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Gray Wolves

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Figure 1. Gray wolf *(Canis lupus).*

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Human-Wildlife Conflicts

The gray wolf *(Canis lupus)* is a wide-ranging carnivore with a global distribution throughout the northern hemisphere. Wolves are the largest member of the family Canidae (Figure 1). It is often considered a symbol of the wilderness.

Historically, wolves were found throughout North America. By the 1940s, however, wolves were eradicated from most of their former range in the continental United States. Gray wolves were listed as an endangered species in 1974. Subsequent recovery efforts have resulted in wolf populations in the western Great Lakes Region, the northern Rocky Mountains, the southwest (Mexican wolf), and the Pacific Northwest.

Wolf conflicts are primarily related to predation on livestock, pets and other domestic animals, as well as their direct and indirect impacts on native ungulates (i.e., big game). Economic losses vary widely with some livestock producers facing high levels of depredation in some areas.

This publication focuses on wolf ecology, damage, and management, particularly as it relates to wolf depredation on livestock and other conflicts with people.

Human Health and Safety

Wolves and people share the same environments more than people realize. In the U.S., wolves are not confined to wilderness areas. Though curious, wolves generally fear people and rarely pose a threat to human safety. Wolf attacks on people are, and always have been, very rare compared to other wildlife species. However, there have been several cases of human injuries and a few deaths due to wolves in North America over the past 100 years. The main factors contributing to these incidents were habituation to people, rabies infections, conditioning to human foods, and the presence of domestic dogs.

It is unusual for wild wolves to associate or interact with people, linger near buildings, livestock, or domestic dogs, but it does occur especially in areas of high wolf densities in and around rural communities. This type of behavior may be more prevalent in areas where wolves are not legally harvested. This “bold” behavior is more typical of a habituated or food-conditioned animal, a released captive wolf, or a released wolf-dog hybrid. Wolves are sometimes attracted to human settlement because of high prey densities (e.g., deer) or other items, such as livestock carcasses or bone piles.

The effects of epizootics and enzootics on wolf populations are not well documented. The transmission of diseases, such as canine parvovirus, from domestic dogs to wild wolves is a conservation concern. Rabies is a human health concern but is infrequently reported in wolves. However, it may have been a cause for attacks on people in European history. Wolves are hosts to various protozoans and parasites, including the hydatid worm, *Echinococcus granulosus*. It can be transmitted to people and grows into a tapeworm in its host.

Livestock Depredation

The scale and scope of wolf depredation on livestock depends on local wolf density; numbers and kinds of livestock; livestock husbandry practices; availability and vulnerability of alternative prey; human density; road density; severity of winters; and local hunting pressure.

In many instances, wolves live around livestock without causing damage or only occasional damage. Wolf pack size has been shown to increase the likelihood of depredations on domestic animals, with larger packs more likely to cause damage. Most losses occur between April and October when livestock are on summer pastures or grazing allotments. Cattle, especially calves, are the most common livestock killed by wolves. When wolves kill sheep or domestic poultry, often multiple individuals are killed or injured.

The number of complaints and depredations on domestic livestock varies by state. For example, in Montana, the number of suspected and verified complaints of wolf damage to livestock steadily increased following the reintroduction of wolves to the northern Rocky Mountains in 1995. Then after 2010, when the state began a legal harvest and trapping season on wolves, wolf depredations declined and plateaued at a lower level (Figure 2). Similarly, in Minnesota where wolves were not extirpated and recovered naturally after federal protection, the wolf population, their geographic range, and depredations on livestock increased steadily in the 1990’s, but has remained relatively stable over the past 20 years as the wolf population size and range has stabilized (Figure 3). In Minnesota, only 1 to 2% of livestock operations in wolf range are impacted by verified wolf depredations annually. It is important to note, however, that losses can be significant to individual producers or producers located in the same region in given years.

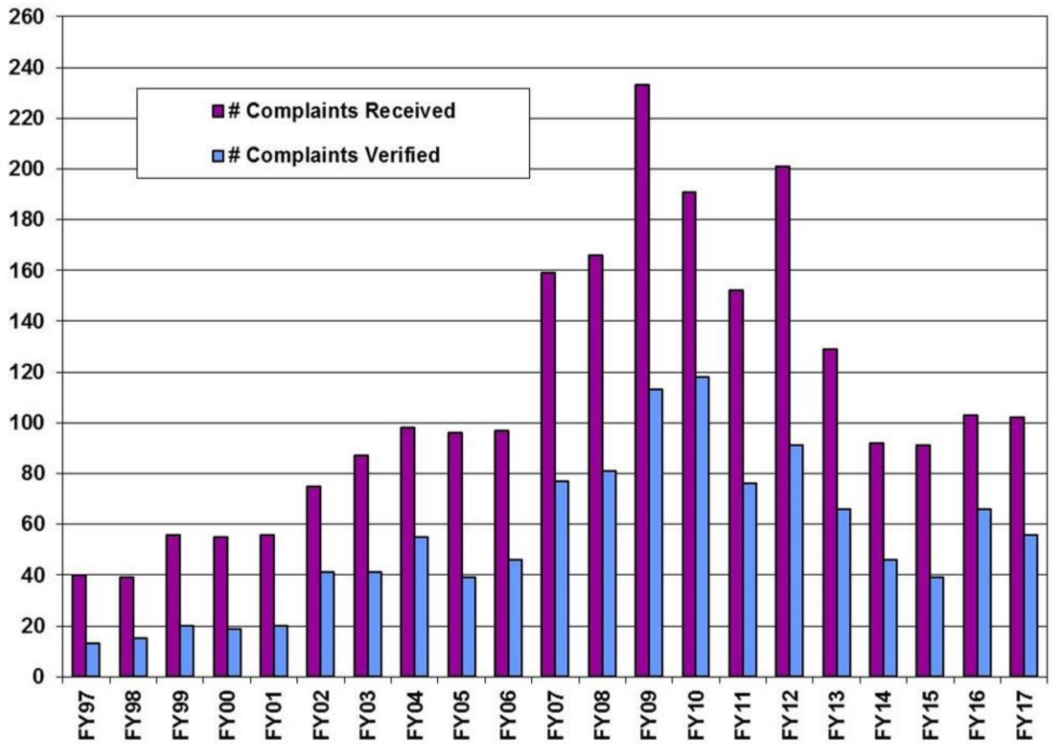

Figure 2. Number of suspected and verified wolf depredation complaints received by the U.S. Department of Agriculture's Wildlife Services program in Montana, 1997—2017.

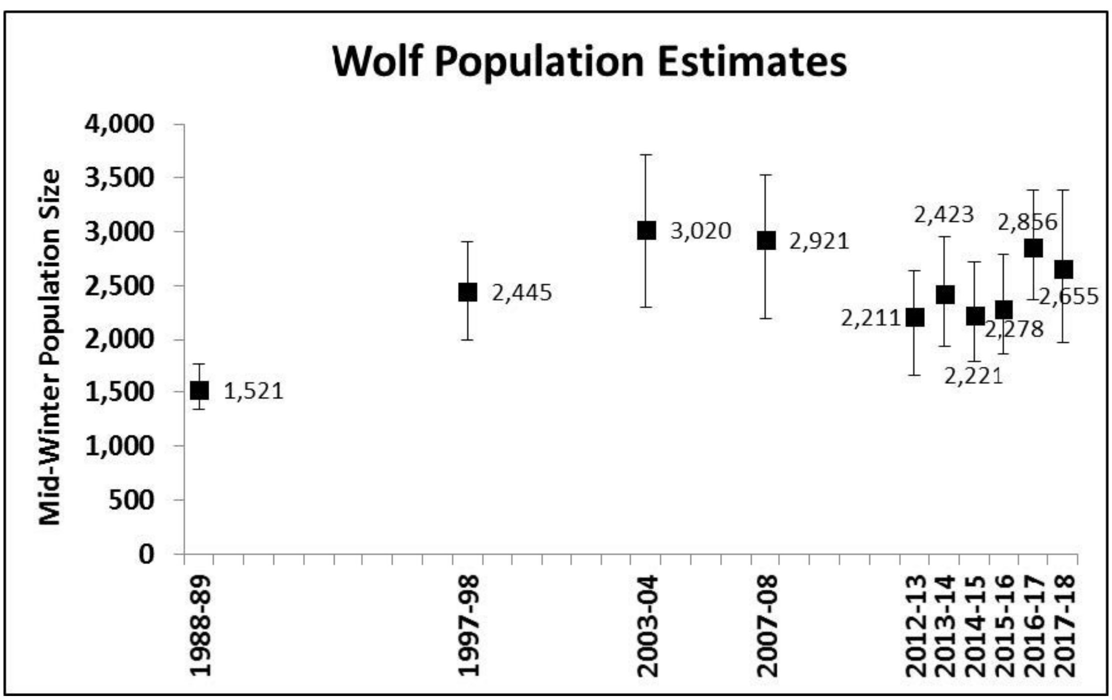

Figure 3. Mid-winter population size of wolves in Minnesota, 1989-2018.

