A Ranchers Guide

COEXISTENCE AMONG LIVESTOCK, PEOPLE & WOLVES

SECOND EDITION

Wolf Awareness
Research • Education • Conservation

Wolf Awareness is a nonprofit organization dedicated to increasing understanding, improving tolerance levels, and promoting and facilitating coexistence among humans and wolves.

Acknowledgements

Principal Author
Sadie Parr

Contributing Authors
Joe Engelhart
Louise Liebenberg
Lesley Sampson
Jennifer Coleshill

Other Contributors
A sincere thank you goes to the various reviewers and collaborators on this project. Your time and support have helped bring this public resource to fruition. A special thank-you goes out to Marco Musiani, Nathan Lance, Marc Cooke, and Matthew Barnes.

PRINTING OF THIS

GUIDE TO COEXISTENCE AMONG LIVESTOCK, PEOPLE & WOLVES 2ND ED.

HAS BEEN MADE POSSIBLE BY

AWFC
Animal Welfare Foundation of Canada

FITZHENRY FAMILY FOUNDATION

LUSH
FRESH HANDMADE COSMETICS

patagonia
Environmental Grants Fund of Tides Foundation

Guide Goal: To Describe Tools and Consolidate Information on Prevention of Wolf Depredation for Livestock Producers

The overall goal of this guide is to describe various tools and provide information about methods that can be adapted to prevent and minimize conflicts among livestock and wolves where they overlap. The guide outlines various management and husbandry techniques that have proven effective at reducing conflicts among livestock and carnivores.

It also provides a brief review and insight about why killing wolves and coyotes often backfires; creating an expensive cyclic pattern that does not reduce conflicts and may even lead to more. This guide is part of a collaborative effort to facilitate coexistence among livestock, producers, and wolves to support vibrant wildlife communities on a shared landscape.

We aim to influence ecosystem based management that can help maintain ecological integrity as well as support producers in their efforts to prevent and minimize death of both livestock and Canadian carnivores. We provide a review of various methods of prevention, mitigation, compensation, and other forms of management used where the risk of wolf - livestock interactions exist. The effectiveness of prevention-based practices vs. pre-emptive killing of wolves and coyotes is becoming increasingly more apparent where the ultimate objective is to reduce depredation events. These methods have the ability to be adapted to individual producers.

The health of our communities depends upon the health of the environment surrounding us.

Table of Contents

Coexistence Among People, Livestock & Wolves

Historically, wolves occurred throughout the Northern Hemisphere from the Arctic to as far south as Mexico, Saudi Arabia, and India. Once they were abundant over much of North America and Eurasia, although human encroachment and habitat loss have reduced their ranges to much smaller portions of their former habitat. In many such areas, people are livestock producers. However, wolves can kill livestock and this obviously creates conflict with people.

Biologists have spent decades learning about wolf depredations on livestock. Most research indicates that pre-emptive culling of wolves does not reduce livestock deaths over time, unless wolves are exterminated (29, 17, 9). Indeed, there is no evidence to show that indiscriminately killing wolves works as a long-term solution; depredation still occurs in areas that have been practicing lethal control for decades.

For decades, if not centuries, public and government have been killing wolves and other predators to protect livestock. For example, the U.S. government was practicing lethal control on coyotes for 80 years in an effort to increase sheep production, only to realize that this had no effect on the sheep industry (16). The real culprits were increasing production costs and decreasing product prices.

Due to historical values and differing social and cultural views (e.g., urban versus rural), a polarity of opinions exists around wolf management. The spectrum ranges from those who want to protect livestock to those who want to protect wolves. Both objectives could be met simultaneously through working cooperatively. For example, a large amount of money has been invested in parts of North

America to kill wolves in the name of livestock protection. This money could have been better spent by investing in tools and methods that have been shown to reduce and prevent depredation events.

Livestock guardian dogs and sheep in a temporary pasture. Photo courtesy of Grazerie Farms©.

As conservation of biodiversity has become a global issue, efforts have been made to restore wolf and other predator populations, which are understood to be critical in maintaining healthy ecosystems. Humans have been raising cattle in the Americas for 500 years. Wolves were present on the landscape long before this, but were extirpated in many areas of Alberta and British Columbia through targeted killing during the 1950s.

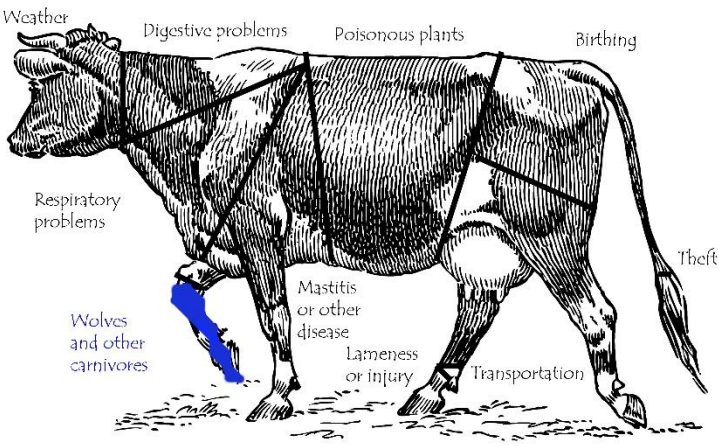
In recent times, wolves have become more accepted by society at large as we have learned about the important ecological roles of top carnivores. In addition, public perception has shifted to recognize wildlife as part of a public trust. Ranchers accustomed to living in predator-free landscapes must again learn how to effectively prevent depredation. It is imperative that livestock producers have all the necessary and available tools to effectively coexist with wolves.

