WESTERN LANDOWNERS ALLIANCE
STEWARDSHIP WITH VISION

# REDUCING CONFLICT
## WITH GRIZZLY BEARS, WOLVES AND ELK

*A Western Landowners' Guide*

NATIONAL GEOGRAPHIC

GEORGE B. STORER FOUNDATION

Partners for Fish & Wildlife

25 BLACKFOOT CHALLENGE
Celebrating 25 Years of Partnerships

HEART OF THE ROCKIES INITIATIVE
A Land Trust Partnership

Cover Photo: Lava Lake Land & Livestock

Inside Cover Photo: Melanie Elzinga

# REDUCING CONFLICT WITH GRIZZLY BEARS, WOLVES AND ELK

## *A Western Landowners' Guide*

Western Landowners Alliance is deeply grateful for the landowners and ranchers, resource managers and others listed below whose collective knowledge and hands-on experience created the substance of this guide. This guide is a compilation of contributions from each of these individuals—a resource created by landowners, for landowners.

### Contributors

Rick Danvir, Lesli Allison, Hilary and Andrew Anderson, Bryce Andrews, Anis Aoude, Matt Barnes, Brian Bean, Jeff Bectell, Gary Burnett, Mark Coats, Jonathan Costa, Jessica Crowder, Wyatt Donald, Glenn and Caryl Elzinga, Jeremy Gingerich, Greg and Karen Hertel, Chase Hibbard, Carrie Hunt, Gus Holm, Heather Johnson, Erik Kalsta, Race King, Cody Lockhart, Hallie Mahowald, Cole Mannix, David Mannix, Doug McWhirter, Michel Meuret, Arthur Middleton, Abby Nelson, Greg Neudecker, Dean Peterson, Mike Phillips, Virginie Pointeau, Steve Primm, Fred Provenza, J. D. Radakovich, Nelson Shirley, Albert Sommers and Cat Urbigkit.

WESTERN LANDOWNERS ALLIANCE
STEWARDSHIP WITH VISION

Published by Western Landowners Alliance
PO Box 6278, Santa Fe, New Mexico 87502
Westernlandowners.org

All photos credited where appropriate. Non-credited photos were purchased under a royalty-free license agreement.

First edition, first printing: December 2018

Design: BadDog Design, Santa Fe, New Mexico

Printing: Starline Printing, Albuquerque, New Mexico

Photo: ML Haring

# REDUCING CONFLICT WITH GRIZZLY BEARS, WOLVES AND ELK

## *A Western Landowners' Guide*

This guide has been produced by and for landowners and practitioners constructively engaged in one of the greatest conservation challenges of our time—how to share and manage a wild, working landscape that sustains both people and wildlife.

Western Landowners Alliance is deeply grateful to the many individuals and organizations that have made this guide possible. The knowledge and insight offered here have not been lightly earned. Each of the contributors brings a wealth of real-world and often hard-won experience in ranching and wildlife management. Some ride daily among grizzlies. Others spend nights on the range among wolves. Out of necessity and interest, they are innovators and close observers of wildlife, livestock and people. They know first-hand the difference between what looks good on paper and what works on the ground.

The resources and best management practices in the guide have also been developed and informed by dedicated researchers, wildlife agencies and nonprofit organizations, a number of which are referenced in this guide. From the landowner perspective, these groups deserve great credit and credibility for seeking out solutions that work for both people and wildlife.

Western Landowners Alliance is indebted to National Geographic Society for making this project possible, and to the wise guidance and unfailing support of Rick Danvir, a founding member, advisor and the principal author of this guide. Rick spent 30 years as a wildlife biologist and manager for the Deseret Ranches, where he pioneered many strategies to integrate wildlife conservation and profitable ranching.

This guide will be successful if the knowledge and perspectives it contains help reduce conflict and prevent losses of both livestock and wildlife. We hope also that it will open new ways of thinking and of relating to land, wildlife and one another.

Lesli Allison
*Executive Director*
*Western Landowners Alliance*

# Introduction

Historically, the relationship between ranchers and large carnivores—native predators capable of killing and eating livestock—in the western United States has been predominantly adversarial. Ranchers and, more recently, government-sponsored programs employed poisoning, trapping, culling, shooting and eventually aerial gunning to reduce predator numbers and conflict.

As a result of these efforts, the gray wolf was extirpated in the lower forty-eight states and the grizzly bear (brown bear) was reduced to a small population in the Northern Rockies. Black bear and mountain lion (cougar) fared better, maintaining populations in most western states. Coyotes fared best, seeming to thrive in the face of persecution, nearly doubling their range to inhabit the eastern as well as western United States.

Curtailed use of poisons, better management by state wildlife agencies and recovery efforts through the Endangered Species Act (ESA) have expanded the ranges and increased the abundance of all five of these large carnivore species. The ESA has been effective for several of these species; as a consequence of federal listing and recovery efforts, wolf and grizzly bear management is being returned to state wildlife agencies, along with that of black bears and mountain lions. Without ESA

Photo: Jonita Sommers

protections and despite the fact that coyote hunting is largely unregulated, coyotes are thriving both in the wild and in urban settings across the country.

The recovery of large ungulates—native hoofed grazers and browsers—including Rocky Mountain elk (hereafter, elk), is also a conservation success story. Elk were once hunted until only a small population remained within Yellowstone National Park, but thanks to efforts by nonprofit organizations (NGOs) and state wildlife agencies, they have repopulated the western states and several eastern states as well. Other large ungulates that were similarly over-hunted by the turn of the century, including bison, bighorn sheep, mule deer and pronghorn, have also recovered to varying degrees.

Photo: Jonita Sommers

As populations of elk, wolves and grizzly bears have increased in the West, conflicts with rural farmers, ranchers and other landowners have also increased. Agricultural challenges from elk and other ungulates include crop depredation, forage competition and disease concerns. Wolf conflict primarily involves livestock depredation. Bears (both grizzly and black) are omnivorous and attracted to a wide range of food sources. When grizzly bears' wide-ranging foraging habits bring them in contact with humans, safety becomes a concern. Grizzly bears may aggressively defend cubs and food sources from perceived threats.

> "Keeping ranching economically viable is the best way to keep wildlife habitats connected and available for wildlife. Working ranches are generally a better place for big wildlife species than in housing developments."
>
> *—Wyoming rancher and state legislator Albert Sommers*

What is the role private lands and ranchers play in maintaining habitat for populations of large carnivores and ungulates? Why should these animals have to co-exist with farmers, ranchers or other rural landowners? Because much of the land that once provided continuous wildlife habitat in the valleys and foothills of the Rockies has been developed into cities, towns and residences, the remaining lower elevation, intermixed private and publicly owned working lands provide important seasonal habitat and key migration corridors. Despite the conflicts with rural agriculture, large carnivores and ungulates are generally better suited to rural working lands than to urban or residential areas. The private and publicly owned working landscapes of the American West are the last best place—indeed perhaps the last chance—for these large species to exist in the lower 48 states.

Wyoming rancher and state legislator Albert Sommers explains it this way:

*It is so important for people to understand the critical role private ranches play in connecting landscapes together. We need to support programs like the Farm Bill to help private ranchers with conflict mitigation practices, fence modifications and conservation easements. For their part, ranchers need to learn what wildlife need on the landscape they are stewarding. Big game migrations wouldn't exist without ranching as an industry that maintains open space. If you have land churn (a high rate of ownership turnover) in the marketplace, it's less likely that the landscape will remain intact. Keeping ranching*

*economically viable is the best way to keep wildlife habitats connected and available for wildlife. Working ranches are generally a better place for big wildlife species than in housing developments.*

Winter in the Northern Rockies is tough for both domestic and native ungulates. Stockpiling forage, whether in bales or in pasture, is essential for maintaining livestock until grass grows again the following year. However, stockpiling forage for fall, winter and spring use isn't possible if elk consume it all. Too many elk can greatly reduce a producer's flexibility and profitability. When elk are trailed to their winter grounds by wolves or when they are carriers of brucellosis, the risks to producers are compounded. Similarly, getting cattle off irrigated meadows and out on range away from the home ranch isn't economically feasible if the young calves are eaten by grizzly bears and wolves. Livestock depredation by carnivores impacts producers' profitability, together with their ability to maintain and manage their associated private lands.

Federal and state regulation has played a key role in the conservation of large carnivores and ungulates in the western United States. At the same time, ongoing collaborative efforts between producers; landowners; local, state and federal governments and agencies; and NGOs are also needed to sustain their populations by mitigating conflict and integrating wildlife and agriculture on western working landscapes. Locally based, collaborative working groups comprising diverse interests are effective in developing and communicating sound solutions, drafting policies and securing funding assistance for conflict mitigation. Producers and landowners are proactively testing and implementing new technological solutions as well as dusting off old tricks. They are learning from and sharing knowledge with their Old World counterparts, some of whom have continuously farmed and herded livestock among wolves and bears for centuries. While not universally effective, in many cases practices such as carcass removal, electrified crop fields and calving pastures, livestock guardian dogs, range riding, livestock herding and predator removal have significantly reduced conflict.

This guide is a compilation of landowner contributions acquired through one-on-one interviews, landowner meetings and group discussions hosted by Western Landowners Alliance (WLA) in 2017–2018. Contributors describe the use and assess the effectiveness of wildlife conflict mitigation strategies and practices. Additional web and print resources are referenced to provide more in-depth information where necessary.

The ranchers' and farmers' practices and lessons learned presented here include the value of collaborative discussions, real listening and developing shared goals with other groups and individuals interested in the conservation of large carnivores and ungulates. They are intended to help owners and managers of private working landscapes reduce conflict and coexist with large wildlife by 1) summarizing scientific understanding of key aspects of ungulate and carnivore ecology and behavior; 2) summarizing conflict mitigation strategies, tactics and programs available to landowners; and 3) assessing their effectiveness through interviews and case studies. Contributing landowners and others share their thoughts on the effectiveness of strategies and programs and discuss additional knowledge, policy and funding needs. The guide also describes and references some of the programs available through state wildlife agencies and NGOs to provide assistance, incentivize coexistence and reduce conflict.

WLA offers this guide to help ranchers, farmers and other private land managers better understand the approaches and practices currently used by fellow landowners to reduce carnivore and ungulate conflict. We hope that it will help inform discussions to improve policies and funding for conflict mitigation. As landowners, we believe that the successful conservation of large carnivores, ungulates and working landscapes are closely linked—wildlife and rural livelihoods equally depend on healthy working landscapes.

# Table of Contents

Anderson Ranch, Montana. Photo: Louise Johns

## Large Carnivores



## Elk and Other Ungulates



## Stories



# Wolf Ecology and Behavior

## *Reproduction and Pack Size*

The pack is the social unit of a wolf population. A pack generally includes a single breeding pair and their current year's pups, often additional nonbreeding related members from prior litters (yearlings and two-year-olds) and, occasionally, unrelated wolves. Wolf abundance and pack size depend primarily on prey availability, prey vulnerability and human tolerance. Wolf density (the number of wolves within a given area, e.g. wolves/1000mi$^2$) depends primarily on ungulate density (Mech and Boitani 2003). The size of a particular pack is usually estimated in winter when wolves are most visible.

Although few wolves live longer than 4–5 years, a breeding pair may begin producing offspring at two years old and continue producing pups annually in their territory for up to 8–12 years. Litter size and pup survival varies with prey availability. Increasing prey abundance leads to increased pup production, with new pairs forming and attempting to establish new territories within existing occupied areas. Packs in areas of abundant prey may produce several dispersing, one- and two-year-old young each year. A pack of nine wolves may raise six dispersing pups a year (Mech and Boitani 2003). New packs are established in suitable unoccupied areas by wolves dispersing from packs—generally along the fringes of existing packs but also pioneering into new, unoccupied areas. A dispersing wolf is generally looking for three things: a mate, food resources and an exclusive territory (Mech and Boitani 2003).

Dispersal rates tend to be higher in areas with few wolves and abundant prey than in areas with high wolf densities and relatively less prey per wolf. The relatively large annual litter sizes produced in areas with abundant prey enable wolf populations to increase quickly when colonizing unoccupied areas with abundant prey or following heavy wolf mortality. Following harvest or control, it is common for wolf numbers to recover within a few years after hunting stops, due to immigration and recolonization by dispersers from adjacent areas (Mech and Boitani 2003).

There is evidence that wolves hunting large prey, such as elk, can support larger packs than wolves hunting small prey species. Studies suggest that the average gray wolf pack size ranges from 3–11 wolves. However, any given pack may range from two to dozens of members as prey density increases or decreases. While pack size may decrease as prey declines, the now smaller pack may continue to defend and hunt within the original territory (Mech and Boitani 2003).

Wolves generally hunt by getting their prey to run and then attacking. Prey selection depends at least partially on the age, size and condition (health) of the prey animals. In the Northern Rockies, the vulnerability of elk and other ungulates to wolf predation is significantly influenced by winter snow conditions. Long periods of deep snow can increase prey vulnerability and also increase ungulate starvation losses. Therefore, prolonged periods of deep snow can improve wolf survival and condition in the short term, when prey are easier to catch and kill, but decrease wolf abundance in the long term, if prey populations are reduced following severe winters (Mech and Boitani 2003).

Human tolerance for wolves ultimately affects wolf abundance, social structure and pack composition. Causes of wolf mortality in unhunted areas include starvation, disease (such as canine parvovirus) and injury or death resulting from interactions with prey, grizzly bears or other wolves. Established wolf packs are generally intolerant of territorial intrusions by adjacent packs or other non-pack members, and this can result in aggression and death (Mech and Boitani 2003).

Pack composition may be more fluid and changeable in hunted populations than in unhunted populations. Killing members of established packs can create opportunities for unattached, often younger dispersing wolves to join surviving pack members or to establish new packs. Hunting creates opportunities for otherwise nonbreeding wolves when territories become vacant or fragmented as the result of the deaths of wolves in breeding pairs. Heavy harvest of wolves by humans may result in increased immigration, more breeding pairs, smaller packs and greater pup production than pre-harvest (Mech and Boitani 2003). A contributor related a relevant experience in Wyoming:

*Wolves might eat elk for a month, then kill a few cattle, then switch to something else. They're not as persistent cattle killers as grizzlies in our country. If you get an alpha female wolf not interested in killing cattle, for Pete's sake don't kill her. An alpha female that wasn't a cattle killer was inadvertently removed and replaced by a female who was a cattle killer. So livestock predation increased.*

Another contributor summed it up as, "The wolves you know are better than the wolves you don't."

## Colonization

Wolf repopulation of unoccupied areas can occur fairly rapidly. In northwest Montana, wolf numbers increased from the nine or so founders observed in the early 1980s to 70 wolves by 1996. Colonizing populations in Michigan and Europe increased at rates of 30–50 percent annually. The biological potential for rapid increase, coupled with abundant prey, allows wolf populations to more than double every two years. Even in the case of severe wolf reduction efforts, adjacent dispersing wolves soon fill the food-rich, wolf-poor void. They form breeding pairs, start having pups, and can refill an area in 2–4 years (Mech and Boitani 2003). Barring the use of poison, the persistence of currently occurring wolf populations is nearly assured.

## Territoriality and Seasonal Migration

Wolf packs are generally territorial. Wolves in areas of flatter terrain, with prey that seldom migrate seasonally, defend fairly well-defined territories year round. Wolves in areas where ungulates migrate from mountainous summer range to winter in the valleys, as is common in the Rocky Mountains, may move seasonally with their prey. The wolves may remain territorial, but the territories shift. In Yellowstone National Park, wolf packs maintain different territories in summer and winter (Mech and Boitani 2003).

Contributors observe that in winter wolves are generally "packed up," meaning that pack members travel together in large groups. However, in the summer, when the alpha female is denning and other pack members are bringing provisions to her and the pups, pack members often hunt singly or in small groups rather than as one large pack. "A group of predator-experienced cattle encountering 1–2 wolves on suitable terrain has a reasonable chance of bunching up, standing their ground and aggressively defending themselves," explains Hilary Anderson.

# Grizzly Bear Ecology

## *Reproduction*

Bears mate in June and July but exhibit a behavior called "delayed implantation." After fertilization, embryos delay developing or implanting in the uterus until winter.

# and Behavior

Whether implantation occurs depends on whether the sow builds sufficient fat reserves to survive the winter and grow and suckle cubs. If fall food resources are poor, the embryos may fail to implant and no cubs are developed. If resources are adequate, embryos implant and 1–3 cubs are born mid-winter in the den. Newborns are very small (less than a pound), as if premature, and in a sense, the den functions as a second womb as they suckle through the remainder of the winter. The denned sow produces milk by metabolizing stored fat; she drinks no water until leaving the den in spring.

In contrast to wolves, grizzly bears have a very slow reproductive rate. Sows in the Northern Rockies generally don't reach sexual maturity and breed until 4–5 years of age, giving birth to litters of 1–3 cubs. Cubs may remain in the female's care for up to three years, and the female doesn't mate again until her litter has dispersed. Consequently, female grizzly bears may only produce 1–2 litters, and only 1–3 female offspring in their first 10–12 years of life. This is one reason grizzly recovery efforts have proceeded slowly and why it is important to avoid habituating bears to human food sources resulting in the need for lethal control. Populations cannot sustain heavy mortality, and habituation to humans as a food source is dangerous to humans and generally fatal to bears.

## Territoriality

Bears do not form lasting pair bonds; they pair up only for breeding. Males tend to wander across large home ranges that may overlap those of other males. Smaller or less aggressive bears minimize confrontation by avoiding larger or more aggressive males. Bears can communicate their whereabouts through scent marking.

Female bears, especially those with cubs, tend to be seasonally territorial, intolerant and sometimes aggressive toward any perceived threat, but their territories are often nonexclusive. Related females and other known bears may be tolerated when food is abundant and conflict can be minimized through avoidance. Unlike wolf territorial behavior, which tends to keep packs dispersed across the landscape, bears from a broad area may congregate in very high densities in small areas of abundant wild or manmade foods. They may become more tolerant of each other, as long as the abundant food supply lasts. (In these ways bears' territorial behavior is similar to that of mountain lions.)

## Feeding

Bears are omnivorous and constantly on the lookout for high-protein, high-energy foods from a wide variety of permanent and seasonal, natural and manmade sources. They seek out garbage, pet foods, bird seed, grain crops, livestock feed, apple orchards, bee hives, cabin pantries, campground picnic baskets, small mammals, insects, grasses and forbs, nuts and berries, fish, tree cambium, carcasses, newborn ungulates and livestock on summer grazing allotments. They have evolved *hyperphagia*—the regular consumption of large quantities of highly nutritious foods prior to denning for the winter—and can double their weight in a short time on good food sources.

Bears emerge from hibernation hungry, and winter-killed carcasses are one of the first foods they may seek in the spring, often returning to areas where they have found carcasses in the past. As newborn ungulates (wild or domestic) become available, bears may congregate and hunt them; however, wild ungulate calves become too quick and mobile for bears to capture within a few weeks of being born. Most bears in the western U.S. then forage on vegetation, insects and smaller animals until fish spawning runs occur or mast crops (nuts and berries) begin to ripen.

Bears can be very aggressive toward other bears and other species, including humans, when guarding a carcass or other food source, which sometimes results in human injury or death. Contributors stressed safety training when living near grizzly bears. As Jeff Bectell explains,

> *Any interaction with a bear can be potentially dangerous. The WBR [Waterton Biosphere Reserve] conducts bear safety workshops for farm and ranch families, from the youngest to the oldest. These workshops are intended to teach people about bears, how to read bear behavior, ways to prevent or avoid conflict and proper use of bear spray, including practicing with inert spray. Some participants are skeptical at the start, but the response by the end has always been positive, including acknowledging the value of bear spray as a safety tool.*

Once bears have learned to access a nutritious food source, it is very difficult to break them of the habit or change their behavior. One contributor noted, "wolf behavior is totally different than bears'. They pack up and control a territory, so by and large you are dealing with one pack. Bears, on the other hand, will crowd into an area. If they recognize calves are a predictable seasonal food source, they will pull in from a long ways out and concentrate."