Guarding Animals and Pets

In addition to livestock depredation, wolves sometimes kill and injure domestic pets and livestock guarding animals, such as livestock protection dogs (LPD) and donkeys.

Wolf attacks on domestic pets (mostly dogs), have increased as wolf numbers have increased in the lower 48 states. Many attacks on domestic dogs seem to be triggered by territorial behavior where wolves view dogs as canine competitors. In such cases, the dogs are often killed or injured. Only occasionally are they fed upon. While generally, there is no compensation for these losses of pets, some state damage management boards are now compensating for the loss of livestock protection dogs (LPD). People residing in wolf country should be aware of the vulnerability of their pets and keep them near their residence or have fencing to contain their pets and exclude wolves.

For decades, LPDs have helped protect livestock from coyotes, feral dogs, foxes, and mountain lions in the U.S. However, some of the dog breeds currently used to protect livestock from coyotes are no match for larger predators, such as wolves and grizzly bears. Recent research has investigated the use of larger European dog breeds to protect livestock from wolves.

Natural Resources

As a keystone species, wolves play a critical role in ecosystem dynamics and the regulation of native ungulate populations. Wolves are large-bodied carnivores that primarily prey upon large herbivores, with prey species varying by location. For example, elk and deer are more plentiful in the northern Rocky Mountains and are the primary prey of wolves in that region, while moose and deer are more commonly available and preyed upon in the Great Lakes region.

The impact that wolves have on native ungulate species is highly variable and dependent on a multitude of factors. For example, in what might at first appear to be a relatively simple ecosystem of one prey and one predator, the relationship between wolves and moose on Isle Royale remains ambiguous. Results of almost 60 years of study show the dynamics between wolves and moose to be a complex interaction of disease, genetics and inbreeding, and food limitations all contributing to changes in wolf and moose abundance on this island ecosystem.

In the northern Rocky Mountains where several areas contain multiple prey species and multiple predators, the interactions in this complex ecosystem is even more difficult to predict. The presence of wolves, grizzly bears, and cougars preying on elk, deer, and moose, makes predicting or elucidating the causes responsible for declines as well as increases in ungulate populations difficult. In some areas, ungulate abundance has declined in the face of predation combined with human hunting. While in other areas, elk abundance is over population objective as identified by state wildlife agencies. Multiple factors, including predation, winter severity, human hunting pressure on both prey and predators, interspecific competition among predators and prey species, and changing landscapes via habitat loss and fragmentation, all contribute to the complexity and difficulty of determining cause and effect in changing dynamics and abundance of ungulate populations.

Damage Identification

Wolves prey mainly on wild ungulates, such as deer, caribou, moose, and elk. Cattle, especially calves, and domestic sheep are also vulnerable to wolf predation. While predation on livestock is not as common as predation on wild ungulates, wolf predation on cattle and sheep has been increasing in the lower 48 states as wolf populations increase.

Wolves are not the only predator species that kill livestock. Other predators besides wolves include coyotes, domestic dogs, black bear, grizzly bear and mountain lions. In the northern Rocky Mountains, it is common for grizzly bears to displace wolves from a carcass making it difficult to ascertain what species

Figure 4. Wolf predation on domestic livestock often results in most of the carcass being consumed.

actually killed the animal. It is important to accurately identify the species responsible in order to select the most appropriate methods and techniques to use in an integrated damage management program. Tracks and scats found at a depredation site are often used in conjunction with the killing and feeding pattern found on a carcass to determine the predator involved.

Wolf Depredation Signs

Wolves usually kill ungulates by attacking the hindquarters or by seizing the flanks. Wolves often bite mid-sized calves (100 to 250 pounds (lbs)/45 to 115 kilograms (kg)) over the top of the back between the rear of the ribs and the pelvis. Sometimes their canine teeth penetrate the body cavity with this bite and sometimes the bite is strong enough to separate the vertebrae.

Slash marks made by the canine teeth may be found on the rear legs and flanks. When the victim is badly wounded, wolves will often disembowel the animal. Wolves usually eat the viscera (internal organs) and hindquarters first.

Wolf kills are characterized by massive trauma, and large tooth marks may not be visible until the animal is skinned or partially skinned during a depredation investigation. Large bones may be chewed or cracked open. Wolves may carry or drag parts of the carcass to nearby vegetative cover, dens or rendezvous sites for the young to consume. Generally, most of the carcass is eaten (Figure 4), sometimes over the course of multiple feedings. Occasionally, feeding is interrupted by other livestock, especially the mother cow, or by the producer.

Wolves readily scavenge dead livestock, thus wolves found feeding on a livestock carcass or having livestock hair in their scat may not have killed the animal.

Coyote Versus Wolf Depredation Signs

Wolf and coyote damage can overlap with depredations occurring on the same property and within days of each other. Coyotes normally kill livestock with bites to the neck and throat, but may pull the animal down by attacking the side and hindquarters. Young calves may be bitten in the flanks, and entrails eaten, destroying any discernable evidence of predation at the site of the attack. The rumen (first stomach) and intestines of sheep are generally not eaten, but are often removed and dragged away from the carcass. When coyotes kill small lambs, their upper canine teeth often penetrate the top of the neck or the skull.

Calf predation by coyotes is most common when calves are young. Calves attacked, but not killed, exhibit wounds to the flank, hindquarters, or front shoulder. Coyotes generally have a lighter feeding pattern (they do not completely dismember the carcass and crush all the long bones) than wolves, and often the carcasses of calves or ewes are still intact, with entrails and meat eaten. Coyotes will return to carcasses for multiple feedings, scavenge on wolf kills, and at times, multiple coyotes (often family groups), can consume large amounts of meat, making it difficult to distinguish between coyote and wolf depredations.

Domestic Dog Versus Wolf Depredation Signs

Depredation by domestic dogs also can be confused with wolf or coyote kills. Domestic dogs can be a serious problem to livestock, especially to sheep pastured near cities and suburbs. Dogs vary how and where they attack, but often attack the hindquarters, flanks, and head. They rarely kill as effectively as wolves or coyotes and are considered "sloppy" predators, slashing and tearing prey that sometimes results in many injured animals. Dogs generally wound animals in the neck and front shoulders; the ears often are badly torn. Skinning the carcass often reveals bruises on 80% of the body due to bites that did not penetrate the skin. Dogs rarely feed on the carcass. If dogs eat sheep or big game, they normally eat the thighs and rear end and often vomit near the site.

Animal Husbandry

Animal husbandry includes a variety of activities related to the care and attention given to livestock. Generally, when the frequency and intensity of livestock husbandry increases, so does the degree of protection from predators.

Various animal husbandry practices can reduce depredation losses by wolves. Some of the most common include:

- confining or concentrating herds/flocks during periods of vulnerability (e.g., at night or during lambing),
- using herders or "range riders" (Figure 5),
- shed lambing,
- synchronizing birthing,
- keeping young animals in areas with little vegetative cover and in close proximity to human activity, and
- properly disposing of livestock carcasses by rendering, burying, composting, or burning to discourage scavenging by wolves.

