's wolf program would not be successful. We also thank Native Range Capture Services for their wolf capture expertise and willingness to go above and beyond to ensure the success of the wolf monitoring program. Ron Blanchard has been a dedicated and valued volunteer with the wolf monitoring program for over 15 years and has provided invaluable assistance, support, insight, and data throughout that time. Aylen Mills provided a significant contribution to the wolf program by summarizing and conducting initial analyses on wolf pack tenures in the WTGMA. 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 additional personnel at the following agencies for their assistance in wolf monitoring and management: U.S. Forest Service; National Elk Refuge; 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 Wyoming. We recognize a successful program needs a strong base of support and to all of the above we continue to be greatly indebted.

Wind River Reservation

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

Yellowstone National Park

We thank the many interested people who come forward every year to study and support wolves in YNP. First and foremost, we thank the Wolf Project volunteers, without whom we would not be able to complete and continue this research. We thank Yellowstone Forever for their support of this program. We also thank the many generous individuals, foundations, and organizations that have provided funding for the Wolf Project through Yellowstone Forever. We deeply appreciate the safe piloting from Mark Packila of Wildlife Air, Jim Pope and team of Leading Edge, Troy Wozydziak of Baker Aviation, and Stephan Robinson and Grayson Sperry of Ridgeline Aviation. We would not be able to learn and teach about wolves without their exceptional skill.

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Appendix A: Tenure of known wolf packs in the Wolf Trophy Game Management Area from 1997-2022 as reconstructed from annual Wyoming Gray Wolf Monitoring and Management reports.