Carrie Hunt, from the Wind River Bear Institute, and Cat Urbigkit, a Wyoming author and sheep rancher, both stress the importance of early and aggressive intervention when attempting to stop bear depredations. If the intervention is early and significant, depredating behavior may sometimes be altered. However, bears are persistent, sometimes just one taste of stored grain, calves or campground fare results in a persistent behavior that is nearly impossible to change.

The adage, "A fed bear is a dead bear," is unfortunately often true. It underscores the message that the best way to avoid human-bear conflicts is to consistently avoid making attractants available. To a lesser degree, this also applies to mountain lions, coyotes and wolves.

# Development of Conflict Management Programs

Conflict management strategies and practices currently in use in the Rockies include a mix of old and new.

The strategy of removing or fencing attractants has been used by landowners dealing with deer, elk and black bears across the United States for many years. On larger landscapes, herders, herding and livestock guardian dogs (LGDs), in combination with targeted lethal control and hunting, have been effective at reducing domestic sheep depredation by coyotes, black bears and mountain lions for decades. Some of these techniques have been adapted to manage conflict with wolves and grizzly bears, as well.

> "We need to embrace these opposing mentalities, both of which are necessary in thoughtful application on this dynamic landscape."
>
> *—Montana rancher and wildlife biologist Hilary Anderson*

In parts of Europe, Asia and Africa, nomadic herders have used similar practices for centuries to protect their livestock from a variety of large carnivores, including wolves and brown bears. Since wolves and brown bears were not eradicated in parts of the Old World, herding and breeding effective LGDs are part of rural culture. In many of these countries, pastoral herders, domestic livestock grazing, native ungulates and large carnivores are all considered part of the natural landscape.

Contributors to this guide emphasized the importance of a proactive approach to conflict management. As southwest Montana rancher and wildlife biologist Hilary Anderson explains,

*Responding proactively or reactively is as much a matter of mentality as it is a tangible action. In order to be proactive, one has to be in the mindset of managing for what we want. When responding reactively, one is usually in the mindset of managing for what we don't want. In the example of wolf predation, a proactive approach would be to manage for healthy cattle working as herd units, while a reactive approach would be to manage for fewer wolves.*

Rather than immediately reacting negatively when confronted with carnivores, Anderson continued, "we need to embrace these opposing mentalities, both of which are necessary in thoughtful application on this dynamic landscape." In this approach, achieving proactive management goals may require wolf removals, among other things, but lethal control would be used as a means of balancing the long-term ecological and economic health of wildlife populations and rural communities.

# Waterton Biosphere Reserve's Carnivores and Communities Program

The Waterton Biosphere Reserve's (WBR's) Carnivores and Communities program operates in four municipalities, two of which are within the boundaries of the Waterton Biosphere Reserve in Canada.

The program focuses on proactive management to decrease conflict between people and carnivores, especially bears and wolves, within the agricultural community of Southwestern Alberta. It is well funded and effective, and it is a major WBR program.

Securing attractants or removing them from bears is a primary emphasis of the program, which includes educational, technical and cost-sharing components. As Jeff Bectell, who leads the Carnivores and Communities program, explains,

> *In southwestern Alberta, the primary agricultural attractants for large carnivores include dead livestock (deadstock), granaries, bee yards, livestock and calving areas. Current attractant management projects include removing dead livestock from the landscape, making grain and feed storage facilities more secure and installing electric fencing to keep carnivores away from other attractants. We work with agricultural producers and rural landowners to decrease conflict on both private and public land.*

The program has been effective. The proactive approach to conflict management sheds a favorable light on agriculture, as well. Landowners have felt more support from both government agencies and conservation groups, not just in terms of program funding, but also in terms of managing problem wildlife. A major long-term goal is to secure a dependable funding source for cost-sharing conflict mitigation practices and predator compensation programs.

The Carnivores and Communities program has also produced technical guides designed to support landowner efforts to reduce conflicts with large carnivores. These guides are available in PDF format or by contacting WBR:

- WBR Carnivores and Communities Technical Guide: *Deadstock Removal Program*
- WBR Carnivores and Communities Technical Guide: *Electric Fencing*
- WBR Carnivores and Communities Technical Guide: *Securing Your Grain Storage*

Photo: Louise Johns

# Issues, Strategies and Practices

Contributors report that the principle carnivore predation issue facing producers is the killing of smaller livestock, specifically domestic cattle-calves and sheep of all ages.

Adult cattle, horses, dogs and other animals are also predated, but much less frequently. Because wolves co-occur across most of the grizzly bear range in the American West, many practices useful for managing wolf conflict also work for grizzly bears. Contributors report that carcass removal, electric fencing, human presence, range riders and LGDs are effective ways to deter both wolf and grizzly bear predation.

## The Importance of Collaboration

Contributors consistently stressed the importance of collaboration in conflict reduction. The collaborative process is key to understanding and success. Collaborative discussion requires a positive attitude, respectful listening and compromise, and some collaborative groups enlist facilitators to assist with the process. Although participation in discussion groups comprised of landowners, agencies, NGOs and other stakeholders can be a slow, time-consuming process, it offers an opportunity for landowners to learn, be heard and incorporate their concerns into the development and adoption of practices and policies. According to Dean Peterson from the Big Hole Watershed Committee in Montana, "We have found solutions through collaborative problem solving with MFWP (Montana Fish, Wildlife and Parks) by sitting down and focusing on the 80 percent of issues we can agree on."

Policies and programs developed with broad participation from diverse interests can then be promoted, supported and defended by the broad coalition that developed them. This kind of collaborative approach may better withstand legal challenges to policies and practices because it was developed and endorsed by diverse interests. Peterson explained the need to "develop a plan, make it happen, monitor the results, re-plan and try again. There are no silver bullets." Different circumstances in different locations sometimes require unique solutions.

The Blackfoot Challenge, a collaborative group in the Blackfoot Watershed near Missoula, Montana, was already in place when wolves and grizzly bears became a local challenge. This group of ranchers, environmentalists, agency personnel and other interested citizens had come to realize that they could solve complex issues as a group by listening to one another and developing broadly supported solutions. They applied this process to solving wolf and grizzly bear conflicts. As David Mannix, a producer in the Blackfoot Watershed, explained, "The thought of federally protected wolves moving into the valley was really troubling to local ranchers. However, the wolf depredations weren't as bad as I had expected early on, even with wolves denning on our summer range."

Contributors agree that real, lasting solutions must work for both wildlife and ranching and need to be applied at a landscape scale. Landowners also point out that with public agency budgets declining, agencies and landowners need to partner to be effective. Landowners and partnering organizations should define success collaboratively and work together to develop long-term goals. Contributors also stress the need to work closely with state and federal land and wildlife managers to allow increased grazing management flexibility and implementation of nonlethal conflict management practices on leased public land.

Accurately reporting livestock losses is necessary in order to assess the effectiveness of practices and to develop compensation programs and population management goals. Producers need boots on the ground to monitor livestock losses and predator activities. Producers in the Waterton Biosphere Reserve (WBR) Carnivores and Communities program cooperated with Alberta Provincial Fish & Wildlife (AF&W) staff to compile records of conflict incidents, including sightings; livestock, bee and grain losses; and physical encounters between people and carnivores (mauling and shootings).

Has collaboration improved ranchers' lives and their relationships with agencies and NGOs? Contributors to this guide say it is essential. On-the-ground tours with agencies and other interest groups have improved understanding and relationships. WBR found that by making the public and AF&W officials aware of the increasing trend in grizzly bear conflicts, public attitudes and agency behavior changed. As a result, recorded grizzly bear conflict incidents in 2015–2017 were only half those recorded in 2010–2014. Contributors are increasingly asked to share their experiential knowledge of ways to reduce conflict with universities, agencies and other practitioners.

## Conflict Management at Smaller Scales

Conflict management strategies for smaller acreages include removing or fencing predators away from attractants (such as carcasses, livestock or crops) and a variety of nonlethal predator deterrents (Bangs et al. 2006, pp. 7–16). Nonlethal deterrents generally include loud noises or electric shock, or they are designed to exploit predators' fear of and tendency to avoid human activity and unknown (or novel) stimuli. Deterrents relying on noises, lights or movements can be effective for short time periods. Contributors found that although predators eventually habituate to these deterrents, their effectiveness can sometimes be extended by using a variety of different practices and changing or rotating them over time.

Compost pile. Photo: Blackfoot Challenge

### Carcass Management

Carcass management generally involves the removal of carcasses from the vicinity of livestock calving operations to a fenced composting area away from livestock. Carcass removal programs are a relatively new practice, developed and operated by place-based collaborative groups such as Blackfoot Challenge, WBR and the Big Hole Watershed Committee for participating landowners in their areas.

Removing and properly disposing of livestock carcasses is an effective conflict reduction practice for bears and wolves, as both predator species are drawn to them. Contributors consistently report reduced wolf activity after removing carcasses from winter areas and calving pastures, especially if the areas are near human habitation. Carcass piles or pits near livestock feeding or calving areas are like ringing a dinner bell for predators and scavengers. As noted by David Mannix, "Bone piles really attract wolves and grizzly bears, and unfortunately bone piles are usually close to home-ranch calving areas. This has been confirmed by radio telemetry data. It seems to be a bigger deal with bears than wolves, but both can be attracted."

Carcass. Photo: Blackfoot Challenge

Groups like the WBR and Blackfoot Challenge realized this early on and began cooperatively picking up carcasses from area ranchers and hauling them to central, fenced composting areas. WBR's Jeff Bectell reports:

> *Removing or securing attractants such as carcasses, beehives and stored grain to reduce bear conflict is a major goal of the WBR Carnivores and Communities program. The carcass removal program alone cost $60,000 in 2017, with about 100 participating landowners. Some WBR landowners reported that simply removing carcasses solved their depredation problems. These were the ranchers living out on the prairie, away from the riparian habitat and travel corridors frequented by bears.*

Blackfoot Challenge runs a carcass pickup service in which most local landowners participate. The program is funded from a variety of sources, including landowner contributions. Participants report the program has reduced depredation losses. Removing carcasses, rather than piling them up at a home-ranch dead pit, has changed movement patterns of both wolves and grizzly bears in the area. In addition, carcass pickups help in determining whether a calf was actually killed or simply dragged out of the bone pile and consumed, leaving remains that look like a kill.

The Big Hole Watershed Committee carcass removal program has also helped reduce livestock depredation. Funded by participating landowners and other sources, a wildlife technician is on-call from late February through late May to remove livestock carcasses. Carcasses are loaded by the landowner into a small dump truck and driven by the technician to a fenced composting facility located away from livestock operations. The goal is to remove any carcass within two days of notification from landowners. After a year, only bones remain of the carcasses.

## Electric Fencing

Electric fencing creates an effective barrier for livestock and wildlife by incorporating voltage that delivers a shock upon contact. The shock's specific voltage can be adjusted as needed. Electric

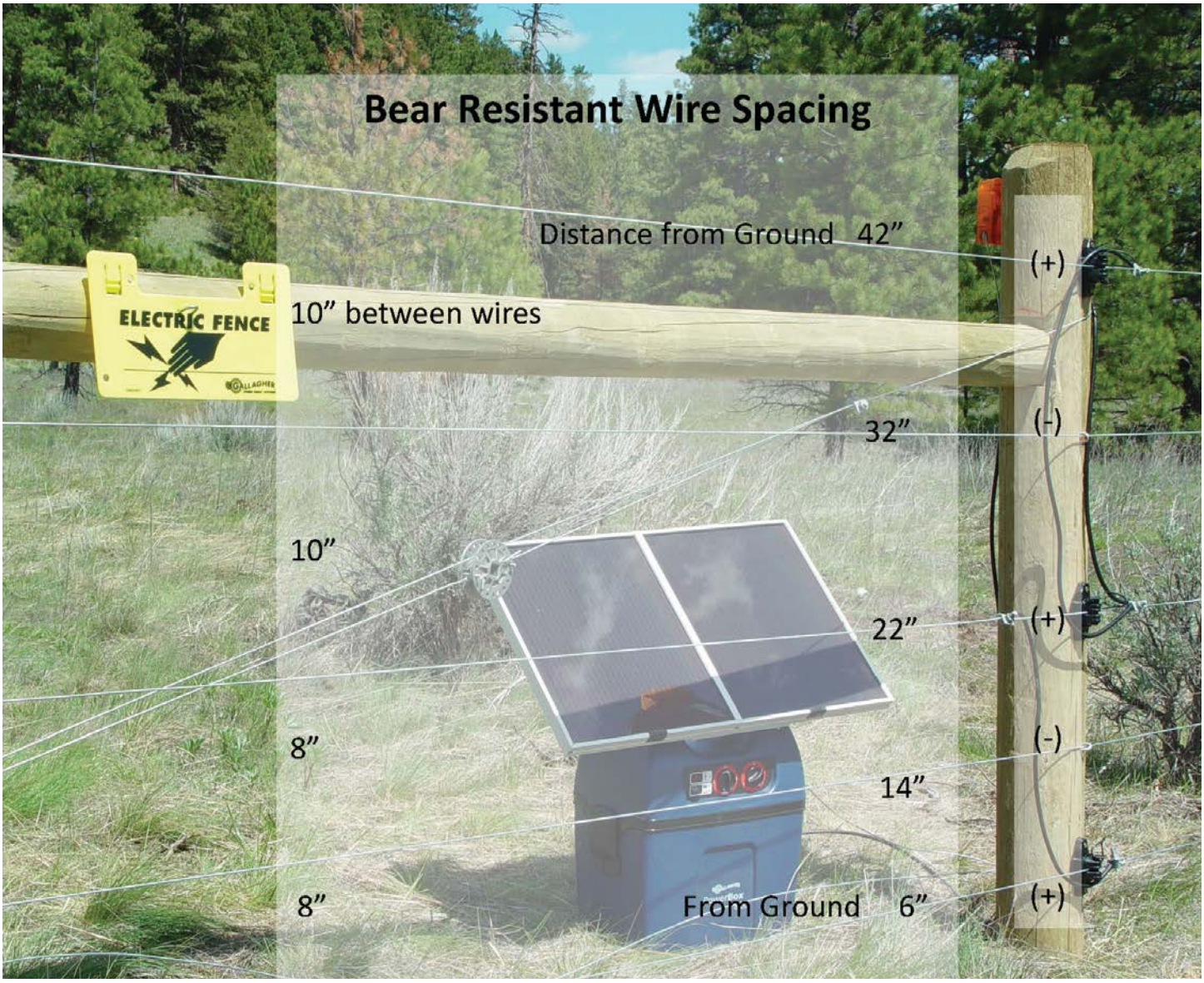



Photo: Blackfoot Challenge

fencing has been used for many years across the United States to deter grizzly and black bears from depredating beehives and raiding cabins, barns and granaries. While opinions differ on fence design and number of strands, contributors agree that electric fencing for grizzly bears is an effective deterrent to depredation in small acreage situations.

In general, electric fencing of adequate voltage and design, when placed around attractants (beehives, granaries, calving pastures, etc.), can be a very effective deterrent if it is fully charged and functional each time an animal touches or tests it. If an animal consistently receives a shock when it touches the fence, it will quickly learn to avoid it. However, if the fence is of insufficient voltage or only intermittently functional, animals may test and cross it repeatedly.

Breaks or shorts in lines and grounding problems caused by extremely dry soil or vegetation in contact with charged fence wire can render fences ineffective. Contributors recommend at least 4,000–5,000 volts to deter wolves and 8,000 volts to deter grizzly bears. Because bears are somewhat insulated from shock by their heavy fur, fencing effectiveness may be improved by smearing an odor along the hot wire periodically to assure that bears touch the fence with their noses (Walters et al. 2010). A few contributors report success deterring wolves and grizzly bears with a single strand of charged electric fence. However, most contributors use multiple strands, with alternating charged and grounded wires.

Blackfoot Challenge and WBR producers have found electric fencing to be a useful small-scale deterrent for both wolves and grizzly bears. Contributing producers, NGOs and agencies agree that electric fencing can be an effective wolf deterrent around calving pastures or other small areas.

> Contributors recommend at least 4,000–5,000 volts to deter wolves and 8,000 volts to deter grizzly bears.

Several contributors routinely set up seasonal or temporary electrified night pens to deter predation of cattle and sheep while on mountainous summer range. Most producers use two or more strands of high-tensile or nylon wire, with one or more strands electrified. Night penning is used to protect bedded herds accompanied by herders on open range.

Greg and Karen Hertel use electric fencing, along with other deterrents, to protect the cattle, hogs, chickens and turkeys they raise in western Wyoming. The main ranch is situated along the Shoshone River bottom, a prime travel corridor for grizzly bears. They have successfully kept grizzly bears away from livestock by using single strands of electric wire and half-inch electric ribbon around cattle and electric netting on poultry. The Hertels have observed bear tracks that would indicate they are aware of the electric fence's charge and do not even approach it. The fencing requires regular maintenance to make sure there are no grounds and that it is putting out the maximum amount of voltage when contacted (4,000–8,000 V). A single strand of electric wire has kept bears away from cows and calves in a forty-acre pasture. The Hertels have observed grizzly bear tracks that indicate how much it disliked electric fencing. This particular bear crawled underneath a steel gate, lifting it off the hinges, in order to avoid crossing an electric fence that wasn't even turned on.

While the WBR Carnivores and Communities program only cost-shares on multi-strand fences, some WBR ranchers have successfully used high voltage chargers and single strands of electric wire added to existing conventional fences. This works "as long as the wire is hot enough to get the bear's attention," noted a contributor. Blackfoot Challenge ranchers have found multi-strand electric fencing to be a valuable tool to deter both grizzly

bears and wolves during calving season. Specifically, they have found five-strand electric fencing to be an effective deterrent for grizzly bears. "We calve in early spring, when the bears are out roaming and hungry. Native feed is scarce and calves are easy prey, so protection is critical."

As grizzly bear populations continue to grow, bear depredation of corn, grain and other crops out on the prairie, particularly near riparian travel corridors, has increased. People and Carnivores, a nonprofit organization that advances carnivore conservation and rangeland stewardship, recommends a three-strand electric fence to exclude grizzly bears from cornfields.[1] Their fence of choice is a slightly modified version of a design used in Michigan that was highly successful at keeping black bears out of beehives. They tested it around a cornfield that abutted a forested area with a high concentration of grizzly bears. Prior to fencing, bears (especially boars) moved into the corn in late summer and stayed through harvest. The fencing reduced both the number of depredating bears and crop loss by 75 percent. People and Carnivores has also found that electric fencing can deter grizzly bears from beehives, buildings, landfills and crop fields as large as 1,000 acres, and they have even mounted it to mobile chicken pens. They advise that turbo-fladry (see "Fladry") will successfully deter wolves but will not deter other large carnivores, such as lions or bears.

WBR grain producers on the Alberta prairie also experience grizzly bear depredation in both grain fields and stored grain. Landowners along riparian or wooded travel corridors are most affected and have found that carcass removal in combination with grain protection has reduced conflict; bears pass by but don't stay or cause problems. Grain storage protection measures include electric fencing and updating to steel, hopper-bottom grain bins or steel storage containers. In some places in the United States, wildlife agencies and NGOs will cost-share with landowners using electric fencing around calving pastures and livestock supplement storage areas.