Management Methods

Responsible and professional reduction or elimination of wildlife damage is the goal of wildlife damage management practitioners. This is best accomplished through an integrated approach. No single method is effective in every situation, and success is optimized when damage management is initiated early, consistently, and adaptively using a variety of methods. Because the legality of methods vary by state, consult local laws and regulations prior to the implementation of any method.

For a summary table of wolf management methods, please see the Appendix.

Figure 5. The use of range riders (a person patrolling a range on horseback) is growing in popularity in many areas with wolves. They help to deter wolves and assist in herd management.

These practices generally require additional resources and effort, and may only delay the onset of predation, or may have undesirable side effects (e.g., night penning requires added effort and frequently causes spot deterioration of pastures, or shed lambing requires added labor and feed costs). For these methods to be effective, producers must develop and adapt strategies to fit their unique situations. Although the economic advantages of modifying husbandry practices may be difficult to quantify, the changes can assist in herd management and production (e.g., range riders often find calves that may have been abandoned or are in distress).

Birthing Pens

Birthing pens are a form of temporary or permanent fencing where cows or ewes are given extra protection during a vulnerable time. Non-protected birthing on the open range is not recommended in wolf country. Not only are birthing animals and their newborn calves or lambs extremely vulnerable to depredation during and immediately following birth, but the blood and afterbirth can be strong attractants to all types of predators. The effectiveness of birthing pens and/or night pens can be enhanced with fladry or turbo-fladry (described below).

Night Penning

Bringing livestock herds or flocks into paddocks or pens at night can help to reduce wolf depredations. Night penning may require a period of adjustment and the help of herding dogs, as livestock become used to being gathered together at night. Eventually, the animals head for the night pens willingly. An added benefit of night penning is that producers are able to monitor the health of the herd and individual animals on a regular basis.

Biofence

A “biofence” is a type of biological barrier that uses artificial scent-marks (e.g., feces and urine) to exploit the territorial behavior of predators. This concept originated in Botswana to keep African wild dogs *(Lycaon pictus)* from leaving protected reserves and entering farmlands to depredate livestock. However, biofences have had limited success in altering wolf pack movements and are not really considered an effective management technique for wolves depredating livestock. Wolves may habituate to a biofence more quickly without the occasional physical confrontation at territorial borders necessary to reinforce territory boundaries among wolves.

Electronic Training Collar

Electronic training collars are a nonlethal method for deterring wolf predation by potentially changing a wolf’s behavior during a predation attack (Figure 6). They are similar to shock collars used to train domestic dogs. Studies have shown that wolves with electronic collars avoided bait sites more than wolves without collars. Collared wolves also moved further away from bait stations after being shocked. However, the avoidance behavior did not continue once shocking ceased.

Investigators note that electronic collars may have limited field applicability since they require the capture and handling of wolves in order to attach the collars or change the collar’s batteries. Also, non-collared wolves

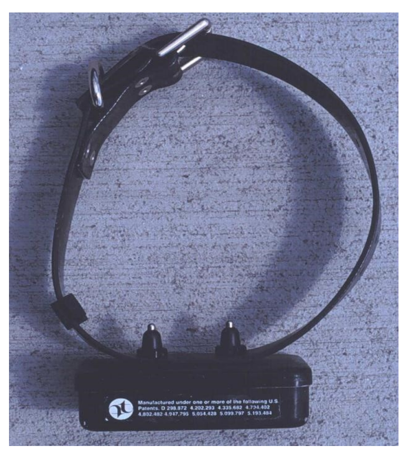

Figure 6. Electronic training collar used to shock a collared wolf when it enters a designated area. Requires capture and placement of the collar on the wolf.

are not affected and may still cause damage. Although this document provides information on this technique, it likely is not a practical solution for managing depredation problems. However, if costs and labor are not an issue and these collars are used, the receiver could be tuned to communicate with the collar at a distance equal to the width of the pasture or area containing the stock needing protection. Having a radio-collared wolf with the training collar could then be triggered when the radio-collar is detected within the range of the receiver.

Exclusion

Effective barriers for excluding wolves from livestock include wire fences, fladry or turbo- fladry.

Fencing

Wolves may be excluded from pastures with well-maintained woven-wire fences that are 6 to 7 feet (ft) (2 to 2.5 meters (m)) high. However, many factors, including the density, behavior and motivation of wolves, terrain and vegetative conditions, availability of prey, size of pastures, and time of year, as well as the fence design, construction, and maintenance, will impact the overall effectiveness of a fence.

Adding an electrified single-wire strand charged by a commercial fence charger to the woven-wire fence can increase its effectiveness. The electrified wire should be placed 8 inches (20 centimeters (cm)) outside of the main fence line and 8 inches (20 cm) above the ground.

Additionally, a 5 ft (1.5 m) woven-wire fence with 9 to 12 alternating ground and charged wires spaced 4 to 6 inches (10 to 15 cm) apart is an effective barrier against coyotes, and may be effective against wolves. A high-tensile woven-wire fence is more versatile, longer lasting, and can be tightened more than a conventional wire mesh fence.

It is unlikely that fences will totally exclude all wolves from an area, however, fences can increase the effectiveness of other damage management methods, such as penning livestock, using guard animals, and trapping. For example, the combined use of LPDs and fencing may be more successful than either method alone. Installation costs usually preclude the use of fences for protecting livestock in large pastures or under range conditions.

Approximately 52% of surveyed livestock producers use fencing to exclude predators from sheep and lambs.

Figure 7. A corral of fladry erected on a grazing allotment in Idaho for night-penning sheep *(left)*, and fladry being set-up on a farm in Minnesota *(right)*.

Fladry

Fladry consists of polypropylene cording or similar material on which red or orange cloth flagging or plastic vinyl taping is hung at 18-inch (46 cm) intervals and strung on temporary or permanent fence posts (Figure 7). First used in Europe to surround wolves in order to hunt them, fladry has been adapted for use as a nonlethal wolf deterrent. Because carnivores are often wary of new items in their environment (like fluttering flags), they are cautious about crossing the fladry barrier.

Turbo-fladry is similar to fladry but is strung on electric fencing material, often PVC-coated for durability. Turbo-fladry combines the effectiveness of fladry with the shock-delivering power of an electric fence. If a wolf overcomes its innate fear of the flagging and attempts to pass the fladry barrier, a shock is delivered. The added "shock value" of the turbo-fladry appears to enhance the avoidance time for wolves.

Both types of fladry are recommended for temporary use, such as on calving or lambing areas, and are typically effective for 90 to 120 days.

Fladry and turbo-fladry are easy to install. A number of producers have developed bagging systems for fladry or reels that can fit on the back of a pickup, ATV, or saddle for easy and rapid installation. Fiberglass poles can be carried and quickly installed with a hammer or sleeve driver. The fladry can be strung through the metal clips normally used with such poles. Turbo-fladry is generally powered by golf-cart or marine batteries that are recharged using solar panels.

As part of a collaboration between the Defenders of Wildlife and USDA Wildlife Services, the combined use of fladry, LPDs, and herders has effectively deterred wolf predation on sheep in Idaho while limiting the need to remove wolves from the area.

Fertility Control

Currently, there are no fertility control products registered for use with wolves. Vasectomy of male wolves has been proposed as a method to manage populations, but has not been tested and may be impractical or economically infeasible. While not tested on wolves, sterilized coyotes killed significantly less domestic sheep than intact coyotes.

Frightening Devices

Lights, distress calls, loud noises, scarecrows, plastic streamers, propane cannons, aluminum pie pans, and lanterns have been used to frighten predators. While all of these devices can provide temporary relief from predator damage, wolves may quickly habituate to them. Changing the location of devices, the pattern of the disruptive-stimuli or combining several techniques prolongs the frightening effect. One research study suggests that light may be the most important component of a frightening device.