## Fladry

Fladry, a nonlethal deterrent placed around livestock specifically to deter predation by wolves, consists of a rope hung along the top of a fence with red flagging tied onto it at intervals. The system was developed in Europe as a way to drive and capture wolves, which are inherently risk-averse and reluctant to cross under unknown objects. It is not recommended for lions, bears or other potential predators. Turbo-fladry—outfitting electric fencing with fladry—provides an added repulsive shock to wolves bold enough to test it, a negative reinforcement that makes this deterrent an aversive conditioning tool, as well.

The consensus of contributors is that fladry and turbo-fladry will deter wolves from entering smaller areas, such as calving pastures, for short periods of time (2–8 weeks). All contributors experienced with their use report that they are short-term techniques, requiring attention and maintenance, and not well-suited to large acreages (greater than 50–100 acres). Several producers use turbo-fladry with good results for up to a month during calving season. A contributor in Montana has successfully used fladry to deter wolf predation around a 40-acre calving pasture during one month each

Andrew Anderson installing fladry, Anderson Ranch, Montana. Photo: Louise Johns

Anderson Ranch, Montana. Photo: Louise Johns

year when wolf predation on calves is common on neighboring pastures without fladry. In addition, several contributors have used fladry as a temporary night pen, but the system is labor intensive when they need to move the bedding site frequently. As rangeland consultant Matt Barnes explained,

> *It's more work to put up a mile of turbo-fladry than a mile of electric fence out on range, and fladry is bulkier than electric fence wire. The wire height is critical, you need to consistently keep the wire charged and keep the flags from wrapping around the wire — maintenance is required. Wolves will find the holes.*

Installation and maintenance of fladry can be difficult and time-consuming, as it can be bulky and prone to tangling.[2] People and Carnivores uses truck-mounted spools to install and pick up turbo-fladry more efficiently. They can install one-quarter mile of fence per hour and report significant reductions in wolf predation in calving pastures up to 100 acres in size.[3]

Fladry is less effective in areas with persistent high winds, such as the plains of Alberta, where the strands can quickly tangle or tear. To be effective at deterring wolves, the above-ground height of both fladry and turbo-fladry is critical. If they are positioned too high, wolves will pass underneath them.

## Fox Lights, MAG and RAG Devices

A number of other practices have been developed to take advantage of wolves' inherent caution and aversion to unknown items in their habitats. These include fox lights and motion- and radio-activated guard devices (MAG and RAG, respectively). Fox lights emit varied light patterns at random intervals during nighttime hours, simulating the presence of a person patrolling pastures or rangelands. MAG and RAG devices activate lights, loud noises or pyrotechnics. MAG devices are activated by strategically placed motion sensors (akin to home security systems), while RAG devices are activated by the presence of radio-collared wolves. These devices are nonlethal, short-term deterrents, most commonly used to protect small acreage attractants, such as spring-summer calving, lambing or bedding areas.

Jim Stone from Blackfoot Challenge.
Photo: Blackfoot Challenge

Fox lights were developed in Australia to deter predation by foxes and other predators. Available commercially, they employ a 360-degree, randomly flashing strobe light to scare predators away. A few producers in the WBR program use fox lights around their cattle. Some ranchers report that combining lights and noise makers with negative reinforcements, such as rubber bullets or bear spray, has been effective in deterring wolves. Like most nonlethal deterrents, these devices may work for only a limited time; wolves eventually become habituated to them. Contributors suggest periodically changing deterrents or rotating through them to reduce habituation and prolong their effectiveness.

Also commercially available, MAG devices can employ combinations of light and noise, mimicking random human activity, to scare away potential predators. These devices are motion-activated, similar to trail cameras. As with fox lights, they should be considered only a short-term solution.

Wildlife agencies often radio-collar a few members of established wolf packs, especially during the early phases of recolonization. In these cases, RAG devices can be effective deterrents. They use a flashing strobe light and loud speakers that emit a noise annoying to wolves. They are activated when the box detects a signal from a radio collar. RAG boxes are expensive, short-term deterrents and not commercially available.

All in all, contributors have found that turbo-fladry, electric fencing and MAG devices can be effective in reducing wolf conflicts on small- to medium-scale pastures but are less effective on large landscapes. "They work well on small acreages, but are difficult to use on a large scale," explains People and Carnivore's Bryce Andrews. While grizzly bears can be deterred from accessing acreages up to perhaps 1,000 acres with electric fencing, small acreage deterrents are not ideal for deterring bear predation of livestock on large open ranges.

**Optaciano with wolf radio collar telemetry receiver, Ketchum Ranger District, Sawtooth National Forest, Idaho. Photo: Lava Lake Land & Livestock**

In some locations, federal and state wildlife agencies provide range riders with radio-telemetry receivers to locate and avoid radio-collared wolves. Contributors' opinions on the value of telemetry locations are mixed. They agree that grazing should be planned to avoid known wolf den and rendezvous sites. Most also agree that knowing the location of collared pack members is useful in late summer through winter, when wolves tend to travel together and hunt in packs. Knowing the location of one or two collared pack members from April through July is less useful because this is the pup-rearing period, when wolves may scatter daily from dens or rendezvous sites to hunt as singles and pairs.

For the most part, contributors agree that telemetry is a valuable tool that producers, agencies and NGOs working together can use to increase understanding of predator-ungulate-livestock interactions and test nonlethal approaches. Several contributors also find game cameras to be a useful tool for identifying predators in the area and learning which ones are feeding on carcasses.

# Lava Lake Institute's Wood River Wolf Project

Several sheep producers in wolf country in south-central Idaho have successfully adapted their operations to deter wolf predation.

**Photo: Avery Shawler, Wood River Wolf Project, Lava Lake Institute**

Brian Bean, sheep rancher and president of the Lava Lake Institute for Science & Conservation, observes,

> *Generally speaking, sheep ranchers have been able to adapt more quickly to wolf presence than cattle ranchers, perhaps because range sheep operators have herders and guard dogs with their bands, and sheep aren't simply put in a pasture and left largely unattended, often for days. We added nonlethal deterrents targeted at wolves to the traditional coyote-deterring strategies we were already using.*

In addition to protecting sheep bands with human presence and livestock guardian dogs (LGDs), sheep ranchers who are part of the Lava Lake Institute's Wood River Wolf Project (WRWP)[4] are equipped with "band kits"—various configurations of nonlethal deterrents. Band kits include such items as noise makers (boom boxes with CDs, starter pistols and air horns), lights (high intensity headlamps, handheld spot lights and fox lights) and other equipment and spares (a small solar panel, blanks for the starter pistol, batteries and other items). Herders learn the use of all of the deterrents and supporting equipment and understand which are best suited to particular situations and physical landscapes. They are trained to deploy multiple deterrents concurrently and how and when to rotate deterrents to avoid overuse and mitigate the risk of habituation. Bean explains, "Each ranch is different; as range operators, we need to learn and train on the full suite of available tools, learn what works for us in our country and vary the practices through time."

Other practices that have reduced depredation by wolves in some situations include shed lambing (lambing in protective sheds, as contrasted with, for example, lambing on the open range where sheep are spread out and harder to protect at a particularly vulnerable time) and night penning (temporary, generally multi-strand electric fencing used to defend bedding areas on the range). Although turbo-fladry effectively keeps wolves out of sheep bands when used for night penning, it is not included in WRWP's band kits. But, according to Bean, "if a participating WRWP operator is heading into an allotment with known wolf presence, or into an area where wolf depredations are known to have occurred in prior years, the project will deliver turbo-fladry to the band at operator request and help the herder set it up."

The practices encouraged and taught by WRWP must fit the situation and terrain, and be adapted through time to avoid wolf habituation. Wolves are smart, they change and adapt. Herders must observe what is happening on the range and adapt as well. Bean continues, "Our goal is to seek physical separation between livestock and wolves as much as possible; herders or range riders will not eliminate depredation but can significantly reduce it in most situations."

Bean explains that with sheep, as with cattle, "stress-related weight loss is real and can be financially significant." He reiterates that the benefits of nonlethal deterrents and practices include not just decreased depredation, but decreased livestock and herder anxiety. Constant tending with herders improves the ability to deploy deterrents effectively and herd stock away from danger, which reduces both depredation loss and anxiety-related weight loss in sheep.

As a result of their efforts, producers in the WRWP have seen a 90 percent reduction in sheep losses to wolves. Bean explains,

> *Properly deployed and rotated, nonlethal deterrents decrease the number of depredation events and the number of animals killed per depredation incident. The reduction we've seen in sheep depredation by wolves here in the Wood River Valley, using herders and nonlethal deterrents, should work for sheep operators elsewhere in the Western states who are willing to make changes in human and livestock behavior. Coyote depredation has been and remains a far bigger problem than wolf depredation for most range sheep operators in wolf country in south-central Idaho.*

He also points out that wolves tend to drive out, suppress or kill coyotes in wolf range.

Sheep in turbofladry, Lost River Ranger District, Salmon-Challis National Forest, Idaho.
Photo: Lava Lake Land & Livestock

## Aversive Conditioning

Aversive conditioning is the process of associating a negative consequence with depredation or other undesirable behaviors. Negative stimuli most often used to condition bears and other predators include noise, surprise, fear and pain. Aversive conditioning is most commonly used in small acreage situations, such as campgrounds, and is generally implemented in combination with education and attractant removal.

The Wind River Bear Institute (WRBI) combines knowledge of bear behavior with aversive conditioning practices and educating people as ways to change bear behavior and reduce the need for lethal control of bears that have learned to associate humans with food. Carrie Hunt of WRBI has been applying these techniques with black and grizzly bears since 1996. "Our work is founded on a simple but groundbreaking approach: we teach both bears and humans the correct behaviors to reduce conflict."

Hunt and her associates use a combination of practices, including capture, loud noises, rubber bullets, bean bag projectiles and pursuit by Karelian bear dogs to associate unacceptable behavior with extremely negative experiences.[5] Karelian bear dogs have been bred for centuries to protect humans from bears. The program has achieved some success in educating bears to change their behavior, especially if intervention takes place early—before the bear has experienced multiple successes.

Carrie Hunt and two of her Karelian bear dogs. Photo: Wind River Bear Institute

> "Our work is founded on a simple but groundbreaking approach: we teach both bears and humans the correct behaviors to reduce conflict."
>
> —*Carrie Hunt, WRBI*

Conflict between campers and habituated black bears was reduced in Yosemite National Park using the combination of aversive conditioning, education and attractant removal. As noted by Madison (2008),

> *The effectiveness of the program relies on a combination of tools, such as effective communication with park visitors, proper storage of all human food and garbage, timely collection of garbage, aversive conditioning of bears entering developed areas, enforcement of regulations and, unfortunately, removal of particular bears that display aggressive behavior.*

The Get Bear Smart Society, based in Whistler, British Columbia, informs bear management across North America.[6] They provide useful information for landowners and communities on attractant management, aversive conditioning and other management policies, and human behaviors that can reduce human-bear conflicts.

## Conflict Management at Larger Scales

In addition to many of the strategies and practices used on small acreages—removing carcasses, fladry, electric fencing and scare devices—effective strategies for nonlethal conflict management on large acreages and open range include frequent human presence, livestock guardian dogs (LGDs), managing livestock in herds and concentrating grazing on a relatively small portion of the range at any one time. Contributors have generally found that it is necessary to group livestock in herds attended by herders in order to effectively protect them with nonlethal deterrents. More importantly, several contributors contend that cattle can be managed to relearn the survival advantages of remaining in groups and even to actively defend themselves from predators.

Several contributors note seasonal patterns of wolf depredation. Although it occurs in all months, most depredation takes place from spring through fall, coinciding with the calving season and summer grazing on large pastures and public land. Livestock that are moved to seasonal ranges are more likely to be within the home ranges of wolves during summer and early fall.

### Type and Size of Livestock

Contributors generally agree that the smaller the livestock, the greater the death loss by large carnivores. Most cattle depredation by bears and wolves involves calves, particularly smaller or younger calves. Several contributors reported that adult or yearling cattle are less susceptible. Contributing producers in central Wyoming estimate that cattle losses to bears are approximately 75 percent calves and 25 percent yearlings. They estimate wolf predation at closer to 50 percent calves and 50 percent yearlings. Some producers in southwestern Montana have found yearling cattle to be more resistant to depredation when riders tend the herd frequently and remove any lame animals. Wyatt Donald explains, "There was an established pack denned in the middle of the ranch all summer but we had no problems. Fortunately, we've been able to manage our yearling cattle about the same way we would have done without the wolves. However, that is not the case everywhere. Not all situations are the same."

Several other contributors are experimenting with rewilding their cattle, culling for survivability and selecting replacement heifers from mothers that consistently raise calves on predator occupied ranges. By running pairs and yearlings raised on the ranch and selecting replacements from successful mothers, producers may be promoting the transfer not only of genetics but also of generational knowledge—how to survive on the landscape—passed from mothers to calves and through matrilineal relationships among related females. This is similar to the ways that elk and other wild ungulates pass knowledge to offspring. In addition, it has been noted that some horned livestock breeds appear less vulnerable to predation. Domesticated bison are undoubtedly the least susceptible species to predation, as they tend to form groups and are capable of defending themselves and their offspring against predators. And, although sheep are quite vulnerable to predators, they readily form herds and are generally accompanied by herders, which facilitates the use of LGDs and other nonlethal deterrents.

Photo: Melanie Elzinga

# Bison as Livestock

Mike Phillips and his associates on Ted Turner's Flying D Ranch in southwestern Montana have documented interactions between bison, wolves and elk on the ranch since 2009.

Photo: Flying D Ranch, Montana

In the ensuing decade, they have documented 49 bison kills, 35 of which were 3–6 month-old calves. This totals a less than 1 percent annual death loss to wolves. Phillips' data indicates elk are by far the primary food source for wolves on the ranch. "Bison tend to group and defend their young from wolves. We experience little bison predation even though we have a large resident wolf pack, but don't need constant human presence or other deterrents." Phillips views the bison as both a healthy food source and a well-adapted, native species that can provide their own predator protection.

Turner Enterprises' Jeremy Gingerich concurs. "Bison fit the environment and require relatively little human intervention and management. They naturally tend to avoid dense cover (ambush areas) and spend much of the day in the breeze on the uplands rather than down in the riparian areas." Gingerich and Gus Holm, the ranch manager at Turner's Vermejo Park Ranch, explain that bison can be effectively herded and moved around the landscape by riders using low-stress handling practices. "We've also found there is a dependable market for bison," adds Holm.

Challenges to new bison producers include product marketing and bison containment, such as ranch perimeter fencing. "You want to identify your market early in the process," explains Gingerich. Many producers use tall perimeter fencing, which can be an issue for migrating native ungulates. Gingerich stresses the need to "incorporate wildlife-accessible fencing in areas of known big game migrations crossing the ranch."

## Timing of Calving

Many producers find that calving later, when temperatures are warmer and new forage is growing, results in better livestock condition and weight gains. Later calving also can reduce the high cost of winter supplemental feeding. In addition, by moving their calving season later to coincide with the birth pulse of native ungulate species (May through June for elk and deer in the Northern Rockies), some contributors have seen decreased depredation. By doing so, cattle-calves become just some of many newborns on the range, and wolves may focus on native prey newborns rather than cattle. Producers calving prior to the native birth pulse are more likely to be targeted by hungry wolf packs. Matt Barnes explains:

> *Where large carnivores cannot be seasonally avoided, changing calving season from what is currently considered conventional for cattle [January–April] to May–June, to coincide with wild ungulate calving season — when the snow is gone and the grass is green — may reduce losses in some cases. When the calving seasons are distinct and consecutive, predators can focus on livestock from the onset of calving to late spring, and then switch to wild newborns. If all wild and domestic calves are born simultaneously, predators may remain focused on wild ones. On mountainous ranges, this is especially likely if the wild ungulates have already begun their upward seasonal migration, with the predators following them, such that livestock and wild ungulates are geographically separated.*

For these reasons, several state wildlife agencies encourage and support later livestock calving seasons. Where feasible, fall calving reduces depredations because only yearlings or bred cows are present on summer range. Cows are moved to lower, more secure pastures for calving in the fall.

## Frequent Human Presence

Contributors agreed that frequent human presence is the most important means of detecting and deterring livestock predation on the range. They advise putting people on the ground nearly every day to observe livestock behavior and determine if and where predation is occurring. Tending the flock or herd daily also allows shepherds or range riders to keep livestock in herds, find carcasses, doctor and remove sick or lame animals and employ predator deterrents. Regular human presence can also reduce livestock stress. Predator activity causes cattle, sheep, horses, bison and dogs to become agitated and restless, informing observant shepherds and range riders that predators are around. Livestock may avoid areas where they have previously encountered predators.

Photo: Melanie Elzinga

According to Albert Sommers, "cattle and horses know where the bears are—watch their behavior." Sommers advises producers to learn to spot kills and kill sites by observing livestock and scavenger behavior, to identify kills and to be bear aware. "There is a human safety concern with herders or range riders in grizzly country. For safety, always work in groups, always carry bear spray and be extremely cautious if venturing out at night when grizzly bears are around."

Lame and sick animals are vulnerable and a liability. Vigilant shepherds and range riders use good animal husbandry practices, such as providing appropriate mineral supplements and keeping sick, lame or old livestock off the range. Contributors note that predated livestock known to be sick or lame should be viewed differently than predated healthy livestock.

## Herding

In the Rocky Mountains, grazing sheep have routinely been tended by herders living with a social group of sheep, horses and working dogs, including both herding and livestock guardian dogs (LGDs). Keeping sheep bunched in herds, protected by human tenders and guardian dogs, has proven effective at deterring predation by coyotes, black bears and mountain lions. Both cattle and sheep producers are finding that these strategies can also deter predation by wolves and grizzly bears.

Ketchum Ranger District, Sawtooth National Forest. Photo: Lava Lake Land & Livestock

Several contributors state that bunching and herding cattle across the landscape both decreases predation and improves rangeland health. Grazing management based on planned rest, employing higher livestock densities, shorter grazing periods and long plant recovery periods can improve animal, soil and range condition (Teague et al. 2010, Barnes and Hill 2013, Danvir et al. 2018). Grazing practices based on these principles go by many names—rest rotation, time-controlled, boom-bust, strategic—but all fit the annual grazing plan for landscape conditions and producers' economic and ecological goals.

With planned-rest grazing, in contrast to spreading livestock broadly across the ranch or allotment, livestock are concentrated on a portion of the ranch for a time and moved periodically to fresh forage, thereby providing periods of plant recovery between grazing episodes. Several contributors managing livestock in large carnivore habitat (particularly that of coyotes and wolves) suggested that this kind of management is doubly positive, improving land health, livestock weight gains and livestock survival. Some, but not all, contributors have found that grouping and herding cattle results in less grizzly bear predation than allowing cattle to scatter.

Pioneer Mountains, Idaho. Photo: Phoebe Bean, Lava Lake Land & Livestock

# Deseret Land & Livestock

Herding, livestock guardian dogs (LGDs) and human presence can be effective predator deterrents.


Photo: Sylvia Danvir

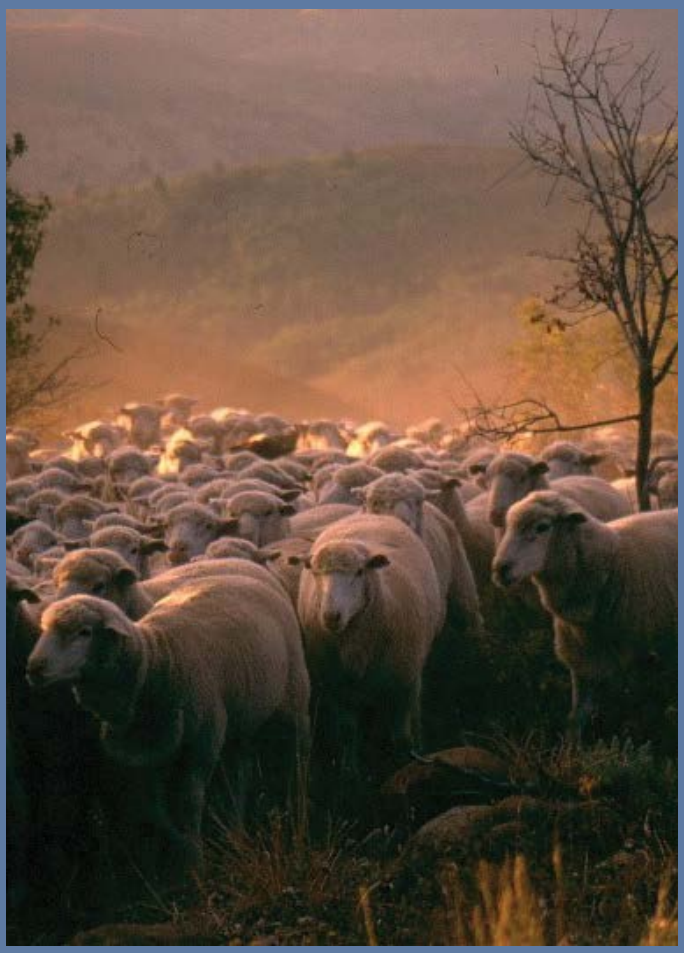


Photo: Deseret Land & Livestock, Utah

In the past thirty years Deseret Land & Livestock (DLL) has used a combination of experienced herders, three to five LGDs (mainly Great Pyrenees) per 1,000 ewes and frequent moves—bedding the flock in the same location no more than three consecutive nights—to effectively reduce sheep predation from coyotes, mountain lions and black bears. Managers at DLL conclude that frequent moves discourage coyote predation, based on observations over the years that flocks kept in the same spot for more than a few nights were targeted by coyotes, despite the presence of herders and LGDs. Moving sheep frequently has also improved lamb weight gains and been less impactful on the land.

Lethal control of coyotes by herders or government trappers was implemented only when coyote predation became habitual. The response to the occasional black bear or mountain lion attack was to immediately move the flock a mile or more away from the conflict area. Moving the flock effectively stopped black bear and mountain lion predation and, as a result, no lethal control of black bears or mountain lions was necessary.

# Anderson Ranch

Hilary and Andrew Anderson manage cattle and range using a combination of progressive range management practices, electric fencing, low-stress range riding and herding in southeast Montana.

By the mid-2000s, they were incorporating holistic resource management principles and predator dynamics into their management. As Hilary Anderson explains,

> *As hunters, wolves are exceptional at exploiting weakness in their prey, which allows them to make quick and effective decisions on the merit of continuing a hunt. Hunting success is largely based on both the wolves' ability to exploit vulnerability and their ability to get their prey on the run. Since prey animals are more dangerous to wolves when standing their ground, wolves work hard to get their prey running. If a group of bison, elk or cattle see wolves coming, they can stand their ground and even run off the predator.*

The Andersons have noticed that the benefits of herd behavior in wild ungulates applies to cattle as well. "All our wolf depredations in recent years were in pastures where cattle were scattered, as opposed to a herd that stood its ground," Anderson noted. While they now experience no losses in their herded first-calf heifers, nearby herds with scattered cattle continue to experience predation. Once cattle relearn the strength and safety of the herd, groups of cattle approached by one or two wolves will stand their ground. In contrast, a lone cow, calf or horse approached by one or two wolves will often run; the wolves then give chase and may attack.

In addition, animals in a group benefit from many eyes watching for danger. Each individual can spend less time watching and more time feeding, which results in less stress and better weight gains. A bunched herd occupies less space, and so is less likely to encounter hunting wolves. Even when found, the herd is less vulnerable due to safety in numbers. Once cattle become accustomed to remaining in a group, efficiency increases for riders as well—they can more quickly find their cattle each day, more easily move the herd to new forage, identify and doctor sick cattle and find carcasses relatively soon after death.

Photo: Erika Larsen

Managing cattle in a way that encourages and supports their natural ability to defend themselves can be helpful. As Matt Barnes explains,

> *Range riders practice low-stress handling to condition cattle to seek safety in groups, keeping them together and moving. You can be with the herd, see what's happening and work large landscapes but at a manageable scale. Rather than thinking of this as a predator problem, we should focus on managing livestock so that they relearn the defensive advantage of the herd. It is more effective to manage the prey species (livestock) than try to manage the free-roaming predator.*

> "It is more effective to manage the prey species (livestock) than try to manage the free-roaming predator."
>
> —*Matt Barnes, rangeland consultant*

Riders who attend cattle daily or frequently can herd them to open country, where both cattle and riders can see approaching predators, and away from denning sites or steep, forested terrain where livestock may be more vulnerable. Bunching livestock in herds increases the likelihood of finding carcasses and facilitates practices like night penning and use of fladry, fox lights, scare devices and LGDs. As Barnes states it, "Herding is key. Having the herd grouped in a manageable area allows the herdsman to see what's going on and try practices that won't work if the herd is widely scattered. It's also better grazing management for the range." In Livestock Management for Coexistence with Large Carnivores, Healthy Land and Productive Ranches (2015), he writes:

> *Livestock management, specifically rotational grazing, herding with low-stress livestock handling, and synchronized calving in short seasons, in some cases corresponding with those of wild ungulates, can—while maintaining or improving rangeland health and livestock production—directly and synergistically reduce predation, while establishing a management context in which other predation-prevention practices and tools can be used more effectively.*

Several other contributors explain that while forage and terrain on the prairies and meadows lends itself to grazing with larger herds, in some mountainous regions of the West the terrain is better suited to smaller groups of cattle spread over a larger area. California rancher Mark Coats suggests that cattle standing their ground in groups of just three to a dozen can reduce predation by coyotes and wolves in mountainous terrain. He advocates using riders, horses, dogs and pressure-release training principles to develop predator awareness and group-forming behavior. He uses header dogs (as opposed to healers) to encourage cattle to calmly bunch and stand their ground when confronted by predators, rather than running from them. Training cattle for 1–2 weeks can result in defensive behavior that last several months, if periodically refreshed.[7]

Photo: Melanie Elzinga

# Alderspring Ranch

On the Alderspring Ranch in central Idaho, Glenn and Caryl Elzinga graze yearling cattle among wolves, lions and black bears.[8]


We have three basic goals, the primary one being that we must have an economically sustainable operation. If our operation can't pay for itself, we can't achieve the other two goals," Glenn Elzinga explains.

The Elzingas' second goal is an ecological one: to continually improve the condition of upland and especially riparian habitats on the lands they steward for a variety of species, including wolves, sage grouse, salmon, bull trout and threatened and endangered plants. Through grazing management, the Elzingas have allowed the riparian areas to reboot and are now seeing species of willow and herbaceous plants once thought extirpated.

> "We need to train a new generation in the science and art of stewarding these lands in a responsible yet profitable manner."
>
> *—Idaho rancher Glenn Elzinga*

The third goal has to do with people. As Elzinga explains, "We need to train a new generation in the science and art of stewarding these lands in a responsible yet profitable manner. Our interns quickly learn that these cattle are a million-dollar investment entrusted to their care, that this job requires focus and commitment."

After years working for the federal government as a professional forester (Glenn) and plant ecologist (Caryl), the Elzingas shifted gears to cattle ranching in Idaho's Pahsimeroi Valley. Part of their program includes training interns in low-stress livestock handling to protect yearling cattle from wolf predation. "We generally hire interns with a clean slate; that is, few preconceived ideas about livestock handling," Glenn Elzinga said. The Elzingas select five or six interns out of 50-60 applicants each year.

In summer, after wintering and calving in the valley, the Elzingas head to the high country with

300 yearling cattle, as part of their certified organic beef operation. "These cattle are moved frequently as calves among electrified paddocks, so they have frequent low-stress contact with humans, horses and dogs by the time we trail to the mountain summer pastures." Using pressure-release, low-stress handling practices along the way, this mixed bunch of 600-1,200 pound yearling heifers and steers learn the safety of the herd. It takes about a month before the group truly functions as a herd, "or, as Bud Williams says, *'make the cattle want to do what you need them to do.'"*

Glenn and Caryl Elzinga, Alderspring Ranch, Idaho. Photo: Linnaea Elzinga

Riders attend the herd constantly, camping alongside them at night. The herd beds in temporary, electrified night-penning enclosures that are moved periodically throughout the summer. Cattle are penned at night and grazed across different grazing circuits each day. "In order to be profitable, these cattle need to average two pounds of weight gain per day through the summer, so they need to get their fill of fresh feed every day." By managing in this way, the cattle gain better, and "they feel safe in the herd, without stress from herders or predators." The Elzingas have also found that keeping the herd moving and on fresh feed reduces death loss from predators and poisonous plants to zero.

One advantage to using yearlings is their trainability. For example, with constant and consistent herding, they quickly learn that riparian areas are not a food source. "Before long, the yearlings don't even try to feed; they just get a drink and move back up slope." The Elzingas observe that riparian areas respond positively to this management. "It's as if they've rebooted. We're seeing species of willows and other plants we thought were long gone."

There are generally two to three riders within 300 feet of the herd at all times, and they have even learned to work the cattle in the timber. "I don't want to avoid the timber. There are times when it is good forage, and it is benefitted by periodic grazing," Elzinga says. He has developed a systematic way to graze cattle in forested areas, even though herders can only see a portion of the herd at any given time. He explained, "The three riders are arranged around the herd at roughly 120 degree intervals. We all know the direction we're moving, and each rider works back and forth along their respective perimeter until they hear or see the adjacent rider. We talk, call or sing so the other riders and cattle know our whereabouts. This effectively keeps the herd bunched, grazing and moving slowly through the timber as a unit."

Photo: Linnaea Elzinga

# Greg Hertel and Airedale Terriers

Greg Hertel has used Airedale terriers for several years to protect himself, family and staff from grizzly bears by keeping them away from livestock and buildings around their Cody, Wyoming ranch.

The Airedales sound a particular bark when they smell or see a grizzly bear, and are let out of their kennel to run the bears off the ranch. These dogs will only run a mile or so from the ranch and return after about an hour. Hertel explains, "Airedales are great bear dogs; they seem to naturally know bears are a threat, so there is not much training required. They are better bear protection than bear spray because they do their job no matter how hard or which direction the wind is blowing." The Airedales accompany his family and staff while they fish along the river or hike in the mountains. If they smell a bear, they bark and run in the direction the scent is coming from, preventing a human and grizzly bear encounter.

Hertel is one of a group of ranchers using herding and rotational grazing techniques to manage grazing and deter livestock predation on public land grazing allotments. They calve in July and August and have had no predation losses in eight years. "Someone is riding our herd every day, moving them out of areas that have already been grazed and into ungrazed areas. We look for health issues with the animals, primarily lameness and pinkeye, and look for grizzly bear or wolf tracks," explains Hertel. He also relates, "One time, after seeing a lot of wolf signs and being told that other riders had seen wolves, Karen and I camped up by the cattle and shot cracker shells from a shotgun all night. We did not see any more wolf signs for the rest of the fall grazing."

Photo: McKenzie Tsaousis

Hertel maintains that frequent herding is both a predator-deterring and a labor-saving practice.

> *By keeping our cattle bunched together, it doesn't take all day to look them over, like it would if they were spread out. We believe that keeping them bunched up, rather than spread out, lessens the chance of a calf or yearling getting picked off. It is also good grazing management. Given the topography and ground cover, I believe that daily riding and keeping the cattle together is an effective and efficient method to manage grass and predation.*

Photo: Cat Urbigkit

## Livestock Guardian Dogs

Livestock guardian dogs (LGDs) have been used to protect livestock from brown bears and wolves in parts of Europe and Asia for thousands of years (Urbigkit and Urbigkit 2010, Urbigkit 2016).There are dozens of breeds of LGDs, all of which originated across Eurasia. Great Pyrenees, Akbash, Komondors, Maremmas and other white-colored breeds of LGDs have been used by sheep producers in the United States for decades, primarily to discourage coyote predation. Sheep are commonly grazed on higher elevation summer ranges, often on federal lands in mobile bands of about 1,000 ewes and their lambs. They are generally accompanied by a herder and his horses, herding dogs (most commonly New Zealand border collies or Australian shepherds) and 2–5 LGDs.

Contributors report mixed reviews regarding the effectiveness of LGDs to deter predation. Several contributors related incidents in which LGDs seemed to draw wolves in, especially during the pup-rearing season, resulting in both LGD and livestock depredation. A group of LGDs may be perceived as threatening intruders, like a rival pack, and consequently be attacked by wolves. Also, although two or three Great Pyrenees or Akbash LGDs are generally adequate to deter coyote predation, they may lack the size and aggressiveness to be effective against gray wolves (Urbigkit and Urbigkit 2010). Despite these challenges, other contributors have found LGDs to be effective deterrents, reducing livestock predation by all large carnivores.

South-central Idaho sheep rancher and president of the Lava Lake Institute for Science & Conservation, Brian Bean, notes, "in the hierarchy of effectiveness of nonlethal deterrents, human presence is first and guard dogs are second." Based on their findings, Lava Lake Institute for Science & Conservation's Wood River Wolf Project advises herders to, if possible, avoid known dens or rendezvous sites in wolf country in the early part of the grazing season. If this is not possible, consider reducing the number of LGDs to two, but no fewer than two, and increase the use of additional

nonlethal deterrents and human presence (e.g. sleeping with the sheep bands). The number of LGDs used per band can vary during the season and are adjusted based on perceived threat. Four or more LGDs per band can be effective when added later in the summer. The number of LGDs guarding a herd or flock must be adequate to deter the number of wolves they may encounter. The larger the wolf pack, the more LGDs are needed. One contributor cautions that when using intact male LGDs in groups, aggressive behavior and fighting between LGDs can occur and in some instances lead to an LGD death.

> "In the hierarchy of effectiveness of nonlethal deterrents, human presence is first and guard dogs are second."
>
> *—Idaho rancher Brian Bean*

Several producers in southwestern Montana report success using mixed-breed LGDs, for example Anatolians crossed with Great Pyrenees or Akbash. Others simply run a mixed pack of several different breeds with their flock, mixing some of the white-colored breeds with Anatolian, Kangal, Karakachan, Ovcharka and Mastiff breeds. Rancher Cody Lockhart employs this strategy to deter sheep predation by wolves and coyotes in Manitoba, Canada. He runs a mixed group of white dogs, which tend to stay with the flock, along with Anatolians and Kangals, which will patrol farther out from the flock and aggressively deter predators, if necessary. He explains that the purpose of LGDs is not to hunt and fight predators, but rather to teach would-be predators to look elsewhere for a safer, easier meal. Lockhart runs as many as one LGD per 100 ewes, outfitting LGDs with spiked collars for protection.[9]

Contributors further noted that LGDs should be selected for their individual effectiveness. Poor performing dogs or dogs that show aggression to humans should be culled. LGDs should be raised with the species of livestock they are intended to protect and should be taught basic commands so that they can be caught and safely handled. Many LGDs are outfitted with spiked collars for protection during wolf encounters. Young dogs should be placed with sheep immediately after weaning and raised with trained adult dogs, from which they learn their role. As with most deterrents discussed in this guide, LGDs are more effective at guarding bunched livestock.

Cat and Jim Urbigkit have worked with many LGD breeds while grazing sheep in central Wyoming. In her book *Brave and Loyal: An Illustrated Celebration of Guardian Dogs*, Cat Urbigkit presents their experiences along with information gained while visiting producers who use LGDs for protection from both wolves and brown bears in Spain, Turkey and Bulgaria (Urbigkit 2016).

Photo: Cat Urbigkit

# LGD Culture in the Balkans

In her book *Brave and Loyal: An Illustrated Celebration of Guardian Dogs*, Cat Urbigkit relates a conversation she had in Bulgaria with Sider and Atila Sedechev, experts on the use of the Karakachan livestock guardian dog (LGD), "the bear fighter of the Balkans."

The Sedechevs maintain that "survival of the guardian depends on the survival of the predator and vice versa." As Urbigkit writes, "Their interest begins with conservation of the dog but extends to a variety of predators because these animals developed and evolved together and need each other to reach their full evolutionary potential—to survive with their evolutionary potential intact" (Urbigkit 2016).

Prior to Soviet rule and the collectivization of agriculture, the Karakachan people were nomadic herders grazing large flocks of sheep with guardian dogs. During Soviet rule, lands were nationalized, the nomads were settled and the flocks were sent to collectives. During and immediately following Soviet rule, many guardian dogs and sheep herds were eradicated. However, as the nation began to reprivatize agriculture, efforts began to conserve the native guardian dogs, livestock and predators, and the landscape in which they originally evolved.

In 1996, the Bulgarian Biodiversity Preservation Society began a program with the goal to conserve the original breed and working abilities of the Karakachan LGD, with a focus on "conservation of the unique symbiosis between all these elements" (Urbigkit 2016). "Bulgaria has one of the highest predator densities in the European Union, estimated at approximately 2,300 wolves and 600 European brown bears," writes Urbigkit. In order to protect rural residents, improve the agricultural economy and conserve working landscapes, the program raises Karakachan pups and places them with local herders.

The program has been extremely effective. "The program to distribute Karakachan pups to livestock producers in regions of the Balkans that are inhabited by large carnivores resulted in an 80 percent decrease in livestock depredations," writes Urbigkit. Flocks protected by Karakachan guardian dogs were soon avoided by wolves, while neighboring flocks without guardian dogs were depredated. "The wolves had turned to easier prey." As part of the program, herders provided with pups are required to raise and provide pups to other herders—"a sort of paying it forward," says Urbigkit.

The Karakachan dog is effective at guarding livestock in part because it is very territorial. "It accepts the flock as its territory, wherever it is." A Karakachan LGD is aggressive with predators and works together with other dogs to drive off wolves and bears by pursuing and, if need be, engaging with them. The dogs become visibly aggressive to strangers approaching the flock, warning them not to approach. Conflicts with recreationists are minimized because, in this part of the world, "the tradition of guarding livestock with big, aggressive dogs has always existed," and therefore the public knows to avoid or move around sheep flocks with guardian dogs.

"As members of the European Union, Bulgaria provides subsidies to livestock producers. The subsidy is higher if the producer uses guardian dogs," writes Urbigkit. Subsidies help to support rural economies, encourage grazing as a tool to reduce encroaching woody vegetation and mitigate conflict with predators.

Photo: Cat Urbigkit

Wyoming author and sheep rancher Cat Urbigkit. Photo: Cat Urbigkit

Most contributors consider LGDs an effective tool when integrated with other deterrents. LGDs are perhaps best suited to private lands and more remote public lands with low levels of recreational use. Conflicts with recreationists and other dogs can be an issue, particularly on public lands. In 2008, a cyclist was attacked and injured by two Great Pyrenees after she rode her bike through a band of sheep on Forest Service land near Vail, Colorado during a bicycle race. The resulting litigation resulted in a $1 million settlement by the rancher's insurance company.

Photo: Michel Meuret, French National Institute for Agricultural Research (INRA)

## Land Cover and Terrain

Land cover characteristics influence livestock predation. In Alberta, producers reported three times as many depredation incidents with cattle grazed on heavily forested but less intensively managed allotments than with cattle grazed on more intensively managed lease areas with less forest cover (ORWRCP 2010). In some cases, land characteristics or local factors may have a larger influence on the likelihood of depredation than the specific wolves comprising a pack (Bradley 2004).