Devices developed to deter wolf predation and prevent habituation include the Radio Activated Guard (RAG) box (Figure 8) and the Movement Activated Guard (MAG) device. The RAG box is triggered and emits lights and

Figure 8. A Radio-Activated Guard (RAG) box consisting of a radio-telemetry receiver that activates the unit when a radio-collared wolf is detected. Unit consists of strobe lights, solar-powered battery, user defined activation distance, and plays more than 30 different sounds to scare the wolf away.

Figure 9. Less-Than-Lethal-Munitions are fired from a shotgun at a wolf to scare the animal from an area.

sounds when a radio-collared wolf comes within a predetermined distance (e.g., the width of the pasture) of the device. The RAG box has been recently redesigned and now includes a text alert system to alert the rancher or herder via cell phone when the device is triggered by a radio-collared wolf. However, use of these devices require recapturing the wolf to replace the collar's battery. Alternatively, the MAG device is activated by a passive infrared motion detector eliminating the need for collaring wolves. RAG and MAG boxes are generally available from USDA Wildlife Services offices with assistance from WS personnel. Defenders of Wildlife is making the redesigned RAG box available to state wildlife agencies.

Another tool used to frighten wolves from an area is Less-Than-Lethal-Munitions (Figure 9) which fire nonlethal munitions (e.g., small plastic projectile, small bean bag, cracker shells) from a shotgun. This tool has a limited range and requires the shooter to be within 300 feet (100 m) of the wolf in order for it to be effective.

Guarding Animals

The use of guarding animals, such as dogs and donkeys, to protect flocks and herds from predators is a common nonlethal predation damage management tool.

<u>Livestock Protection Dogs</u>

Livestock protection dogs (LPD) are used to deter predators from livestock in many countries worldwide. Approximately 32% of surveyed livestock producers in several western states use LPDs to protect their flocks. In Colorado, a study reported sheep producers estimated their LPDs saved them an average of $3,216 annually from coyote depredations and reduced their need for other control techniques.

Dog breeds most commonly used as LPDs include Great Pyrenees, Komondor, Akbash, Anatolian, and Maremma. However, these breeds may be vulnerable to wolf predation. With the expansion of wolf populations into the northern Rocky Mountains and the northwestern U.S., new larger-bodied breeds of LPDs from Europe have been evaluated for use as LPDs. A USDA Wildlife Services study examined three LPD breeds from Europe (Turkish Kangal (Figure 10), Bulgarian Karakachan, and the Portuguese Transmontano) and determined they all successfully protected sheep from a variety of large predators but showed different guarding traits and behaviors. Producers may want to balance the traits of multiple dog breeds by having some that prefer to stand guard with the flock and others that seek out and investigate potential threats.

Figure 10. The Turkish Kangal *(shown)* is one of three large European dog breeds investigated to reduce predation by large carnivores.

Studies investigating the efficacy of LPDs have shown the dogs to be effective in some situations and ineffective in others. This may be due to the inherent difficulty of guard dogs protecting large flocks dispersed over rough terrain and in areas where thick cover conceals approaching predators. Some poorly trained or minimally supervised guard dogs have killed sheep and lambs, harassed or killed wildlife, and threatened people that intrude upon their territory. However, not all LPD failures or undesired behaviors stem from poor training or supervision. There is considerable behavioral diversity within a litter of guard dog pups; some turn into valuable and effective guard animals, while others do not, despite similar training and effort. The use of LPDs may preclude the use of other management methods, such as snares and traps.

Donkeys and Llamas

Approximately 6% and 22% of surveyed livestock producers in the western U.S. use donkeys and llamas as guard animals, respectively.

The protective behavior of donkeys apparently stems from their dislike of dogs. A donkey will bray, bare its teeth, chase and try to kick and bite wolves. If using guard donkeys, it is recommended to only use a jenny (female) or gelded jack (male; intact jacks are too aggressive towards livestock), and to place one donkey per flock or group and keep other donkeys or horses away to prevent the guard donkey from bonding with them versus the flock or herd. Furthermore, donkeys should be introduced to the livestock about 4 to 6 weeks prior to the onset of anticipated predation events to properly bond with the group. Donkeys are most effective in small, fenced pastures. Donkeys are relatively low maintenance. They generally eat pasture or rations suitable for other livestock and need only general health care – usually having their hooves trimmed once a year.

Llamas are also a practical and effective tool for deterring predators, mainly coyotes, from livestock. Llamas can be kept in fenced pastures with sheep or goats, do not require any special feeding program, are relatively easy to handle, and live longer than LPDs. Traits that may be useful in selecting a guard llama include leadership (frequency with which individuals were followed by other llamas), alertness, and body weight.

Although guard animals may not deter wolves completely, they may change the predators' behavior and activity patterns when near livestock. In several states, such as Minnesota, both guard donkeys and llamas have been killed by wolves.

Repellents

There are no effective chemical repellents for use with wolves.

Shooting

Shooting is a selective and common method for lethally removing wolves. Safety is a critical factor and may preclude the use of firearms due to local laws or human habitation. Consider all available management options and proceed accordingly.

The choice of firearm, caliber, and bullet will vary based on circumstances in the field. Rifles suitable for taking wolves include a .243 caliber, 6 mm, or larger with a suitable bullet type for taking an animal up to 120 lbs (55 kg).

Aerial Operations

The use of aircraft for shooting wolves is regulated by the Airborne Hunting Act and is allowed under special permit in states where legal. Aerial operations are very selective, allowing for the removal of targeted packs or individuals.

Aerial operations, using fixed–winged airplanes and helicopters, are used for removing wolves that are depredating livestock. Fixed-wing aerial operations are limited primarily to open areas with little vegetative cover. Because of their maneuverability, helicopters are useful for shooting in areas of brush, scattered timber, and rugged terrain.

Although aerial operations can be conducted over bare ground, they are most effective where there is snow cover. Wolves are more visible against a background of snow versus brown vegetation. Their tracks are also more visible in the snow. During the summer, vegetation that is still green also makes for a good background for spotting wolves.

Aerial operations can be more efficient if a ground crew works with the aircraft. Before the aircraft arrives, the ground crew often works to locate wolves in the area by eliciting howls. Two-way radio communication allows the ground crew to direct the aircraft toward the sound of the wolves, thus reducing search times.

In areas where aerial operations are allowed, federal law requires each state to issue permits. Some states or federal agencies may also require low-level flying waivers. Aerial operations require special skills and training for both the pilot and gunner.

The addition of radio-collars to study and locate the pack has also proved useful in wolf management for many western states. The radio-collar allows for identification of nearby packs that may be depredating livestock, and can then be relocated when needed.

<u>Recreational Hunting</u>

Where legal, firearms can be used to lethally take wolves causing damage found near depredation sites and livestock production areas. In some areas, local wolf populations also may be reduced through recreational hunting. Wolves may be called into firearm range with a predator call or by voice howling.

Toxicants

There are no toxicants currently registered for use with wolves in the United States.

Translocation

Although translocation efforts are expensive, they are often considered essential when dealing with rare or endangered predators. Translocation of wolves from Canada to central Idaho and Yellowstone National Park led to the recovery of wolves in the northern Rocky Mountains. However, capturing and moving animals causing damage is not considered a viable solution for solving wildlife damage problems. Wolves that have killed domestic animals and are translocated to prevent future damage typically leave the release site, travel great distances, and return to the original capture site or another area containing domestic animals where they resume depredation activities.

Trapping

Trapping describes several types of tools and techniques used to commonly capture wolves. These include foothold traps and cable restraint devices that are designed to live-capture wolves.

Trapping rules and regulations vary by state. Most states have regulations on various types of traps, baits, sets, and trap visitation schedules. Some states do not allow the use of foothold traps. Consult local laws and regulations prior to using any traps.