Terrain is defined as the mixture of slopes, rocks, ravines, hills and ridgelines that shape the landscape, affecting the distribution of forage resources and thus determining livestock distribution, grazing and movement. The way in which herders factor terrain into the daily grazing and movement patterns of herded sheep in the French Alps is described in *The Art and Science of Shepherding — Tapping into the Wisdom of French Herders* (Meuret and Provenza, 2014). Herders follow daily grazing circuits, comprised of a series of sectors, "base units of grazing land," which are defined based primarily on landscape features, including alti-

tude, aspect (sun exposure), slope, terrain, soil and vegetation types. Herders see the land as a series of compartmentalized grazing areas (those having reasonably open terrain, good visibility and uniform vegetation cover) separated by obstacles, such as flowing streams, ravines and rocky ridges. The grazing circuit is the route and order in which the herder and flock move from grazing sector to sector throughout the day, crossing obstacles at routinely used "pinch points."

Sheep located on concave or flatter terrain within sight of other flock members are more easily settled—or kept in the flock—than sheep on more broken terrain in which other flock members can't be seen. In steeper, broken or wooded terrain flock coherency breaks down, with some sheep moving quickly through, looking for more open country, while others break off and linger in scattered ravines and small pockets of good forage. As flock cohesion breaks down and individuals or small groups break off on their own, especially into isolated pockets, brushy or steep terrain, visibility decreases and vulnerability to predation increases.

Similarly, lone or scattered cattle close to cover or steeper terrain are more vulnerable to predation. Terrain and woody cover can play a role in determining whether cattle or predators have the advantage. It is tougher for cattle (pairs or yearlings) to herd and stand their ground against predators on steep terrain. If the terrain and cover allow wolves or grizzly bears to get close and surprise the cattle, the cattle will run. In situations where cattle tend to scatter across steep, forested terrain, despite the best efforts of riders, they may experience poor weight gains due to continuous pressure from predators. Wolves generally kill wild ungulates, so herding cattle away from timber and steep slopes frequented by elk can reduce the ease of predation and opportunities for it to occur. Several southwestern Montana ranchers find wolf depredation on cattle increases in late summer and fall, especially in forested areas. Contributors uniformly find herding and bunching cattle is more challenging in steep, forested terrain.

Land cover contributes to predation when it includes poisonous plants, such as larkspur (*Delphinium* spp.), which kill cattle, creating carcasses that can attract bears and potentially predispose them to attack live cattle. "Avoid poisonous plants that kill cattle and can attract

Photo: Michel Meuret INRA

Photo: Michel Meuret INRA

bears," cautions Albert Sommers. Avoiding carcasses on range can reduce predation and the risk to riders. As Sommers notes, however, carcasses are not always easy to find, especially when cattle are scattered across steeper or more covered terrain. Also, because members of a bunched herd know when and where a kill occurs, they may move away from and avoid kill sites. This can be helpful in the short-term but problematic in the long term, if cattle are reluctant to return to places where predation occurred in the past.

## Adaptability and Flexibility

Protecting livestock from predation is a basic tenet of animal husbandry. Doing so improves the quality of life for both livestock and the people who steward them. Contributors agree that since wolves and other predators continually learn and may adapt to deterrents and other changes in the environment, ranchers must also be ready to change management and adapt in response. Brian Bean emphasizes the need to rotate through and change deterrents and tactics over time to avoid predator habituation. If an effective deterrent is used over a too-long period, wolves eventually come to understand that the tool represents less risk than supposed, and that particular tool consequently will prove less effective. Ranchers must observe what is happening on the range and adapt as needed.

Contributors find livestock can also adapt and adopt defensive behaviors through rewilding and training, which can reduce predation and stress. Conditions are always changing and unpredictable. However, producers can react and adapt if they are present, aware and have the flexibility to change management tactics and grazing plans when needed. Management flexibility is key, together with multiple tools and tactics and the ability to implement them. This includes flexibility in grazing management. Contributors emphasize the need to work collaboratively with public land managers, wildlife agencies, universities and solution-oriented NGOs to increase understanding, share knowledge around what is and isn't effective, define "common ground" and, with that understanding, develop broadly shared goals, when possible.

## Alternative Food Availability and Depredation

Contributors agree that when native ungulate populations are plentiful, they remain the preferred food source of wolves. David Mannix suggests that "one way to reduce livestock depredation is to manage wildlife populations to ensure there are plenty of deer and elk to eat." Wolves may increase predation on livestock when wild ungulate numbers decline. The same principle holds for the omnivorous grizzly bear. Drought-related or permanent loss of insects and nuts, berries or other vegetation may increase grizzly bear reliance on crops and livestock.

Diversionary feeding refers to the practice of providing seasonal food supplementation as a means of reducing conflict with wolves. The Mexican Wolf Recovery Program in New Mexico and Arizona, for example, provides producers with diversionary food caches, including road-killed native prey carcasses (Appendix 3). These are used as nonlethal tools to reduce livestock depredation by wolves on summer ranges, during the wolf denning season. Diversionary feeding has also been used to reduce timber damage by black bears feeding on cambium in the spring on private timberlands in the Pacific Northwest (Nolte et al. 2003).

# *Nonlethal and Lethal Predator Management*

Several contributors to this guide have experienced low rates of predation, while nearby operations have not been as fortunate. Although many factors may influence predation, common practices among ranchers experiencing low depredation rates include removing carcasses and other attractants, protecting calving areas with electric fencing, using range riders and herding cattle on summer ranges. All contributors agree that lethal control is the least desirable option but nevertheless there are times when it is necessary. If predation is occurring on healthy, well managed livestock (i.e. producers are already using nonlethal conflict reduction practices), lethal control may be warranted. Removal of wolves in recovered populations is less a biological than a social concern. Particularly bold or habitually depredating wolves can be removed by landowners or Wildlife Services personnel. Contributors recommend engaging state agency wolf specialists or Wildlife

Services when depredation problems arise in order to document and confirm depredations for compensation and data collection purposes.

Contributors have learned that nonlethal and lethal deterrents can be complementary; the possibility of lethal consequences can prolong and accentuate the effectiveness of nonlethal deterrents (Walters et al. 2010). At the same time, contributors agree that lethal control is only effective in the long term if it is used in conjunction with nonlethal deterrents and conflict reduction practices. Without proactive, nonlethal deterrents, lethal control of coyotes and wolves is at best a temporary reprieve because reproduction rates are high and eliminated pack members will soon be replaced.

Contributors recommend keeping non-depredating resident wolf packs intact. As one contributor explains, "If a pack is not killing, leave them be. The worst thing you can do is remove a breeding pair, particularly the alpha female, from a resident pack that is preying on native ungulates rather than livestock." On the other hand, when nonlethal deterrents are not working, contributors stressed the need to remove chronic or habitually depredating animals or packs.

Contributors recommend lethal control of grizzly bears only in cases where nonlethal practices and deterrents are not working and the problem behavior is escalating and being adopted by additional or younger bears. Young bears learn from adult bears; if livestock and crop depredation is allowed to occur repeatedly and unchecked it may well perpetuate through the generations.

One contributor explains it this way:

> *When the animal has become habituated—has killed stock two or more times in a short time period—they aren't going to stop, and lethal control should be an option unless the population is imperiled. Occasional kills, as opposed to consistently killing multiple nights in a row, might deserve a second or third chance. Management decisions need to be made. How many individuals do we need to sustain the population? What can we do to remove conflict? We need to seek balance.*

# Grizzly Bear Depredation in the Upper Green River and Tom Miner Basins

Ranchers in the Upper Green River Cattlemen's Association have continued to graze cattle over the past 20 years, as the resident grizzly bear population increased and reached federal recovery goals.

The Green River Drift is Wyoming's oldest stock drive. It still functions as it has for more than 100 years and is now listed as a Traditional Cultural Property (TCP) on the National Register of Historic Places, the first ranching-related TCP in the nation. The association has been managing their cattle with range riders for 120 years.

In the early 2000s, association ranchers experienced about 2 percent calf mortality, increasing to over 12 percent in 2017. In recent

Hilary Anderson, Anderson Ranch, Montana. Photo: Cory Richards

years, the association has implemented nonlethal deterrents, including herding. Newborn elk are a seasonal food source for grizzly bears in spring, but unfortunately cattle-calves have also become a significant summer source. Multiple generations or cohorts of grizzly bears have learned to feed on cattle, which has resulted in continued depredation.

Recent attempts at bunching and herding cattle on a portion of the Upper Green River allotment did not effectively deter grizzly bear predation. "We found more carcasses where we concentrated cattle than anywhere else on the allotment that summer," explained Albert Sommers. According to Matt Barnes,

> *It is possible that daily human presence with these more concentrated cattle increased the percentage of carcasses discovered, making the predation rate seem higher. However, it may also be that if you already have bears that are keyed into cattle as a seasonal food source, bunching may be ineffective because the bears will kill regardless. If that's true, bunching and herding may need to be implemented when, or before, the killing first begins, rather than years later, after the bears are already food conditioned.*

Problem grizzly bears have been removed for habitual cattle depredation or bold behavior toward humans, but livestock depredation continues to be a problem. Association ranchers continue to work proactively with agencies and NGOs to mitigate the conflict.

In contrast, Andrew and Hilary Anderson in Montana's Tom Miner Basin and Centennial Valley experience far less cattle predation by grizzly bears, although grizzly bear densities in the area are also some of the highest in the Rockies. Why predation rates differ between the two areas is not entirely clear. However, several factors may be in play. First, the Andersons have been working to rekindle defensive behavior in their cattle and decrease vulnerability for the past decade. "We try to follow how wild ungulates move and behave to both acquire optimal feed while also reducing vulnerability to predation," explains Hilary Anderson. Implementing these practices in the mid-2000's may have reduced subsequent bear depredation. Second, the few bears that habitually killed cattle in Tom Miner Basin were removed, before the behavior spread to other bears. Third, bears in the Upper Green River may be more environmentally and behaviorally predisposed to prey on ungulates. In Tom Miner Basin there are adequate, alternative food sources available to meet the metabolic needs of bears, so cattle are seldom used as a food source, at least at current population levels. However, as Anderson cautions, "at some point the bear population may exceed their current food resource. When that happens, it may be that bear depredation will increase."

This comparison underscores the importance of empowering landowners to have deterrents in place early in (or before) the recovery process of large carnivores. It also points to the need for management-oriented research partnerships among landowners, universities, agencies and NGOs to quantify the effectiveness of conflict management practices and to better understand local factors that influence predation, such as behavior, prior history, weather, terrain, vegetation and food abundance.

The first years of wolf recolonization can present a challenging learning curve for landowners, livestock and wolves. During the early phase of wolf recovery, when wolves have not yet reached federal or state recovery goals, depredation incidents must be handled by Wildlife Services agency personnel. Contributors agree that it is essential for landowners, agencies and NGOs to work collaboratively during this early recovery phase to provide training in nonlethal practices and to implement them, and then to communicate and record results. Funding, compensation, cost sharing and technical support from agencies and NGOs for producers is also critical during this difficult phase. As one contributor summarizes, "Funding for nonlethal control and compensation for losses reduces ranchers' financial burden, increases tolerance, provides the necessary tools to implement nonlethal tactics and may allow higher predator populations."

Photo: Lava Lake Land & Livestock

In areas where wolves have reached recovery goals and populations are under state management, the effectiveness of nonlethal practices has generally improved. Several contributors state that nonlethal deterrents significantly reduce wolf depredation as well as decrease stress-related weight loss and disease in their cattle. This is important because stress-induced financial losses can be more significant than depredation losses. For example, 10 percent less weight gain on 1,000 calves is a bigger financial hit than a 5 percent predation loss.

> "Properly deployed and rotated, nonlethal deterrents decrease the number of depredation incidents and the number of animals killed per depredation incident."
>
> —*Brian Bean*

Lava Lake Institute's Wood River Wolf Project (WRWP) in Idaho recently published results from a seven-year case study in which they combined the tactical knowledge of skilled conflict management technicians with herders' flock management skills to significantly reduce wolf depredation. The impetus for the study came from WRWP's observation that "killing depredating wolves without addressing the underlying causes of depredation only temporarily eliminates depredation attacks on livestock" because depredation often begins again once a new pack forms in the vacant territory. Thus, the study was designed to assess whether sheep depredation could be significantly decreased using only nonlethal deterrents.

In addition to human presence, herding and LGDs, WRWP herders are trained to use several different nonlethal deterrents employed singly or in combination and changed periodically. They are equipped with a portable "band kit" including such items as noisemakers (boom boxes, starter pistols and air horns), lights (high intensity headlamps, handheld spot lights and fox lights[10]) and other equipment and spares (a small solar panel, blanks for the starter pistol, batteries and other items). The result of the study was that wolf depredations occurred 3.5 times less in the deterrent-protected area than in a comparison area where deterrents were not employed (Stone et al. 2017). Brian Bean stresses that vigilance and the use of these practices, as dictated by circumstance, reduces both depredation and anxiety-related weight loss in sheep. "Properly deployed and rotated, nonlethal deterrents decrease the number of depredation incidents and the number of animals killed per depredation incident."

# Sheep, Shepherds and Wolves

Considering the failure of nonlethal means to protect herds against wolves in France—more than 1,000 animals killed per year over the past 10 years; 12,000 total losses in 2017—researcher Michel Meuret and colleagues recommend targeted and lethal regulatory actions, despite the strictly protected status of wolves.

Without these actions, the state of affairs will become untenable for breeders and herders, as well as for land and local community managers. Grazing abandonment due to intense pressure from wolves will degrade the biodiversity of landscapes.

For nearly 30 years, breeders have been called on to graze in ways that conserve remarkable species habitats and minimize the risk of wildfire. They volunteer to do this because they benefit from paid grazing contracts and because their grazing practices employ talented herders. French natural resource managers realize that mountain habitats grazed for centuries by intensively herded animals have greater biodiversity. After grazing abandonment, or extensive grazing in fenced pastures, woody species increasingly dominate the landscape and grassland-dependent wildlife species disappear.

Then, wolves, one of several protected species in France, arrived on the scene, dispersing from Italy, where they encountered significant poaching. Their return and recolonization were promoted by some as an expression of recovered biodiversity. Their populations have increased in number and they now occupy the entire French Alps, with 60 wolf pack territories. Currently, the density of packs in the region of the Southern Alps is comparable to that of the Greater Yellowstone Ecosystem in the American West.

Livestock farmers receiving financial support from France and the European Union are urged to recruit assistant herders, use numerous guard dogs, secure electric fencing and systematize night penning. These deterrents are increasingly widespread, but they are costly to install, create considerable constraints for breeders and herders, and result in conflicts with hikers, who have experienced unpleasant or harmful confrontations with

# in the French Alps

Photo: Michel Meuret INRA

guard dogs. Worse, despite their use, losses due to wolf predation continue to increase.

Why? What went wrong? Wolves, as a strictly protected species in France, have learned to disassociate livestock from humans and humans from danger. For decades, the use of any lethal means to eliminate the most insistent individual wolves or packs has been strictly prohibited. For smart and opportunistic wolves, the presence of humans working with herds is not associated with an expected and severe threat. Nonlethal deterrents, used alone, have become increasingly crossable barriers. Without targeted removal of wolves that have become conditioned to prey on livestock, the sustainability of livestock production and the biodiversity of landscapes in the French Alps are deeply jeopardized.[11]

# Large Carnivore Landowner Assistance Programs

Contributors stressed the need for dependable, non-lapsing funding and technical assistance for conflict reduction early in the recovery process, as well as compensation for depredation losses.

Both direct losses (depredated livestock) and indirect losses (stress-induced poor weight gains and disease) have a financial impact on producers. One contributor explained that, "given the current carnivore livestock losses in some areas, ranchers need compensation assistance for their operations to remain economically viable." Losses can vary significantly between ranches in the same area. One contributor explains "some ranchers experience much more depredation than others, so we need to determine how to accurately compensate ranchers." As another contributor explains:

> *We can't run programs to mitigate conflict without ongoing funding—and the funding is not guaranteed. As long as there are carnivore issues, there will need to be publicly funded programs for conflict mitigation. Wildlife are a public asset, and landowners bear a disproportionate share of the cost.*

Livestock guardian dog and herder, Blaine County, Idaho. Photo: Lava Lake Land & Livestock

Technical assistance, cost-share and compensation programs are available from a variety of sources. Appendix 2 includes a list of placed-based, collaborative organizations that support landowners, along with NGOs that provide a variety of assistance.

State and federal agencies are also a good source of assistance. Livestock depredation compensation programs are available in most western states, funded through either the state wildlife agency or the state agriculture agency. Sources of information on compensation, predator deterrent cost-share programs and other conflict reduction programs are listed in Appendix 3.

# Elk and Other Ungulates

Private working lands provide important forage and habitat for large native ungulates, but equitably meeting the needs of both ungulates and livestock is a challenge.

Principle conflicts between landowners and large ungulates throughout the West include depredation of standing and stored hay and other crops, competition for range forage and managing native ungulate population abundance and distribution. Additional conflicts for landowners in the Greater Yellowstone Ecosystem (GYE) include potential brucellosis transmission from Rocky Mountain elk (elk) to cattle and increased livestock predation when elk and livestock comingle or are in close proximity. Concentrations of elk on privately owned wildlands can also create poaching, trespassing and unauthorized antler hunting problems for landowners.

While there are conflict issues with other native ungulates, including bison, pronghorn, mule deer and white-tailed deer, most ungulate conflict issues involve elk. Several contributors located in areas with over-abundant elk and disease concerns find elk conflicts to be riskier and more challenging than wolf conflicts.

# Elk Ecology and Behavior

Like large carnivores, elk are capable of surviving and thriving in a wide variety of habitats, from the timbered mountains to the foothills, valleys, open prairie and deserts of the West.

Most elk in the Rockies are migratory, summering at higher elevations and spending late fall through early spring at lower elevations. Researchers Arthur Middleton and Hall Sawyer, along with photographer Joe Riis, have documented long, complex and perilous migrations of elk, mule deer and pronghorn linking the high summer habitats of the GYE with lower elevation wintering areas up to 150 miles away.[12] This work highlights the dependency of the large ungulate herds of the GYE on lower elevation public and private working lands.

Highways, energy and residential developments and invasive plant species constitute significant threats to many historical migration and seasonal use areas of large ungulates. In contrast, private working lands with wildlife-friendly fencing provide essential habitat and migration corridors.[13] Elk and bison are capable of living 15–20+ years, with females generally producing a single calf per year from the time they are three years old. Deer and pronghorn may live 7–10 years, generally producing 1–2 fawns per year. Complex knowledge of migration routes, seasonal habitats and foraging areas is passed along from generation to generation. Female elk, bison and deer groups observed on summer range are generally matrilineal, consisting of related females that share knowledge and resources. Although deer and pronghorn consume newly emerged grasses, range grass is not a big component of their diet. Depredation issues with deer and pronghorn largely involve planted crops and orchards. Grass is a principal dietary component for bison and elk, resulting in conflict issues over range forage, as well as crop depredation.

# Issues, Strategies and Practices

Conflicts with elk and other large ungulates can be generally categorized as 1) depredation of crops, meadows and livestock forage; 2) ungulate overpopulation and distribution; and 3) brucellosis concerns. In parts of the West, elk depredation of dryland and irrigated fields, including grain, alfalfa and grass hay, has become an issue from August through March.

Producers are impacted economically when elk consume the nutritious alfalfa, hay, grain and other crops intended for harvest or as fall-winter-spring livestock forage.

Like native ungulates, most livestock summer at higher elevations and winter at lower elevations, potentially resulting in overlap and competition for forage and space throughout the year. Livestock often follow behind elk; elk are first to the high country, sometimes returning to lower elevation crops on agricultural lands in late summer as range forage cures. Competition for range forage resources from over-abundant elk populations can impact ranchers financially. In addition, high densities of elk can have negative impacts on ecosystems, including riparian areas and aspen forests, creating challenges in terms of managing for watershed and land health. Comingled elk and livestock may increase livestock-wolf contact and wolf depredation. Livestock comingling with or using lands occupied by brucellosis-infected elk in winter and spring are at increased risk of contracting brucellosis.