Wolf trapping success varies with local wolf densities and activity patterns, soil and snow conditions, trapper skill, abundance of livestock, wild ungulate density, other large carnivore activity, and other factors. Productive areas for capturing wolves are identified by observing wolf sign (e.g., wolf tracks, scat, scratches) and other evidence of regular wolf use. Often wolf sign is found on wolf travel routes such as forest roads, minimum maintenance roads, agricultural field roads, cattle trails, snowmobile trails, dikes and other routes through wolf habitat that provide easier travel for wolves than surrounding habitat. Setting traps on these wolf travel routes, as well as near wolf kills, rendezvous sites, and scavenging sites are effective ways to capture wolves.

Using a trap to selectively remove an animal that is causing depredation is difficult. However, removing wolves in close proximity to a damage site in the days immediately following a verified wolf depredation has proven successful in reducing or delaying subsequent damage. Generally, the more wolves removed, the longer the delay until the next damage incident. Sometimes just attempting to trap the offending animal and increasing the level of human activity in the area may deter future depredations.

Foothold Traps

Commonly used foothold traps for capturing wolves include #4, #5, #7, MB-750, Alaskan #9, Braun wolf trap, and others with coil-spring or double-long spring mechanisms. Wide, offset jaws, padded or rubber coated jaws (McBride EZ-grip), multiple swivels, and shock springs are common modifications on foothold traps to help reduce capture-related injuries.

Foothold traps for wolves can be equipped with a long (minimum 8 ft [2.4 m]) chain attached to a heavy duty two-pronged drag in areas with suitable vegetation (Figure 11). A drag allows a captured wolf to move from the set location and seek shelter in vegetation. Drags are typically used instead of in-ground anchors in sandy or loose soils, and in areas with dense vegetation for the drag to hook onto away from the trap site.

In terrain or habitat unsuitable for drags, foothold traps can be anchored solidly at the trap set location with the use of trap stakes (Figure 12) or other anchoring systems. Often two re-bar stakes (½-inch (1.3 cm) diameter by 24-inch (60 cm) long) are hammered into the ground in a "cross-staked" pattern to prevent stakes from being pulled out by a captured animal. Alternatively, a "bullet" or earth anchor can be used to secure a foothold trap (Figure 13). These devices are attached to the trap chain using a chain or strong cable (1/8-inch [0.3 cm] diameter minimum), and driven into the ground to a depth of 18 to 24 inches (46 to 61 cm) below the trap with a specialized driver.

All swivels, j-hooks, s-hooks, and other connections on wolf traps and chains should be spot-welded so captured wolves cannot open the connections and escape. Pan-tension devices also should be considered to minimize captures of smaller nontarget species. Use of trap monitors can be beneficial for traps set in areas with difficult access, or in areas occupied by endangered species requiring prompt removal of an animal from the

Figure 11. Foothold trap configured with chain and 2-pronged drag-hook.

Figure 12. Foothold trap configured with two stakes for anchoring the trap in place.

Figure 13. Foothold trap equipped with a "bullet" anchor which is driven into the ground. When the chain is pulled, the anchor pivots, anchoring the trap in place.

Figure 14. Placement of a foothold trap in the ground begins with two-stakes in a “cross-staking” configuration and chain to anchor the trap in place (A), then dirt is filled around the trap with a plastic baggie over the pan preventing dirt from getting under the pan (B), more dirt is then sifted over the trap (C), with the final trap set being blended into the surroundings to conceal the trap (D).

trap. Additional anchoring of the trap may be needed when working in areas with grizzly bears to allow release of the bear from the trap.

A foothold trap usually is set in the ground by digging a trench just deep and wide enough to fit the trap, stake (or drag), and chain in the bottom of the hole. The trap is set firmly on top of the buried chain and should be about ¼ to ½-inch (5 to 10 mm) below the soil surface (Figure 14). A piece of canvas, cloth, mesh screen, waxed paper, or a plastic sandwich bag is placed over the trap pan to prevent soil from getting beneath the pan and preventing it from being depressed by the target animal. Alternatively, closed cell foam or other compressible material can be placed underneath the trap pan to keep out dirt. The weight of a wolf’s foot on the pan will compress the material under the pan and allow the trap to trigger. Cover the trap with soil and other natural materials (i.e., leaves, pine needles, dry grass) found in the area near the trap.

There are two main types of foothold trap sets: blind and flat. A blind or trail set is used to trap an unsuspecting wolf as it is traveling on its commonly used trails. It is set without a bait or attractant. A flat set takes advantage of a wolf's curiosity and urge to investigate smells. It is often set off of the travel route and baited with an attractant, such as meat bait, scat or urine, on or near a grass clump, log end, rock, bone or some other natural backing to entice the wolf to stop and smell the attractant, but not roll on it. Alternatively, the attractant could be placed in a small hole (at least 6 inches [15-cm] deep) dug behind the trap.

Many states do not allow trapping of wolves, or restrict trapping near a carcass or exposed bait, so check local and state regulations. Foothold traps must be checked often to minimize the amount of time animals are restrained. To avoid catching nontarget animals, such as bears, eagles and vultures, do not place foothold traps near a carcass.

Cable Restraint Devices

Cable restraint devices (also known as snares) are made of varying lengths and sizes of wire or cable that is looped through a locking device that allows loop to tighten (Figure 15). There are generally two types of cable devices: neck and foot. Neck cable devices can be used to restrain a live animal or as a lethal tool depending on their design, lock type, cable diameter, anchor type,

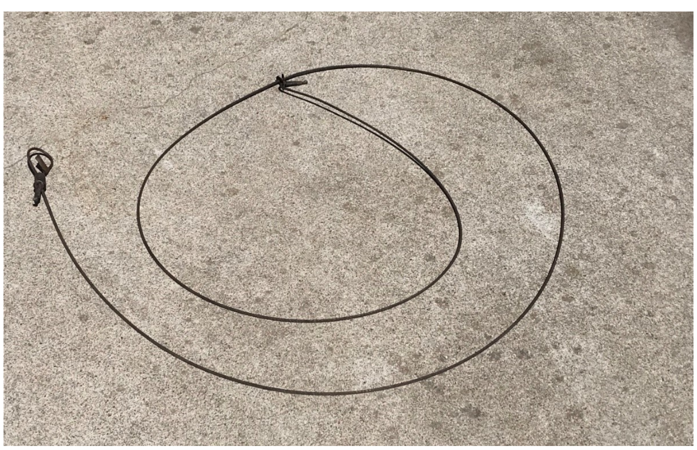

Figure 15. Cable restraint devices are made of varying lengths and sizes of wire or cable looped through a locking device that allows the loop to tighten.

length, and whether the captured wolf can entangle itself in nearby vegetation or fencing. The device is set where an animal crawls under a fence, travels through tall grass, brush or some other narrow passageway. The device is placed so the animal must put its head through the cable loop as it passes through the restricted area. The device's loop tightens as the wolf proceeds through the loop and the lock travels toward the terminal end of the cable, holding the captured wolf by the neck. Cable devices should be strong enough to resist twisting and chewing by a captured wolf. Cable that is 1/8-inch (0.3 cm) diameter (e.g., 7 x 7 cable) is frequently used. A cable device's loop is typically 13 to 16 inches (33 to 41 cm) in diameter and is placed so it hangs 16 to 18 inches 41 to 46 cm) above the ground.

Care should be taken when using neck cable devices to avoid unintentional capture of wild ungulates, livestock, or bears. Selectivity, effectiveness, and risk of capture of nontarget species can be improved with proper design and placement. A breakaway device and a snare stop incorporated into the cable device's lock allow larger animals to escape if accidentally caught and should be considered in areas where there is the potential to catch nontarget species. Diverter wires or sticks placed directly over the set are used successfully in some locales to reduce unintentional capture of wild ungulates. Deer and livestock can be prevented from interfering with a cable device by placing a pole or branch across the trail, directly over the set about 3 ft (0.9 m) above the ground.

Spring-activated cable devices are used to capture wolves and other large predators by the foot. When the animal steps on the trigger the spring is released, propelling the device's loop around the foot. The animal instinctively recoils, tightening the cable.