## The Importance of Collaboration

Contributors agree that resolving large-scale crop depredation, forage competition, elk-livestock brucellosis and predation conflicts requires cooperative and coordinated actions by landowners, agencies, sportsmen and outfitters. Stakeholders must work together to establish carrying capacity limits for wildlife and livestock, structure hunts to achieve herd management objectives by removing antlerless elk and determine metrics for understanding the costs of ecosystem services provided by landowners that contribute to sustaining ungulate populations. Contributors agree that it is in everyone's best interest to coordinate ungulate management across boundaries. As Montana rancher Erik Kalsta explains, "You have to have the participation of all the landowners to make it work. Elk are survivors, they quickly learn where it's safe to be." When landowners and agencies work together, they can successfully address ungulate conflict in ways that would not have been possible without broad cooperation.

## Managing Crop and Irrigated Meadow Depredation and Use of Range Forage

Many contributing landowners experience large numbers of elk moving to their irrigated hay meadows in August, as range forage cures, and remaining until the following spring. Montana rancher Race King noted that "it's not unusual to count several thousand elk in a single irrigation pivot." These seasonal shifts from forest to irrigated lands also coincide with the onset of the archery hunting season. Wildlife managers have learned that vehicle management on nearby public lands can influence elk movements to private lands.

Contributors agree that most small-acreage haystack and crop depredation issues can be eliminated with permanent fencing or reduced with hunting, hazing and scare devices. When dealing with elk depredation of irrigated meadows and range forage, contributors agree that nonlethal deterrents can be effective, but only in the short-term. Nonlethal deterrents include the use of herding, hazing and scare devices. Most nonlethal approaches provide only temporary protection and

Photo: Melanie Elzinga

are best suited to smaller areas and higher valued resources. When hazing, herding and hunting were compared in a Montana study, hunting was the only effective method for dispersing elk off refugia on private land (Walters et al. 2010).

### Permanent Fencing

Contributors agree that a typical 8-foot-tall woven-wire or multi-strand barbed wire fence provides an effective physical barrier to elk and

other ungulates. Single- or double-strand electric poly-tape fences act as psychological barriers due to learned avoidance conditioning. Avoidance conditioning occurs when an animal contacts the fence, often with the nose or tongue, and receives a powerful electric shock. Training can be expedited by baiting the electrified fence wire with peanut butter or molasses applied directly to the fence to create a negative stimulus when touched (Walters et al. 2010). Permanent or electric fencing of sufficient height for crop fields and orchards can eliminate damage; however, their expense may make them cost prohibitive, especially where the value of protected resources is low and the protected area is large (Walters et al. 2010).

Some Waterton Biosphere Reserve (WBR) ranchers have deterred ungulate depredation by retrofitting existing stack yards (42 inches tall) with 3-D fencing to deter elk, mule deer and white-tailed deer. Three-D fencing consists of an electrified outer fence separated by 3–4 feet from a non-electrified inner fence. Elk and deer will not crawl under the electrified fence, and they won't jump over it because they cannot comfortably land in the narrow space between the two fences. A benefit is that 3-D fencing is less expensive than building a traditional eight-foot stackyard fence. Although WBR does not fund ungulate conflict mitigation practices, some WBR members have reduced fence damage in places where elk frequently cross by adding vertical strips of vinyl siding to fence wires. The increased fence visibility prompted ungulates to jump over rather than run through fences.

While effective, 8-foot-tall, multi-strand wire or electric fencing is costly. Therefore, contributors identify fencing for small acreage crop depredation as an "area of opportunity" for federal and state agencies, sportsmen and NGOs to work together and provide cost-share opportunities. Cost-share fencing for haystacks is a reasonably cost-effective, long-term solution if properly maintained. State wildlife agencies often provide stackyard material and landowners supply the labor.

## Scare Devices

Scare devices include lights, scarecrows, propane guns, pyrotechnics and noise makers. Wyoming Game and Fish biologists report success using inflatable "scary man" deterrents such as tube men or air dancers (the tall, gyrating inflatable devices often seen outside car dealerships). These devices can be effective for several weeks and are especially useful near residential areas. In addition, they are less bothersome to residents than other deterrents because they don't rely on flashing lights or loud noises.

Contributors note that elk habituate quickly to sound-emitting scare devices, soon rendering them ineffective. Therefore, scare devices are likely to be effective for just a short time, requiring frequent rotation and use of multiple stimuli concurrently (e.g. a combination of loud noises, a moving tube man and occasional rubber bullets).

## Hazing and Herding

Hazing and herding involves approaching, disturbing and moving depredating animals using a mix of practices, including pyrotechnics, dogs and humans on foot, horseback or in vehicles. Dogs and invisible fencing systems have also been used to haze ungulates and protect orchards and

Photo: Erika Peterman

annual crops. However, the use of dogs to chase, haze or herd deer and elk from crops may conflict with laws designed to protect wild ungulates from harassment by unaccompanied or feral dogs. Contributors found hazing and scare devices to be largely ineffective when there is little alternative forage; it can be difficult to haze animals away from hay when deep, crusted snow makes other winter forage unavailable.

# *Managing Elk Overpopulation and Distribution*

Elk overpopulation complaints arise when the combined number of livestock and elk temporarily or chronically outstrips available forage resources. Over-abundant elk populations can be an issue on higher elevation summer range, in terms of forage competition and habitat degradation. High densities of elk can negatively impact ecosystems, including riparian areas, aspen and other vegetation, thereby creating challenges for landowners managing for watershed health. One contributor fenced elk off the river running through a property and invested in aspen exclosures and regeneration projects to try to reduce impacts—at high economic cost to the landowner. Some contributors regard elk predation by large carnivores as beneficial in terms of reducing elk abundance and moving or redistributing elk across the landscape. Year-round hunting and predation by bears, wolves and mountain lions can help reduce abundant elk populations and redistribute elk herbivory more broadly across the landscape.

Contributors agree that high elk populations are primarily an issue in valleys and foothills, which are often valuable agricultural and residential properties. Weather extremes—dry summers that produce little forage or deep-snow winters that cover foothill forage and concentrate elk in valleys—can temporarily change elk distribution, creating intense competition with livestock for limited forage and space. These temporary conflicts are often handled with compensation payments, nonlethal deterrents or targeted hunts.

The most challenging problem is the issue of elk populations that chronically exceed wildlife agency population objectives. Population objectives are commonly developed by a process involving landowner and public input and based on a mix of ecological, social, recreational and other concerns. Where traditional recreational hunting and predators are not adequately reducing elk populations, additional regulated hunting, specifically targeting antlerless animals (females or young of the year) is generally required. However, elk population objectives can only be achieved if all landowners within a management area cooperate. If even a small percentage of a unit is closed to hunting, it functions as a refuge where elk congregate. As a result, population reduction objectives are not achieved and problems persist.

Elk distribution on the landscape is a product of weather, human land use and elk abundance. Elk distribution can be changed using a combination of nonlethal deterrents (fencing, hazing and scare devices) and hunting. However, elk distribution can only be managed if suitable areas and habitat are designated specifically for elk use. Long-term distribution solutions often require a carrot-and-stick strategy; that is, enhancing habitat in areas where elk presence is desired (carrot) and moving them away from areas where their presence is not acceptable (stick).

## Hunting

Hunting (lethal control) is the only effective means of reducing over-abundant populations, and it is often the most effective way to remove individuals or groups of depredating animals or to move animals away from conflict areas (Walters et al. 2010). Many landowners have developed hunting operations to help them meet their management goals. They enroll in state wildlife agency access or landowner permit programs, or develop hunting leases with hunters and outfitters. On winter range, after the antlered big game seasons end, they work with outfitters, individuals or state agency programs to remove and disperse elk with antlerless hunting.

The most effective large-scale means of managing elk population abundance and distribution are hunting programs targeted to reduce specific elk populations, removing, dispersing or redistributing problem animals. These programs (often called targeted elk hunts, elk dispersal hunts or shoulder season hunts) target specific conflict areas using longer, more flexible seasons (e.g. August through February). Montana Fish Wildlife and Parks (MFWP) has a shoulder season hunts program, a firearm season occurring before and after the general firearm hunt and archery seasons. Most shoulder season hunts focus on harvesting antlerless elk on private lands. Shoulder season hunts vary in timing and function, and are tailored to specific situations. Because the purpose of shoulder season hunts is to reduce over-objective elk populations, the primary goal is to remove more elk than are recruited into the herd each year.

Some contributors have found shoulder season hunts to be an effective practice for reducing elk abundance and redistributing elk from problem areas. State wildlife agencies may provide hunt

coordination and additional law enforcement assistance. Hunters may be targeted to specific dates, areas and problem animals. Contributors agreed that cooperation among landowners in the targeted hunt area is essential because a single non-participating landowner can create an elk refuge, compromising hunter success and hunt effectiveness. Dean Peterson, a Montana rancher, explains, "Having residential developments or ranches closed to hunting on even a small percentage of the watershed makes population management nearly impossible."

According to another Montana contributor, "MFWP added a shoulder season hunt in our area, running from August through February. It really helped reduce summer as well as winter depredation. Elk didn't move down to the valley until the hunt ended and moved back off as soon as the foothills greened up." This contributor also reemphasizes the importance of full participation. "Since one local rancher didn't participate, we didn't remove as many cow elk as we hoped to."

Not surprisingly, this hunt also functioned as a dispersal hunt; the elk moved to and wintered on the noncooperating landowner's ranch.

Shoulder season hunts on private agricultural lands may not provide the wildland elk-hunting experience desired by many hunters. However, with the right knowledge and abilities hunters can harvest wild game while simultaneously helping landowners and managing herds. Efforts by hunting organizations and state wildlife agencies have begun in a few states to improve hunter behavior, hunting access and hunting effectiveness.

For example, the Montana Master Hunter program is an attempt to increase hunters' access opportunities and improve landowner-sportsmen relations by putting more ethical, educated and effective hunters in the field.[14] Certification requirements include completing course work on hunting and land and conservation ethics, wildlife biology and habitat management, farm and ranch management, landowner-sportsmen relations, pre-hunt planning, hunting skills and care of harvested game. Requirements also include attending a range shooting school. Similar in concept to the Montana program, the Washington State Master Hunter certification requires completion of a home study course and comprehensive exam, a shooting proficiency test, conservation work, crime observation and reporting training, signing the master hunter's code of ethics and passing a criminal background check.[15]

# Elk Dispersal and Shoulder Season Hunts

In late winter 2012, Montana Fish, Wildlife and Parks (MFWP) began testing the effectiveness of hunts to disperse elk and mitigate brucellosis risks, one of several recommendations from the Montana Brucellosis Working Group.[16]

The hunts were tested in an area where increased seroprevalence of brucellosis was detected in the elk population and where elk overlap with cattle during the peak period of transmission risk (January–June). Throughout the winter, MFWP worked with local ranchers to implement several of the working group's recommendations, including hazing elk with riders on horseback, fence building and targeted kill permits. For three weeks in March, hunters removed antlerless elk (usually one hunter per day), as a way to redistribute elk away from winter cattle pastures. The hunt was effective; the elk moved away, demonstrating that a combination of fencing, hazing and targeted hunting is useful for ranchers dealing with the brucellosis challenge.

MFWP has also lengthened the firearm hunting seasons, creating shoulder hunts, in management units where elk populations significantly exceed management objectives. Seasons can begin August 15 and run until February 15 if necessary. In addition to providing more hunter days, these hunts can move elk herds around the landscape, increasing their vulnerability. Along with longer and flexible hunting dates, they provide opportunities to harvest elk on ranches where elk congregate (often on irrigated meadows) before or after the typical five-week rifle season. Several contributors report that longer seasons have helped manage elk distribution and abundance in their areas. Montana rancher Erik Kalsta sees an additional need for targeted, flexible anterless elk hunts. He suggests that "shoulder season hunts need to be structured to reduce elk populations, depredation and disease. Shoulder season permits should target female (antlerless) elk. While recreational considerations are certainly important, they should be of secondary concern." Despite the presence of wolves, Kalsta now raises sheep rather than cattle, in part due to brucellosis concerns and the potential for chronic wasting disease and bovine tuberculosis down the road.

> "It's next to impossible for a rancher or FWP biologist to make a decision regarding elk or public hunting access that doesn't affect others"
>
> *—Montana rancher Chase Hibbard*

Contributors also stress that successful management of elk with targeted hunting requires broad-scale cooperation and collaboration. "It's next to impossible for a rancher or FWP biologist to make a decision regarding elk or public hunting access that doesn't affect others," says Chase Hibbard, a central Montana rancher and former state legislator. "For example, if one rancher outfits and only shoots bulls but not cows, then he could cause a growing winter elk population on surrounding ranches. What one party does affects others."[17]

Mannix Brothers Ranch, Montana. Photo: Erika Peterman

For dispersal hunts to be successful, there must be suitable areas for elk to move to, away from conflict areas. Contributors identified a need to identify adequate elk winter-spring ranges and fund habitat management to attract and hold elk. Designated elk wintering areas can be enhanced by periodic burning, mowing or grazing with livestock to remove decadent forage, improve forage quality and attract elk. Montana rancher Race King notes, "Elk don't always use the non-livestock-grazed areas set aside for them. They often prefer the regrowth on cattle-grazed allotments." Forestry practices such as thinning and prescribed fire can also significantly improve forage conditions for elk and other ungulates in some habitats.

David Mannix, Mannix Brothers Ranch, Montana. Photo: Erika Peterman

Contributors report that timing livestock grazing and rest can also be used to manage elk distribution. Elk are attracted to the higher forage quality in regrown pastures one or more months after livestock move out (Danvir and Kearl 1996). Pastures grazed April–June generally provide better winter forge quality for elk than pastures grazed July–September. Spring grazing on elk winter ranges can increase forage quality and use by elk in the following winter. Livestock grazing and rest can influence native ungulate distribution on summer and winter pasture (Clegg 1995; Mangus 2011).

However, elk re-grazing of pastures following livestock grazing can be a problem if a period of rest (for rangeland health) is prescribed. David Mannix explains, "It can be difficult to restore range with targeted grazing or to build fuel for fire [by resting pastures] when the elk follow around behind cows, re-biting regrowth that needs to be rested."

# Livestock Grazing and Hunting to Change Elk Behavior

Deseret Land & Livestock (DLL) provides an example of the use of positive and negative pressure, a carrot-and-stick approach, to significantly reduce reliance by elk on managed feeding ground.

In this instance, a privately managed feeding ground in northern Utah was established in 1983 during a deep-snow winter to resolve a major elk depredation issue. Because their normal forage was covered, elk were feeding on hay stacks and livestock feed rows along 30 miles of the Bear River Valley in Utah and Wyoming. To resolve the problem, elk were rounded up, settled on a feed ground on DLL and fed there for some portion of each winter over the next 25 years.

In 2008, things began to change. Building on observations of elk behavior and winter habitat preferences during late-season, guided antlerless elk hunts, DLL, Utah State University (USU) and the Utah Division of Wildlife Resources (UDWR) funded a graduate study to re-wild the herd's winter diet from fed hay to range feed, using behavioral observations and principles. The impetus for change included the threat of brucellosis transmission from elk to livestock, incompatibility of an elk feeding ground if (or when) wolves arrived and concern that the feeding ground might facilitate the spread of chronic wasting disease (CWD) to cattle if it showed up in the elk herd.

Elk migrate south from the Greater Yellowstone Ecosystem (GYE) to winter adjacent to DLL during severe winters. Dax L. Mangus explains the carrot-and-stick process used to shut down the DLL feeding ground in Reducing Reliance on Supplemental Winter Feeding in Elk (2011):

> *To affect a change in elk winter feeding behavior, we applied a combination of positive reinforcement for desired behaviors and punishment for undesired behaviors. The positive reinforcement served to reward elk that exhibited desired behaviors while punishment served to decrease undesirable behaviors. Positive reinforcement for being in various locations came in the forms of refuge from hunting pressure and harassment and increased forage availability, while punishment for being in particular locations came in the forms of hunting pressure and harassment.*

Positive reinforcements (carrots) included safe zones, where elk were not hunted. These were rangeland pastures that held adequate forage and/or had been improved via strategic livestock grazing or by other range improvement methods. "Elk select rested pastures in rest-rotation grazing systems because they typically have either actively growing forage or dormant forage not used by cattle" (Mangus 2011).

Elk were hunted and pressured as needed November–January in order to move them to the safe zones from irrigated meadows and other areas where their presence was not acceptable. Late season antlerless elk hunts had been used in the area for years to manage elk population size.


**Photo: Hugh Hogle**

By designating hunt and safe zones, it was possible to use them to manage winter elk distribution, as well. According to Rick Danvir (DLL wildlife manager at the time), to ensure that the hunts were effective all hunters were required to pass a shooting test, administered by ranch staff, to minimize wounding loss. They were then guided by ranch personnel to improve hunter success and assure hunting occurred only where desired. Ranch records indicate that guiding hunters increased hunter success from under 30 to over 60 percent. Implementing the shooting proficiency test increased hunter success to nearly 90 percent and significantly decreased wounding losses. Most hunters harvested their elk on their first day afield, and hunter days per elk harvested averaged about 1.3. Guides were provided at no charge, which cost the ranch about $100 per hunter.

Mangus continues, explaining the complementarity of hunting and hazing,

> *Hunting is an effective way to reduce/prevent depredation and human-wildlife conflicts. Hunting can also increase the effectiveness of hazing and harassment to prevent damage as animals learn the threat is real. When hunting is used to reinforce hazing, animals tend not to habituate. Conversely, animals routinely hazed or harassed eventually learn the threat is benign and these methods quickly lose effectiveness (Mangus 2011).*

Mangus stresses that "while hunting and hazing influence elk behavior, elk depredation is likely to continue if there are no acceptable alternative sources of winter food." According to Danvir, successfully reducing use of the DLL elk feeding ground required both the carrot and the stick, "providing acceptable alternative sources of winter forage to reinforce desired forage and habitat selection behaviors in addition to the punishment that provided elk the motivation to change behavior." In the end, the program eliminated use of the feeding ground in all but severe winters and decreased feeding costs in severe winters by half. "The combination of multiple methods, based on principles of behavior, undoubtedly contributed to our success."

## Managing Brucellosis Concerns

Brucellosis is an infectious disease caused by the bacteria *Brucella abortus*. It is transmittable to humans and can be carried by many animals, including wild and domestic ungulates, wild and domestic canids and bears. *Brucella* bacteria infect the reproductive system, resulting in late-gestation abortions, premature births, retained placentas, and male and female infertility. Brucellosis also causes lameness and arthritis in bison, elk, deer, moose, cattle and horses.

Wild and domestic animals become infected by inhaling or ingesting *Brucella* contaminated birth fluids, birth tissues, forage plants, soil and drinking water (Thorne et al. 1979). Brucellosis can also be sexually transmitted and females can transmit it to their young through milk. Risk of transmission from fetal tissues and fluids of infected elk is greatest from February to mid-June, during elk calving season.

Brucellosis was introduced to North America by infected cattle imported from Europe in the early 1860s. Bison in Yellowstone National Park (YNP) were likely infected in the early 1900s by cattle or captive-bred bison brought to the park. The YNP elk were likely then infected by the bison. Now, the wild bison and elk inhabiting YNP are one of the few known remaining reservoirs of *B. abortus* in the United States. There is an effective vaccine for cattle, but in the past decade, brucellosis appears to have been transmitted from elk to cattle. Transmission of brucellosis is also occurring among elk outside YNP, apparently spreading by contact between adjacent elk herds.