Foot cable devices can be used in a cubby set (a set which funnels the wolf to step on the trap from one direction), or set in a narrow trail known to be traveled by wolves. Selectivity of the cable device may be improved by placing sticks under the trigger that break only under the weight of heavier animals. Open-cell foam pads can be placed under trigger pans to prevent unintentional triggering of devices by small mammals. Foot cable devices are generally not as effective at capturing wolves as more traditional foothold traps, but they are lighter and easier to carry.

Handling and Euthanasia

Wear protective equipment (i.e., disposable latex or nitrile gloves, safety glasses) when handling live or dead wolves. Avoid contact with claws, teeth, blood, saliva, urine, or feces.

The most dangerous part of a wolf is its mouth with sharp teeth and the ability to break bones with the power of its bite. A catchpole or Y-pole may be used to momentarily restrain a wolf, but administration of immobilizing drugs is recommended if handling or transporting the animal is required.

When working with a live wolf, move slowly and deliberately. Speak in a calm voice. Place a hood or towel over the wolf's eyes to reduce stress. Keep a live wolf cool or in a shaded area to avoid heat-related injury.

Thoroughly washing your hands, body, and clothing after trapping and handling wolves will reduce the chances of contracting a zoonotic disease or parasite, such as tapeworms.

The American Veterinary Medical Association provides guidelines for euthanizing animals. Pharmaceutical euthanasia agents (including barbiturates) can only be administered by a licensed veterinarian or someone working under the direction and control of a veterinarian. It is recommended that applicators use a sedative followed by an intravenous injection of the euthanasia agent.

Captured wolves may also be euthanized with a well-placed shot to the brain with a hollow-point bullet from a .22 rimfire cartridge (or of equivalent or greater velocity and muzzle energy) or a centerfire rifle bullet to the heart, if the brain cannot be safely and reliably targeted.

Disposal

Check your local and state regulations regarding carcass disposal. In some disease-related cases, deep burial, or incineration may be warranted.

Economics

Economic benefits of wolves are mainly through consumptive and non-consumptive uses. Wolf hunting is now allowed in much of the northern Rocky Mountains, which generates revenues that would be considered consumptive use (e.g., the sale of licenses for hunting and trapping wolves in Montana is over $400,000 per year). Plus, hunters spend money for travel, housing, food, and equipment, generating income for hotels, restaurants, and hunting guides. Some ranchers may be able to offset losses associated with wolves by providing access to their property and services (e.g., guiding, housing) to people that hunt wolves. An outfitter in Idaho offers wolf hunting on Idaho ranches for $3,800 for a single hunter.

In terms of non-consumptive use, wolves provide opportunities for people to view, film, photograph, listen to, or otherwise experience wolves in their natural habitats. Tourists flock to Yellowstone National Park for a chance to see wolves. When first introduced into Yellowstone National Park in 1995, economists estimated that visitor use would increase by 5% for out-of-area residents and 10% for local residents. Ten years later, economists confirmed that visitation increased as predicted and that wolf-related visitation produced $47 million annually in travel expenditures in Idaho, Montana, and Wyoming.

The largest economic cost is from wolves harassing and/or killing livestock (Figure 16). The economic cost of livestock killed by wolves is determined by multiplying the number of animals lost times fair market value. However, counting these losses is difficult because the exact number of livestock killed by wolves is not known. From 1987 to 2005 in Montana, Idaho, and Wyoming, 528 cattle, 1,318 sheep, 83 dogs, 12 goats, 9 llamas, and 6 horses were confirmed killed by wolves, and over $550,000 was paid from a private compensation fund (Defenders of Wildlife). In 2014, the U.S. Fish and Wildlife Service confirmed a total of 136 cattle (both adults and calves) and 114 sheep (adults and lambs) killed by wolves in 2014 in the northern Rocky Mountains. Generally, the proportion of livestock killed by wolves is low, and mortality caused by wolves is a small economic cost to the livestock industry as a whole. Although wolf predation on cattle and sheep accounts for less than 1% of the annual gross income from livestock operations in the northern Rocky Mountains, these costs are unevenly distributed and localized.

In the Great Lakes region, the 3 states (Wisconsin, Michigan, Minnesota) reported a total of close to $300,000 in compensation for wolf damage to livestock in 2019. In 2020, these 3 states also reported about $770,000 in management costs dealing with wolf damage (this includes federal and cooperator funding, and funds for employing nonlethal methods).

Additionally, studies show that costs could be higher when including unconfirmed deaths and indirect losses such as lower market weights, reduced conception rates due to stress, and producer mitigation costs to deter wolves or to seek compensation. For example, one study found that calves in herds that experienced predation were 22 lbs lighter and, when added across all calves in those herds, accounted for a greater loss than confirmed depredations. Other studies found unverified and indirect losses to be at least 6 times that of verified losses. A later study found that these estimates of unaccounted losses may be overstated. Clearly, more research is required to know exactly how much producers might lose if wolf populations expand.

Another potential cost of wolves is reduced income for some businesses, primarily big game hunting. At a

Figure 16. Direct damage costs from wolves include the death and caring of injured livestock as a result of being pursued or attacked.

local level in states with high wolf populations, elk numbers are stable or increasing in many areas where wolves and elk interact, but they have declined in others. At the statewide level, the number of elk harvested by hunters has not declined in the northern Rocky Mountains, despite increases of wolves. An economic analysis in Montana concluded that, overall, wolves have not had a significant economic effect on elk harvest in the state. Rather, demand for hunting shifted from the southwest region near Yellowstone to areas farther away from where wolves were first introduced. However, at a local level, where wolves contribute to declines in big game herds and hence hunting opportunities, this resulted in a cost to those reliant on hunting to support their livelihoods.

Many states fund compensation programs for livestock producers impacted by confirmed wolf depredations with some non-governmental organizations contributing toward nonlethal damage management programs (e.g., funding range riders and fladry) on private and public lands.

Livestock compensation programs for losses due to wolf damage vary by state with some states compensating only for verified losses, and others compensating for both verified losses and unrecovered livestock. A study in Idaho documented that for every verified wolf depredation, there may be 7 to 8 head of cattle that were also depredated but never found or verified. Some states, therefore, make compensation payments at a ratio of 7 head for every one verified loss. Check state regulations for information on compensation payment programs.

Current compensation programs generally only consider direct losses from wolf predation, while indirect effects may be just as costly. The presence of wolves in an area may cause livestock to change their behavior, similar to changes in elk behavior following wolf reintroductions. Increased vigilance in livestock and less time foraging may cause livestock to lose weight, thereby reducing overall herd productivity which translates into reduced profit margins when selling. Other indirect effects include changes in weaning weights and conception rates, and increased cattle sickness. Producers have reported less weight gain in cattle and underutilized forage in pastures having high levels of wolf activity. The presence of wolves in an area may result in increased costs associated with livestock management, such as spending more time patrolling herds to keep wolves' away, locating kills, and potentially implementing increased nonlethal measures that were not necessary before.

Wolf damage estimates to livestock varies by state. For example, Minnesota has a well-established wolf population and control of wolves for livestock depredations has been quite consistent for several decades. Conversely, in neighboring Wisconsin, the wolf population has grown steadily since the late 1990s (Figure 17) with increasing depredations on livestock. The re-establishment of wolves grew rapidly following reintroduction and current populations in Montana, Wyoming, and Idaho are relatively constant with surplus animals dispersing into Oregon, Washington, California, Utah, and Colorado. Each state has or is developing wolf management plans for addressing their wolf populations based on the wolves' status (i.e., endangered, delisted, etc.), population size, and public attitudes.

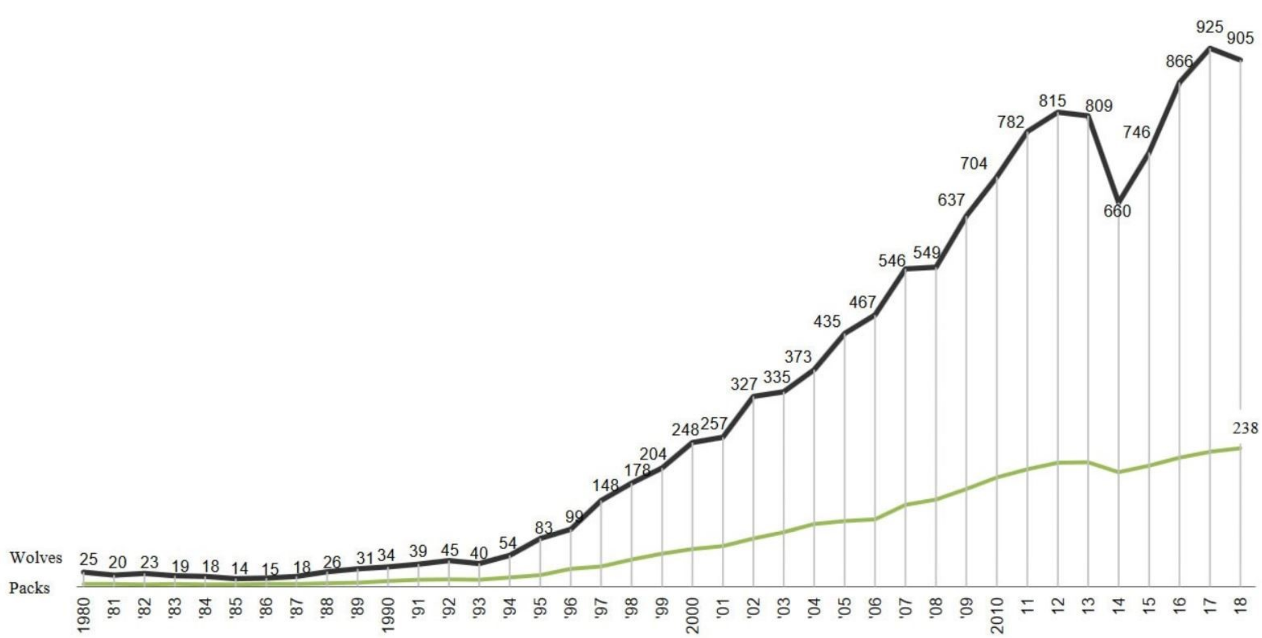

Figure 17. Wolf population numbers in Wisconsin, 1980-2018.

Most state and federal agencies recognize the need to manage wolf populations, particularly addressing livestock depredations. Educating the public on these needs and balancing the public attitudes towards lethal removal of wolves makes the situation controversial. The economics gained by some, at the expense of others, will continue to be debated as wolf populations expand into surrounding states.

Species Overview

Identification

The gray wolf belongs to the Canidae family in the genus Canis. With the help of advanced genetic analysis, there are currently four recognized subspecies of gray wolf in North America. These include:

- Arctic wolf (*Canis lupus arctos*) - endemic to the Elizabeth Islands, Canada
- Great Plains wolf (*Canis lupus nubilus)*
- Mexican wolf (*Canis lupus baileyi*)
- Northwestern wolf (*Canis lupus occidentalis*)

The red wolf (*Canis rufus*) is recognized as a separate species. Historically, the red wolf was found throughout the eastern United States from east Texas to Florida and as far north as Pennsylvania. Today, a small wild population resides in eastern North Carolina. Approximately 200 individuals are found in zoos and other captive facilities across the United States.

Physical Description

Canis lupus is the largest living canid. Males weigh from 44 to 175 lbs (20 to 80 kg) and females 35 to 120 lbs (16 to 55 kg), with larger individuals found further north. Although called the gray wolf, their pelage varies with some wolves having fur that is completely black, to the Arctic wolf which has fur that is completely white. In general, the pelage of gray wolves is tan or light brown mixed with brown, black, and white.

Figure 18. Range of wolves in North America as of 2018. Tan color indicates range of the gray wolf, while green color indicates range of the Mexican wolf in the southwest U.S. The range of the red wolf in northeastern North Carolina is not depicted.

Range

Historically, the gray wolf was found throughout Eurasia and North America except in the southeastern United States. Gray wolves can live in almost all types of habitats from tundra to forests and from deserts to swamps. Present distributions have been severely restricted and gray wolves are found primarily in Alaska, Canada, northern Minnesota, northern Wisconsin, Michigan's Upper Peninsula, and areas of Idaho, Wyoming, Washington, Oregon, Arizona, New Mexico, and Montana (Figure 18). However, wolves are currently expanding their range in the contiguous United States. Between 1995 and 1996, 31 gray wolves were reintroduced to Yellowstone National Park. In 2019, there was an estimated 60 wolves in the Park, but over 520 estimated in the Greater Yellowstone Ecosystem. Wolf packs have recently been found in northern California and northwestern Colorado.

Pack Structure and Function

Wolves are social animals that live in family-based groups or "packs" that have a linear-hierarchical social structure. The "alpha" male and female are the dominant individuals in a pack. All other wolves in the pack are subordinate. An individual wolf's social status within a pack can change over time and is determined by age, health, physical condition, and other factors.

Packs function as a unit that defends a specific area called a territory. While defense of the territory is mainly conducted by the alpha pair, all individuals undertake subtle defensive actions including scent marking and howling. Scent marking occurs mostly along territorial boundaries. Howling is used not only to communicate among pack members but also to inform neighboring packs of the resident packs' presence. The alpha pair are generally the only individuals to engage in direct attacks on encroaching wolves.

Reproduction

In general, the alpha pair breeds in January or February. Subordinate females occasionally breed and produce a successful litter.

After a gestation period of 62 to 63 days, a pregnant female wolf gives birth to an average of 6 young. Litter sizes range from 1 to 11 individuals. The young are born blind and are completely dependent on the mother during lactation, and on the pack for food provisioning once the young are weaned. Members of the pack feed the young by regurgitating food or indirectly by provisioning the lactating female. Young reach sexual maturity around 3 years old at which time they may disperse and leave the pack.

Dens and Rendezvous Sites

Pregnant female wolves give birth to young in a den where they remain for approximately 5 weeks. Although the young are mobile enough to move around, they stay relatively close to the den until they are approximately 10 weeks old and begin to learn about the social structure of the pack and hunting. When the young are approximately 10 to 20 weeks old, the pack leaves the den area and moves to a "rendezvous site" where there are numerous "nest" sites, trails and play areas. The rendezvous site (or sites) serves as a focal point for pack members to congregate and are often used through the summer months into early fall. When the young-of-the-year are large enough to travel with the adult wolves, the rendezvous sites are generally abandoned.

Mortality and Life Span

Wolves in the wild typically live 4 to 5 years, but there are reports of wild 11-year-old female wolves producing litters; although older female wolves may enter reproductive senescence before that age.

Wolves primarily die from accidents, disease, starvation, injuries from fights with other wolves, injuries from prey, and human-caused mortality. As densities of prey decrease, more wolves die due to starvation. Human-caused mortality is due to legal and illegal hunting and vehicle accidents.

The effects of pathogens and parasites on wolf populations is not well documented. In some wolf populations, 2 to 21% of wolf mortality was attributed to disease. The most common diseases of adult wolves are mange and rabies, with pups being susceptible to canine distemper virus and canine parvovirus. The transmission of diseases, such as canine parvovirus, from domestic dogs to wild wolves is a conservation concern. A study of serum samples from 387 wolves in Minnesota documented serologic exposure to eight diseases. Diseases included canine parvovirus (82% adults, 24% young), canine adenovirus (88% adults, 45% young), canine distemper virus (19% adults, 5% young), eastern equine encephalitis (3% adults), West Nile virus (37% adults, 18% young), heartworm (7% adults, 3% young), and Lyme's disease (76% adults. 39% young). Parasites were found in 15% of fecal samples examined. Mange and lice are also present in many wolf populations. There is no reported relationship between prey density and the incidence of disease in wolf packs.