Photo: Melanie Elzinga

Ranching in areas containing brucellosis-infected elk adds risk and requires additional cost, planning and vigilance. Ranchers are required to blood test and vaccinate cattle for the disease and avoid grazing livestock on lands occupied by elk January through June. The USDA Animal and Plant Health Inspection Service (APHIS) worked with the states of Montana, Wyoming and Idaho in 2009–2010 to create Designated Surveillance Areas (DSAs) to prevent transmission of brucellosis to areas outside the GYE and destroy individual cattle that test positive for brucellosis. Additionally, when brucellosis is detected, the herd and potentially exposed herds may be placed under quarantine or depopulated, which can have serious financial implications for the producer and wipe out years of building genetics and behaviors.

Several practices have been employed to reduce elk-cattle brucellosis transmission, with varying degrees of success. These include capturing, testing and killing elk testing positive for brucellosis; feeding, fencing and hazing elk away from livestock; and extended, flexible hunting

seasons to kill or disperse elk. The set of practices considered effective for reducing both elk-cattle and elk-elk disease transmission include vaccinating cattle, fencing, hazing and hunts designed to keep elk dispersed and separated from cattle January through June, when transmission risk is greatest. Concentrating elk on winter

Photo: Erika Peterman

feeding grounds can effectively reduce elk-cattle transmission but may increase the risk of elk-elk transmission. Contributors emphasize that "all these solutions cost time and money, and require collaboration between landowners, agencies and sportsmen."

Some ranchers in DSAs have shifted their operations to running yearling steers, spayed heifers or sheep to eliminate risk of infection, brucellosis testing and vaccinating. Ranchers may adjust the timing and locations of grazing to avoid elk and may fence hay stacks, cattle feeding grounds and pastures with elk-proof fence. In some areas, MFWP hires horseback riders to haze elk away from cattle and provides permits to ranchers to shoot elk.

## *Comingled Livestock, Elk and Wolves*

Several contributors have seen reductions in wolf depredation by keeping livestock away from elk on both summer and winter ranges. Conflict management practices (e.g. hunting, fencing and hazing) used to reduce elk depredation can also be used to avoid mixing livestock with elk, as can timing livestock grazing to avoid elk concentration areas.

Whether native ungulate presence influences wolf depredation on livestock remains unclear. In Idaho, Montana and Alberta, livestock depredations were more prevalent in pastures where elk were present (Kovacs et al. 2016). Wolves are likely attracted to areas with larger numbers or higher densities of native ungulates (particularly elk), and livestock in those areas may be at greater risk of encountering wolves and being attacked. However, it has also been suggested that wolves may kill livestock at greater rates when the availability or vulnerability of native ungulates is low (Mech et al. 1988). Nelson et al. (2016) also emphasize the complex nature of livestock predation in relation to wolves, elk presence and terrain. Livestock predation by wolves in areas with resident elk most commonly occurred where cattle and elk were commingled. However, in areas where elk were migratory (not always present), livestock depredation sites were more often associated with landscape attributes such as wolf dens, streams and open habitat. Contributors emphasize this as an area requiring further research.

# Large Ungulate Landowner Assistance Programs

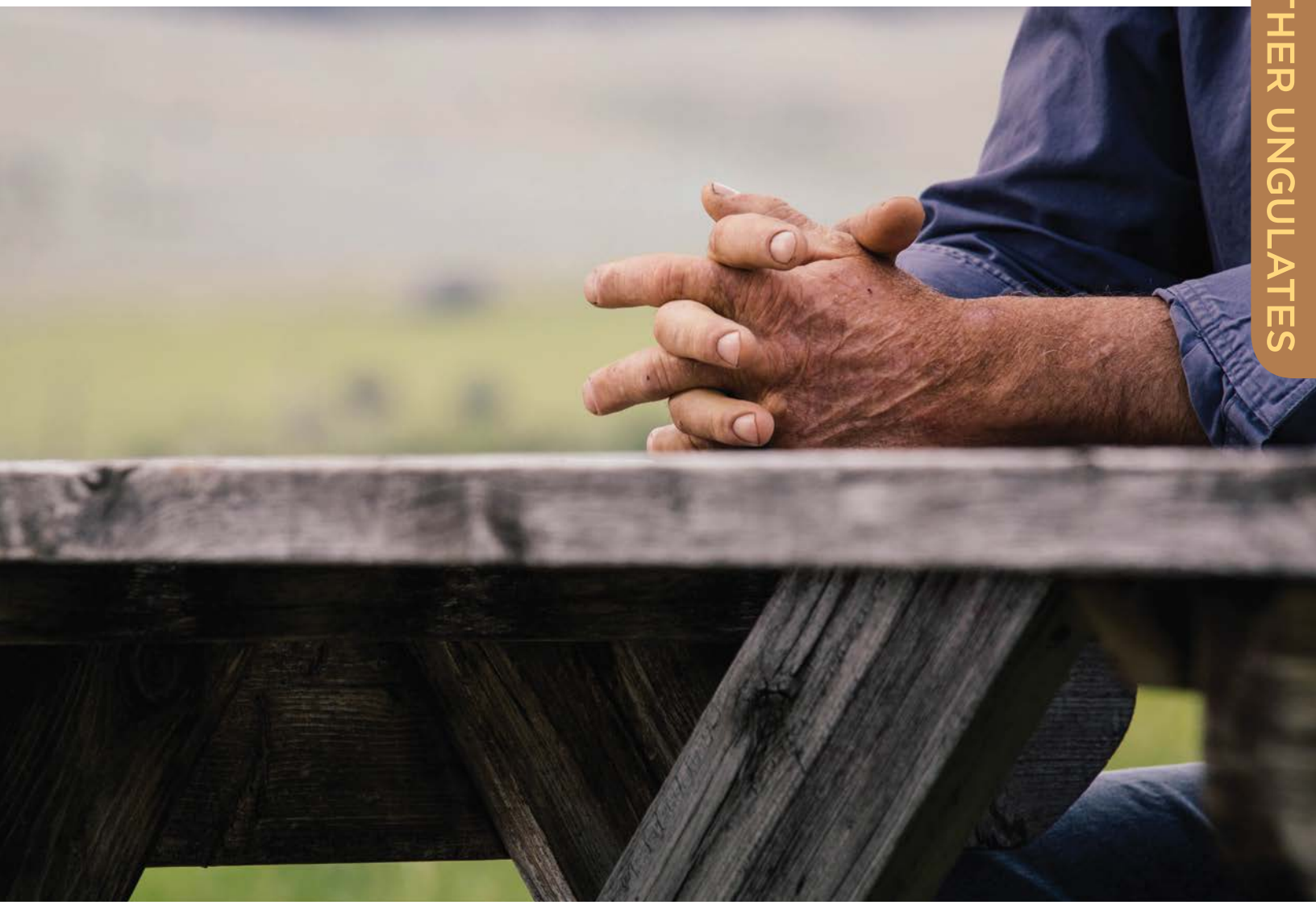


Photo: Erika Peterman

State wildlife agencies have developed a variety of programs designed to provide compensation or incentivize wildlife tolerance, management and hunter access on private lands. These private lands-public wildlife programs vary among states.

Some provide compensation or cost-share on habitat improvements; some incentivize public access for recreation and ungulate population management; and others allow landowners to direct hunting permits to specific hunters as a financial incentive for providing wildlife habitat. Programs available in several western states are described in Appendix 3.

# In Conclusion

The art and science of conflict reduction is evolving quickly, as proactive and innovative producers, landowners, agencies and NGOs continue to develop and perfect useful practices.

Here are a few recurring principles in the comments, stories and case studies included in this guide:

- Recognize that human presence is a deterrent and that frequent attention to crops, flocks and herds by skilled practitioners is the most effective and therefore the most important conflict reduction practice.
- Remove or secure attractants—including carcasses and crops—from wildlife. It is often more difficult to change the behavior of a food-conditioned animal than to secure the attractant in the first place.
- Learn the proper use of multiple nonlethal deterrents.
- Match the practice to the situation and change deterrents periodically to avoid habituation.
- Be aware that in most cases the more concentrated the herd and the smaller the acreage you are protecting, the more effective deterrents will be.
- Understand the relationship between nonlethal and lethal practices. In places where lethal intervention is permitted, wolves become more secretive and wary of humans; therefore, nonlethal deterrents are more effective in places where the threat of lethal control exists.

Finally, it cannot be stated too strongly that conflict reduction is only one aspect of responsible working lands stewardship and that it requires collaborative planning and managing by multiple partners for the needs of large carnivores, ungulates and people on the landscape. Landowners and others who care about wildlife diversity and heritage and who are dedicated to restoring and sustaining the health of working lands must work together to assure a place for grizzly bears, wolves and elk in the West. It is also essential for the public, including environmental advocates, sportsmen and regulatory agencies, to recognize the economic, cultural and ecological importance of keeping working lands economically viable and intact, and to support and partner with landowners in this effort.

Photo: Flying D Ranch

# Literature Cited


Bangs, E., M. Jimenez, C. Niemeyer, J. Fontaine, M. Collinge, R. Krsichke, L. Handegard, J. Shivik, C. Sime, S. Nadeau, C. Mack, D. W. Smith, V. Asher and S. Stone. 2006. *Non-Lethal and Lethal Tools to Manage Wolf-Livestock Conflict in the Northwestern United States. Proceedings of the 22nd Vertebrate Pest Conference*, R M. Timm and J. M. O'Brien, Editors. University of California, Davis.

Barnes, M. and A. Hill. 2013. "Forward: Strategic Grazing Management for Complex Creative Systems," *Rangelands* 35:3–5.

Barnes, M. 2015. "Livestock Management for Coexistence with Large Carnivores, Healthy Land and Productive Ranches," http://www.peopleandcarnivores.org.

Clegg, K. 1994. "Density and Feeding Habits of Elk and Deer in Relation to Livestock Disturbance." MS Thesis, Utah State University, Logan.

Danvir, R.E. and S.L. Kearl. 1996. "A Holistic Approach to Managing Wildlife and Big Game Movements with Livestock: The Lost Creek Foundation," *Sharing Common Ground on Western Rangelands: Proceedings of the Symposium*. U.S. Forest Service Gen. Tech. Report INT-GTR-343, Ogden, Utah.

Danvir, R., G. Simonds, E. Sant, E. Thacker, R. Larsen, T. Svejcar, D. Ramsey, F. Provenza, and C. Boyd. 2018. "Upland Bare Ground and Riparian Vegetative Cover under Strategic Grazing Management, Continuous Stocking and Multiyear Rest in New Mexico Mid-grass Prairie," *Rangelands* 40:1–8.

Kovacs, K. E., K.E. Converse, M.C. Stopher, J.H. Hobbs, M.L. Sommer, P.J. Figura, D.A. Applebee, D.L. Clifford, and D.J. Michaels. 2016. *Conservation Plan for Gray Wolves in California*. California Department of Fish and Wildlife, Sacramento.

Madison, J. S. 2008. "Yosemite National Park: The Continuous Evolution of Human–Black Bear Conflict Management," *Human–Wildlife Interactions* 2(2):160–167. Also available at http://digitalcommons.unl.edu/hwi/54.

Mangus, D. L. 2011. "Reducing Reliance on Supplemental Winter Feeding in Elk (*Cervus canadensis*): An Applied Management Experiment at Deseret Land and Livestock Ranch, Utah." MS Thesis, Wildlife Biology, Utah State University, Logan.

Mech, L. D., S. H. Fritts, and W. J. Paul. 1988. "Relationship Between Winter Severity and Wolf Depredations on Domestic Animals in Minnesota," *Wildlife Society Bulletin* 16:269–272.

Mech, L.D. and L. Boitani. 2003. *Wolves: Behavior, Ecology and Conservation*. Chicago: University of Chicago Press.

Meuret, M. and F. Provenza, editors. 2014. *The Art & Science of Shepherding:Tapping the Wisdom of French Herders*. Austin: Acres U.S.A.

Nelson, A., M. Kauffman, A. D. Middleton, M. D. Jimenez, D. McWhirter, and K. Gerow. 2016. "Native Prey Distribution and Migration Mediates Wolf Predation on Domestic Livestock in the Greater Yellowstone Ecosystem," *Canadian Journal of Zoology* 94:291–299.

Nolte, D.L., K. K. Wagner and A. Trent. 2003. "Timber Damage by Black Bears–Approaches to Control the Problem." Missoula: USDA Forest Service Technology and Development Program 3E32E84, Animal Damage Management.

ORCP. 2010. "Wolf-Livestock/Domestic Animal Conflicts," in *Oregon Wolf Conservation and Management Plan* (Chapter III). Available at https://www.dfw.state.or.us/Wolves/docs/2010_wcmp_wolf_livestock_conflicts.pdf.

Stone, S. A., S. W. Breck, J. Timberlake, P. M. Haswell, F. Najero, B. S. Bean, and D. J. Thornhill. 2017. "Adaptive Use of Nonlethal Strategies for Minimizing Wolf–Sheep Conflict in Idaho," *Journal of Mammalogy* 98(1):33–44.

Teague, W. R., S. L. Dowhower, R. J. Ansley, W. E. Pinchak and J. A. Waggoner. 2010. "Integrated Grazing and Prescribed Fire Restoration Strategies in a Mesquite Savanna: I. Vegetation Responses," *Rangeland Ecology & Management* 63:275–285.

Thorne, E. T., J. K. Morton, and W. C. Ray. 1979. "Brucellosis, Its effect and Impact on Elk in Western Wyoming," in M. S. Boyce and L. D. Hayden-Wing (eds), *North American Elk: Ecology, Behavior and Management*. Laramie: University of Wyoming Press.

Urbigkit, C. 2016. *Brave and Loyal: An Illustrated Celebration of Guardian Dogs*. New York: Skyhorse Publishing.

Urbigkit, C. and J. Urbigkit. 2010. "The Use of Livestock Protection Dogs in Association with Large Carnivores in the Rocky Mountains: A Review," *Sheep & Goat Research Journal* 25:1–8.

Walter, W. D., M. J. Lavelle, J. W. Fischer, T. L. Johnson, S. E. Hygnstrom and K. C. VerCauteren. 2010. "Management of Damage by Elk (Cervus elaphus) in North America: A Review," *Wildlife Research* 37:630–646.

Zaranek, H. 2016. "Stockmanship and Livestock Predation Mitigation," *Stockmanship Journal* 5(2):34–46.

# Notes

1. *Corn Bears*, a short documentary by People and Carnivores, is available on Facebook at www.facebook.com/PeopleAndCarnivores/videos/vb.418613648160747/1549983641690403/?type=2&theater.
2. Information on fladry installation is available from People and Carnivores and Defenders of Wildlife. See Appendix B.
3. *How to Use Fladry*, a short video produced by People and Carnivores, is available on Facebook at www.facebook.com/PeopleAndCarnivores/videos/vb.418613648160747/1748119091876856/?type=2&theater.
4. Learn more about the Wood River Wolf Project and the resources they provide at https://www.woodriverwolfproject.org.
5. For more information about Wind River Bear Institute and its Karelian bear dogs, visit https://windrivertailsandtrails.com/karelian-bear-dogs/.
6. Learn more and/or contact the Get Bear Smart Society at www.bearsmart.com.
7. Access training videos at Rancher Predator Awareness, www.rancherpredatorawareness.com.
8. Meet Glenn and Caryl Elzinga and learn more about their operation at the Alderspring Ranch Grassfed Organic Beef website, https://www.alderspring.com.
9. Hear more from Cody Lockhart and others about livestock guardian dogs in a short video at People and Carnivores at www.facebook.com/PeopleAndCarnivores/videos/1549949488360485/.

10. Access more about fox lights, fladry, and other deterrence methods at Wood River Wolf Project's website, www.woodriverwolfproject.org/tools/, where you will also find photos and videos.

11. Meuret, M. and F. Provenza, editors. 2014. *The Art & Science of Shepherding: Tapping the Wisdom of French Herders*. Austin: Acres USA, Inc.

12. The Red Desert to Hoback Mule Deer Migration, the Path of the Pronghorn and Elk Migrations of the Greater Yellowstone are chronicled by the Wyoming Migration Initiative at http://migrationinitiative.org.

13. Design and funding information for wildlife friendly fencing is available in Appendix 2.

14. Comprehensive information about the Montana Hunter Advancement Program and Master Hunter certification is available at http://mtmasterhunter.com.

15. Learn about the Washington Department of Fish and Wildlife's Master Hunter Permit Program at https://wdfw.wa.gov/hunting/masterhunter.

16. Montana Fish, Wildlife and Parks website (for more about elk dispersal and the Montana Brucellosis Study Group, including multiple reports): http://fwp.mt.gov/fishAndWildlife/diseasesAndResearch/healthPrograms/brucellosis/default.html.

17. Tom Dickson, "The Elk Next Door: Why one person's prized (or profitable) elk has become another person's elk depredation problem." at Montana Outdoors (originally published in 2003): http://fwp.mt.gov/mtoutdoors/HTML/articles/2003/elkdepredation.htm.

# Appendix 1: Glossary

**Attractants** refers to potential food items for large carnivores and ungulates—particularly agricultural products, including crops and living or dead livestock.

**Aversive conditioning** is to cause avoidance of something by using an unpleasant or punishing stimulus. If a depredating animal has an unpleasant experience, such as fear (loud noises or lights) or pain (electric shock, rubber bullets) when attempting to enter an area, it is being taught or conditioned that it should not repeat this action.

**Carcass removal** is moving dead livestock carcasses from areas accessible to scavenging wildlife. Carcass removal generally pertains to places where livestock are concentrated for activities such as calving and winter feeding. Traditionally, most producers collect carcasses of livestock that die in calving season and over the winter into piles or pits near calving or feeding areas. These carcasses can draw scavengers (including wolves and grizzly bears) from miles away, which may result in predation on living livestock.

**Depredation** refers to unwanted preying by large carnivores or ungulates on livestock, stored crops or crops in the field.

The **Endangered Species Act (ESA)** was enacted in 1973 by the U.S. Congress to "provide for the conservation of endangered and threatened species of fish, wildlife and plants." It is administered by both the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). Visit the WLA website to download the publication, "Speaking from Experience: Landowners & the Endangered Species Act," Allison et al. 2017.

**Extirpation** is the complete extermination of all members of a species within a given area.

The **Farm Bill** is the primary agricultural policy tool of the United States government. It funds soil, water and wildlife conservation programs administered by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

**Fladry**, a nonlethal deterrent placed around livestock to discourage predation by wolves, consists of red flagging tied at intervals onto a rope, which is hung along the top of a fence. Fladry was developed in Europe as a way to drive and capture wolves, which are inherently risk-averse and reluctant to cross under unknown objects.

**Fox lights** are 360-degree, randomly flashing strobe lights, used to scare predators away from livestock. They were developed in Australia to deter predation by foxes and are now commercially available in the U.S.

**Hyperphagia** refers to the highly increased appetite and food intake exhibited by bears, usually prior to denning in the fall. Bears may double their weight during relatively short periods of hyperphagia.

**Karelian bear dogs** were bred in Finland to hunt aggressive game, including bears, moose and boars. Their especially well-developed ability to hunt and protect against bears is the source of the name. They can be used to condition bears from depredating small areas like campgrounds.

**Large carnivores** are native predators capable of killing and eating livestock.

**Larkspur** (*Delphinium* spp.), a native plant of the Rocky Mountains, is toxic to cattle if eaten in sufficient amounts.

**MAG** (**M**otion **A**ctivated **G**uard) devices employ combinations of light and noise, mimicking random human activity to scare away potential predators. These devices are motion-activated similarly to the way trail cameras are.

**Radio telemetry** receivers are monitoring equipment used to track animals wearing radio transmitters (collars). Receivers may be issued to livestock producers to facilitate their own proactive management activities and aid in the detection and prevention of livestock depredation. Wildlife management agencies in Washington and Oregon notify livestock producers or managers when collared wolves are in the vicinity of their property and/or livestock. Such notifications may allow for movement, herding or increased human presence and vigilance in the area to prevent depredations. The Oregon Department of Fish and Wildlife has developed an automated system that notifies potentially affected livestock producers or managers by text message or email when collared wolves are in the vicinity of their livestock (Kovacs et al. 2016).