Population Status

As of 2019, stable wolf populations exist in many regions in the U.S., including Alaska, Minnesota, Wisconsin, Michigan, Wyoming, Montana, and Idaho, with growing populations in parts of Oregon and Washington (Figures 19, 20). Wolves have recently been documented in northern California and northwestern Colorado. A small population of introduced Mexican wolves exists in Arizona and New Mexico, and a small population of red wolves exists in eastern North Carolina. Both the Mexican and red wolf populations are considered more vulnerable to extinction than other North American wolf populations.

Food Habits

As obligate carnivores, wolves eat primarily meat. Their main prey includes large ungulates, such as moose, deer, and elk. In Alaska, wolves also prey upon caribou and musk oxen. Beavers are an important seasonal food source in some locales. Occasionally, wolves eat small mammals or scavenge on carcasses. While wolves are more successful hunting vulnerable prey (i.e., small, young, or old individuals that are easy to catch), they are opportunistic hunters, pursuing prey whenever the chance arises. However, successful capture of prey is often very low.

Voice and Sounds

Gray wolves make a variety of sounds, including barks, growls, howls, whimpers, whines, and yelps. Whines, whimpers and yelps indicate submissiveness, distress or friendly behaviors, while growls and barks suggest dominance or aggression. While most vocalizations are used to communicate over short distances, howls can carry over long distances and are used to communicate between packs or to members within a pack who are separated from each other. Although the specific purpose of howls is not clear, it is thought that howling aids in the coordination of movements among pack members, and facilitates spacing among packs, social bonding among pack members, and mating.

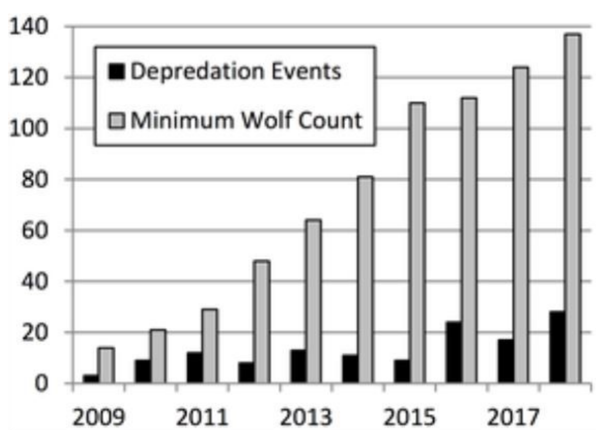

Figure 19. Minimum number of wolves and number of depredation events in Oregon, 2009-2018.

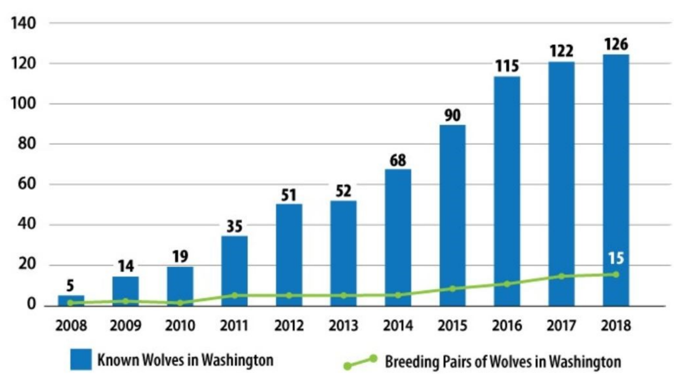

Figure 20. Known number of wolves and number of breeding pairs in Washington, 2008-2018.

Tracks and Sign

Although adult wolves, adult coyotes, and large dogs have four symmetrical toes on the front and hind feet, adult gray wolf tracks are much larger and distinguishable by their more oval shape and forward pointing middle toes (Figure 21). Other wolf signs include scat, urine deposits, and scratch-ups (scratches on the ground), which are generally thought to be territorial boundary markers. Wolf kills are characterized by massive trauma and large tooth marks usually on the hindquarters or flanks.

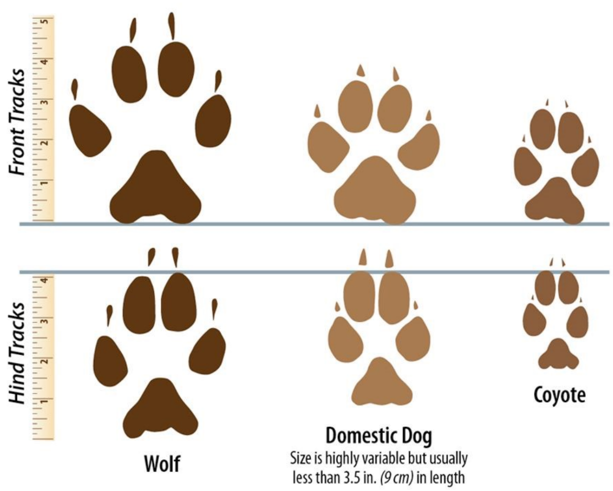

Figure 21. Track sizes of a wolf, domestic dog, and coyote.

Legal Status

The legal status of wolves varies from state to state. For example, in California the gray wolf is protected as an endangered species under both the California and federal Endangered Species Acts. In Wyoming, gray wolves are delisted and managed by the state. In North Carolina, the red wolf is protected as a federally listed endangered species.

The legal status of many wolf populations remains in flux as opposition to delisting in some states is challenged in the courts. Check the legal status of wolves in the state prior to implementing any management methods.

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Figure 1. Photo by Eric Gese, USDA-APHIS Wildlife Services
Figure 2. Graph from Montana Fish, Wildlife, and Parks
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Figure 5-9, 14. Photos by USDA-APHIS Wildlife Services
Figure 10. Photo by Julie Young, USDA-APHIS Wildlife Services
Figure 16. Photo by Len Fortunato Courtesy Heather Thomas
Figure 17. Graph from Wisconsin Department of Natural Resources
Figure 18. Graph from 2018 IUCN Red List, *Canis lupus*
Figure 19. Graph from Oregon Department of Fish and Wildlife
Figure 20. Graph from Washington Department of Fish and Wildlife
Figure 21. Drawing by David Moskowitz; http://westernwildlife.org/gray-wolf-outreach-project/signs-of-wolves/

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Glossary

Alpha: The highest ranking individual in a social group. Other animals in the same social group may exhibit deference or other species-specific subordinate behavior towards the alpha or alphas.

Carnivore: Animal whose diet mainly consists of meat.

Depredation: The act of consuming agricultural resources (i.e., crops or livestock).

Fladry: A simple, nonlethal tool used to prevent livestock predation. It is a temporary fence, consisting of a line of brightly colored flags hung at regular intervals along the perimeter of a pasture.

Nontarget Species: Animals inadvertently or unintentionally impacted by a management action.

Territory: The area a wolf pack resides in and actively defends from other intruding wolves.

Ungulate: A hooved, plant-eating mammal, such as an elk, moose, sheep, cow or horse.

Keywords

Canids, *Canis lupus*, Depredation, Fladry, Guardian animals, Livestock, Snares, Traps, Wolves

Disclaimer

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Some methods mentioned in this document may not be legal, permitted, or appropriate in your area. Read and follow all pesticide label recommendations and local requirements. Check with personnel from your state wildlife agency and local officials to determine if methods are acceptable and allowed.

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Appendix

Damage Management Methods for Gray Wolves

Type of Control	Available Management Options
Animal Husbandry	• Carcass removal and disposal • Herders/shepherds/"Range Riders" • Night penning and shed lambing • Pasture selection • Synchronized birthing
Exclusion	• Woven-wire and electric fencing • Corrals • Fladry/Turbo-fladry
Fertility Control	No fertility control agents available
Frightening Devices	• Less-Than-Lethal Munitions • Radio Activated Guard and Motion Activated Guard • Strobe lights and noise makers
Guarding Animals	Livestock protection dogs, donkeys, llamas, and other guarding animals
Repellents	No effective chemical repellents available
Shooting	May require use of non-toxic/non-lead ammunition; Allowed with proper Federal and State permits
Trapping	Foothold traps, cable restraint devices; Allowed with proper Federal and State permits