**RAG** (**R**adio **A**ctivated **G**uard) devices use a flashing strobe light and loud speakers that emit noise annoying to wolves. The device is activated when the box detects a signal from a radio collar, thereby scaring away the approaching wolves.

**Range riders** are employees paid by producers and/or agencies to tend livestock herds throughout calving and summer grazing seasons, facilitating a more rapid response to predators. Range riders may have access to telemetry equipment to determine the location of nearby radio-collared wolves. In Montana, in addition to potentially reducing the risk of livestock depredation, the use of range riders has cultivated trust between ranchers, residents, and agency staff (Kovacs et al. 2016). The most successful range riding operations focus primarily on herd management rather than on controlling predators. The costs of range riding can be prohibitive for smaller operations, but this can be overcome when smaller operations pool resources. Landowners and producers who contributed to conversations conducted by WLA expressed interest in research to increase the effectiveness of range riding and in training programs for range riders.

**Seroprevalence** is the level of a pathogen in a population, as measured in blood serum. In this case it is used to describe the occurrence of the brucellosis virus (*Brucella abortus*) in elk populations.

**Terrain** refers to the topography or physical features of a tract of land (hills, ravines, cliffs, etc.).

**Turbo-fladry** refers to electric fencing outfitted with fladry (see "Fladry").

**Ungulates** are hoofed, herbivorous mammals. In this guide, ungulates refers to large, native grazing or browsing mammals, including elk, bison, deer and pronghorn.

**Working lands** refers to nonresidential, managed farm, forest and ranch lands that support agricultural operations (such as livestock grazing and cropping), wildlife populations and habitat.

# Appendix 2: Resources

**Place-based collaborative working groups** can often direct landowners to information on funding for management and compensation. To learn whether there is a collaborative group operating in your area, contact your state wildlife agency, state agriculture agency, local conservation district or Natural Resource Conservation Service (NRCS) office.

## Several collaborative groups contributed to this guide:

**Blackfoot Challenge** (www.blackfootchallenge.org/) focuses on resource issues and communities in the Blackfoot Watershed of western Montana.

**Big Hole Watershed Committee** (www.bhwc.org/) focuses on issues and communities in the Big Hole Watershed of southwestern Montana.

**Heart of the Rockies** (https://heart-of-rockies.org/) is a land trust organization working to conserve clean water, western landscapes and communities in the Northern Rockies from Wyoming to British Columbia.

**Lava Lake Institute for Conservation & Science** (fiscal sponsor of the Wood River Wolf Project) (www.lavalakeinstitute.org/) focuses on conservation and increased understanding of wildlife and ecosystems in central Idaho.

**Montana Watershed Coordination Council** (https://mtwatersheds.org/app/) unites, funds and coordinates work among watershed communities throughout Montana.

**Waterton Biosphere Reserve's Carnivores and Communities Program** (http://www.watertonbiosphere.com/projects/carnivores-communities/) is part of UNESCO's Man and the Biosphere Program. It focuses on resources and communities in western Alberta.

**Wood River Wolf Project** (https://www.woodriverwolfproject.org/tools/) offers information and resources for reducing conflict and implementing nonlethal strategies including band kits (sets of deterrent tools and devices) and recommendations for their use.

## Non-governmental organizations (NGOs)

**Defenders of Wildlife** has developed a guide for landowners entitled, "Livestock and Wolves: A Guide to Nonlethal Tools and Methods to Reduce Conflict" (https://defenders.org/publications/livestock_and_wolves.pdf).

The **Get Bear Smart Society** (http://www.bearsmart.com/live/programs/) offers practical advice to improve coexistence with bears. Bear Smart is represented locally in many parts of the country.

**People and Carnivores** (www.facebook.com/PeopleAndCarnivores) provides useful information on conflict mitigation for and coexistence with large carnivores in the West.

**Rancher Predator Awareness** (www.rancher-predatorawareness.com) provides training videos for landowners interested in teaching livestock to resist predation by forming groups.

**The Wind River Bear Institute** (https://windriver-tailsandtrails.com/karelian-bear-dogs) provides information on the use of Karelian bear dogs and other behavioral techniques to reduce conflict with bears.

## Guides to designing wildlife friendly fencing

Paige, C. 2012. A Landowner's Guide to Fences and Wildlife: Practical Tips to Make Your Fences Wildlife Friendly. Wyoming Land Trust, Pinedale, WY. Available at www.sagegrouseinitiative.com/wp-content/uploads/2013/07/Wyo_FenceGuide.pdf.

Paige, C. 2015. A Wyoming Landowner's Handbook to Fences and Wildlife: Practical Tips for Fencing with Wildlife in Mind. Wyoming Community Foundation, Laramie, WY. Available at https://wyomingwildlifefoundation.org/wp-content/uploads/2016/06/Fencing-Guide.pdf.

## Guides to identifying livestock cause of death

Knight, J. 2004. "Ranchers guide to wolf depredation." Montana State University Extension Service. Available at http://animalrangeextension.montana.edu/wildlife/documents/wolf_depredation.pdf.

Washington Department of Fish and Wildlife. 2013. "Livestock Mortality Investigations. A Reference Guide for WDFW Field Personnel." Available at http://wdfw.wa.gov/conservation/gray_wolf/livestock/livestock_mortality_investigation_manual_mar2013.pdf.

## Additional reference material

Bradley, E. H., H. S. Robinson, E. E. Bangs, K. Kunkel, M. D. Jimenez, J. A. Gude, and T. Grimm. 2015. "Effects of Wolf Removal on Livestock Depredation Recurrence and Wolf Recovery in Montana, Idaho, and Wyoming," Journal of Wildlife Management 79(8):1337–1346.

Gese, E. M., S. P. Keenan and A. M. Kitchen. 2005. "Lines of Defense: Coping with Predators in the Rocky Mountain Region," USDA National Wildlife Research Center – Staff Publications 97. Available at https://digitalcommons.unl.edu/icwdm_usdanwrc/97.

Linnell, J. D. C. and N. Lescureux. 2015. Livestock Guarding Dogs: Cultural Heritage Icons with a New Relevance for Mitigating Conservation Conflicts. Trondheim: Norwegian Institute for Nature Research. Available at http://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/livestock guarding dogs_web.pdf.

Smith, L., J. Hutchinson and L. DeNesti. 2014. Wolf-livestock Nonlethal Conflict Avoidance: A Review Of The Literaturewith Recommendations for Application to Livestock Producers in Washington State. A Project of Western Wildlife Outreach, available at https://wdfw.wa.gov/conservation/gray_wolf/livestock/wolf_livestock_conflict_avoidance_literature_review_11_2014_final_submitted_version.pdf .

Wilson, S. M. 2016. A Guidebook to Human-Carnivore Conflict: Strategies and Tips for Effective Communication and Collaboration with Communities. Slovenia Forest Service–LIFE DINALP BEAR project, Ljubljana, Slovenia. Available at http://dinalpbear.eu/wp-content/uploads/ENGLISH_Guidebook_Seth_Wilson_WEB2.pdf.

# Appendix 3: Agency Landowner Assistance Programs

## *Large Carnivore Assistance Programs*

### Federal

In states where wolves are still protected under the federal Endangered Species Act (ESA), the U.S. Fish and Wildlife Service (USFWS) and USDA Wildlife Services are primary sources of funding for compensation and conflict management. ln states where wolves and other large carnivores are not federally protected under the ESA and are under state management, FWS assistance is limited. However, Wildlife Services can provide assistance with depredation issues (https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/operational-activities/sa_livestock/ct_protecting_livestock_predators).

The U.S. Fish and Wildlife Service Mexican Wolf Recovery Program (https://www.fws.gov/southwest/es/mexicanwolf/) funds compensation and mitigation programs for New Mexico and Arizona producers with funds from the 2014 Farm Bill. The Arizona Loss Livestock Board (ALLB) addresses the economic impacts of wolves on individual producers by "reimbursing confirmed and probable wolf-caused losses, helping reduce losses by approving projects and funding programs to discourage and prevent wolves from killing livestock, providing 'Pay for Presence' funding and seeking appropriate levels of secure funding to support the actions of the Board." The Payments for Wolf Presence program was developed by the Mexican Wolf/Livestock Council to create incentives for ranching in ways that promote self-sustaining Mexican wolf populations, viable ranching operations and healthy western landscapes. While contributors to this guide agree that this is a good approach, adequate funding remains an issue.

### States and Provinces

Alberta: Wildlife in Alberta are managed by the Alberta Environment and Parks-Fish and Wildlife (http://aep.alberta.ca/fish-wildlife/default.aspx). The Waterton Biosphere Reserve (WBR), despite its successes in conflict mitigation, is still in need of a dependable compensation program. However, compensation for livestock kills can be a touchy subject and opinions about how much and for what vary. Losses in Alberta are unevenly distributed among producers. Due to a significant burden of proof and the amount of time necessary to verify loss and file claims, livestock losses are often not reported and not fully compensated (https://www.sciencedirect.com/science/article/pii/S0190052816300864).

California: Wildlife is managed by the California Department of Fish and Wildlife (https://www.wildlife.ca.gov/). At present, California compensates for livestock losses to wolves. Information on nonlethal deterrents is available in "Livestock Protection Tools for California Ranchers," a 2018 University of California, Agriculture and Natural Resources publication (https://anrcatalog.ucanr.edu/pdf/8598.pdf).

Idaho: Wildlife in Idaho are managed by Idaho Fish and Game (https://idfg.idaho.gov/). The Idaho Governor's Office of Species Conservation can compensate producers using range riders or other deterrents for verified livestock losses due to wolves through funding from the U.S. Fish and Wildlife Service's Wolf Livestock Demonstration Project Grant Program (https://www.idahofb.org/News-Media/2017/10/funding-available-for-wolf-depredation).

The Idaho Wolf Depredation Control Board was created to provide landowner assistance for

mitigating conflicts with wolves (https://dfm.idaho.gov/publications/bb/strategicplans/general/stratplan_wolfboard.pdf).

Montana: Montana Fish, Wildlife and Parks (http://fwp.mt.gov/) provides technical assistance to landowners for carnivore conflict management. The Montana Livestock Board provides compensation for confirmed losses and can cost-share with qualifying landowners and landowner groups for loss preventive measures, such as riders, fencing, and deterrent devices (http://liv.mt.gov/Attached-Agency-Boards/Livestock-Loss-Board).

Oregon: Oregon Department of Fish and Wildlife (ODFW) (https://www.dfw.state.or.us/), provides technical assistance, allows non-injurious deterrents for wolves and may authorize permits allowing the use of nonlethal injurious deterrents (e.g., rubber bullets, bean bags). While ODFW cannot compensate landowners for damages by wildlife, the Oregon Department of Agriculture provides some funding, administered through counties, to compensate landowners for livestock losses and to implement livestock management and other nonlethal conflict mitigation practices.

Washington: Sheep, cattle or horses killed or injured by bears, mountain lions or wolves in Washington are eligible for compensation using state funds. Washington Department of Fish & Wildlife (WDFW) pays the full value of verified losses on acreages less than 100 acres, or two times the value on acreages greater than 100 acres (based on the assumption that not all losses are found on larger acreages) (https://wdfw.wa.gov/conservation/gray_wolf/livestock/compensation.htm).

The WDFW develops site- and producer-specific management plans to reduce wolf conflict, utilizing a suite of practices, including confining cattle during calving, managing carcasses, keeping calves off-range until they reach at least 200 pounds, avoiding wolf denning and rendezvous sites, and maintaining human presence and rotational grazing. WDFW provides technical support, cost-sharing for approved practices and compensation for confirmed losses.

Wyoming: Large carnivore depredation and compensation issues are handled by the Wyoming Game & Fish Department (WGF). Contact local or regional staff by accessing the WGF website (https://wgfd.wyo.gov/). The article, "Compensation Programs in Wyoming for Livestock Depredation by Large Carnivores" (https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1004&context=icwdmsheepgoat), discusses Wyoming Game Commission calculations used to reimburse livestock losses from WGF funds. WGF also offers Living in Bear Country and Bear ID programs at their website.

## *Large Ungulate Assistance Programs*

All programs discussed below are administered by state wildlife agencies. For additional information, contact local, regional or state wildlife representatives.

Depredation Permits. Most western states have permits available to deal with specific depredation situations on private lands. These permits are generally issued by the states to hunters and may include agency staffing to assist in coordinating the hunts in collaboration with affected landowners to target specific depredation problems and problem ungulates.

Funding to Improve Habitat or Access. All the western states surveyed (AZ, CA, CO, ID, MT, OR, NM, NV, UT, WA) have some form of funding and technical support to improve habitat and encourage hunter access on private lands.

Habitat Partnerships. At least two states (AZ, CO) have developed programs to minimize conflicts with wildlife and proactively encourage landowners, sportsmen and agencies to work together to manage public wildlife on private

lands. Funds are appropriated by the state for local habitat partnership committees for conflict reduction and habitat improvement. In the case of the Colorado Habitat Partnership Program, a percentage of all state hunting license revenues are returned to the management unit for the committees' use.

**Landowner Association Permits** (UT). These permits are made available to associations of landowners with suitable big game habitat within limited entry buck and bull hunting units. The number of permits allotted is based on a percentage of permits available for the entire unit, and the association landowners are required to provide comparable access to a number of public hunters equal to the number of association permits (50:50 split).

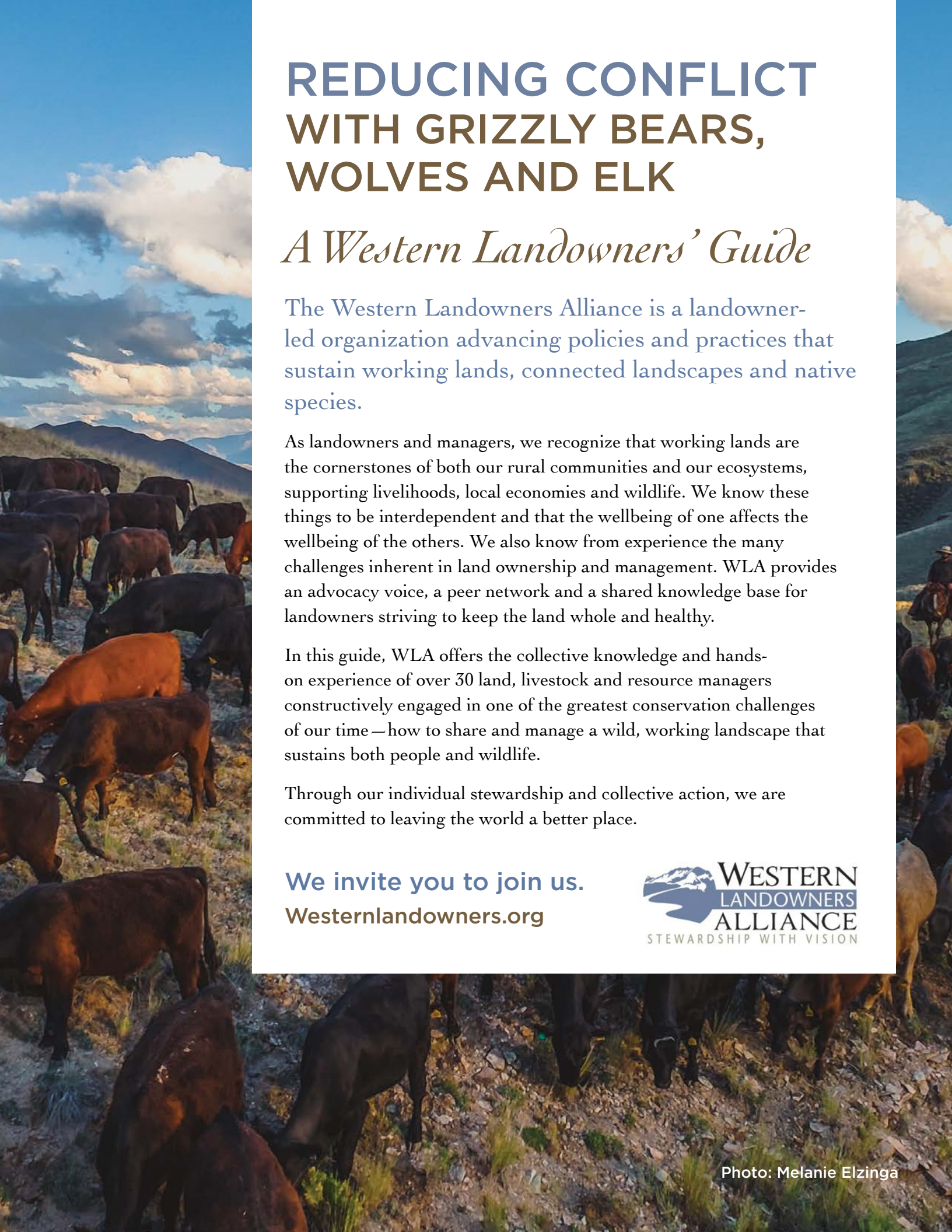
**Landowner-Directed Permits**. At least four states (CA, CO, NM, UT) have programs that provide big game male and female permits that landowners can direct to specific hunters. Some landowners partner with outfitters to market these hunts. These programs are generally directed to larger landowners providing significant acreages of ungulate habitat. Some programs provide extended seasons, and some require provision of free access to an additional number of public hunters for a comparable experience. Programs such as Colorado Ranching for Wildlife and the Utah Cooperative Wildlife Management Unit (CWMU) would fall under this category.

**Landowner Hunting Permits**. At least four states (CO, ID, NM, UT) provide a small number of permits to landowners (or their agents) with property that includes suitable habitat within limited entry (limited permits available for the unit) areas. These permits are generally intended as an appreciation or incentive hunt opportunity in exchange for provision of wildlife habitat.

**Landowner Mitigation Permits** (UT). As part of a depredation-mitigation plan (including livestock forage loss) the Utah DWR may provide mitigation doe and cow tags to hunters authorized by the landowner through the use of mitigation hunt permit vouchers (vouchers are used by hunters to obtain a permit for the specific hunt). Landowners may charge a fee for the voucher. The hunt unit includes the problem area and may include a buffer around it. The program does not apply to "once-in-a-lifetime species," and generally no more than 20 doe and or 20 cow elk permit vouchers are issued per landowner.

**Payments for Hunter Access**. At least five states (ID, MT, NM, UT, WY) have programs to lease or compensate landowners for access to private lands.

Photo: Erika Peterman



# REDUCING CONFLICT WITH GRIZZLY BEARS, WOLVES AND ELK

## *A Western Landowners' Guide*

The Western Landowners Alliance is a landowner-led organization advancing policies and practices that sustain working lands, connected landscapes and native species.

As landowners and managers, we recognize that working lands are the cornerstones of both our rural communities and our ecosystems, supporting livelihoods, local economies and wildlife. We know these things to be interdependent and that the wellbeing of one affects the wellbeing of the others. We also know from experience the many challenges inherent in land ownership and management. WLA provides an advocacy voice, a peer network and a shared knowledge base for landowners striving to keep the land whole and healthy.

In this guide, WLA offers the collective knowledge and hands-on experience of over 30 land, livestock and resource managers constructively engaged in one of the greatest conservation challenges of our time—how to share and manage a wild, working landscape that sustains both people and wildlife.

Through our individual stewardship and collective action, we are committed to leaving the world a better place.

**We invite you to join us.**

**Westernlandowners.org**

WESTERN LANDOWNERS ALLIANCE
STEWARDSHIP WITH VISION

Photo: Melanie Elzinga