Perspectives

Currently, there is no known place in North America where livestock is the majority of wolf prey (18). Research done in southwest Alberta has indicated that cattle are an important part of the summer diet of wolves, however this area interfaces wildlife habitat with grazing lands, is rich in boneyards (areas where carcasses are dumped), and wolf-killing is a widespread practice (15), creating a zone with a problem situation.

Not all wolves predate on livestock. In 2005, research done in Idaho, Montana, and Wyoming indicated that less than 3% of all livestock mortality was due to wolves, grizzly bears, and black bears combined. Total livestock losses due to non-predators was at least 89%, with respiratory and digestive problems contributing the most; between 8 – 32% (16). In Canada, many cattle succumb to death after eating toxic plants, with carnivores coming in to scavenge on remains but wrongly being blamed as the cause of the mortality.

Total cattle losses due to wolf depredation are often minor when compared to other causes of death (16). Where wolves and livestock overlap, there will be occasional losses. However, throughout the lifespan of a domestic animal; weather, genetics, feeding, birthing and transportation all pose much greater risks to survival.



In areas where research has been done, increases in the numbers of wolves killed indiscriminately has not reduced depredation events for more than a season.

Killing wolves pre-emptively will not result in decreasing wolf-livestock conflict, but may actually increase depredation as found in the eastern slopes of the Rocky Mountains in southwest Alberta (31, 17).

Killing wolves pre-emptively will not result in decreasing wolf-livestock conflict, but may actually increase depredation.

However, when producers record livestock deaths, results consistently show that prevention and protecting livestock from wolves reduces conflicts. Prevention of livestock conflict could, therefore, offer an effective tool for addressing the problem of livestock depredation on a local scale while fostering nature conservation (20).

When comparing approaches to dealing with depredation of livestock in areas where they overlap with wolves, the most rational, successful, and cost-effective approaches are:

- Prevention of conflicts through increased protection of livestock (ie. fladry, livestock guardian dogs, fencing, etc.) and/or provision of services such as carcass removal programs, range riders, etc.)
- Elimination of individual wolves causing repeated damage (so-called 'problem wolves')

When producers record livestock deaths, results consistently show that prevention and protecting livestock from wolves reduces conflicts.

Husbandry Practices May Reduce Depredation Risk

Husbandry practices where predators share the landscape with domestic stock can have a major influence on whether wolves or other carnivores will be attracted to an area, and how they will behave.

Municipal districts in Alberta and Saskatchewan using bounty-killing programs have paid hundreds of thousands of dollars in recent years to people who bring in dead wolves and coyotes, only to have vacant territories filled in by the same species within a few years. Additionally, when wolves or coyotes are killed indiscriminately they rebound with a very high reproductive capacity. Real investments include non- lethal preventative measures that last.

Some of the more commonly used techniques for conflict prevention discussed in this guide include: removing deadstock and attractants, confining, or concentrating flocks and herds during periods of vulnerability, establishing a human presence using herders and range riders, the use livestock guardian dogs, or other guarding animals, synchronizing birthing to reduce the period of maximum vulnerability, and pasturing young animals in open areas and near humans.

The type of husbandry used has a large influence on predation when compared to the type of wolf management used or wolf population densities (18).

It is important to be realize that all tools have limited effectiveness. This helps us to understand and redirect our energy to worthwhile questions such as "*how long will this work*?" and "*what is the best approach to use under this ecological context?*" and "*what are the long terms costs?*" (4).

Remain "Unattractive"

One of the easiest steps to take to prevent attracting predators to areas where livestock is being raised is to remove deadstock immediately from pastures. If carcasses are not removed, a predator will come in to feed (32,15, 14).

If a producer can remain "unattractive to wolves" and other carnivores by promptly managing for dead and sick livestock, as well as maintaining a strong human presence, livestock depredation rates will decrease in most areas.

A pair of range riders with their cattle herd. Image courtesy of Joe Englehart©

Recognize and Work with Seasonal Patterns

Understanding seasonal patterns can help improve planning and management, and potentially alleviate conflicts. By monitoring these patterns livestock producers will be more prepared to predict risks and plan for increased prevention and investment of resources if required.

Seasonal patterns reflect livestock calving and grazing practices, as well as seasonal variation in wolf pack energy requirements (21). Some evidence suggests that depredations can be high between April-May when calves are young and more vulnerable. This period is also when wolf pups are born which raises the energy requirements of the family (12). Early spring and summer months also produce toxic plants which cause livestock deaths and may bring scavengers into an area if carcasses are not removed.

Young calves are most vulnerable. Image courtesy of Louise Liebenberg©

July-August is another time when wolf-livestock interactions may increase, when pup growth results in more energy demand for the pack, and pups are learning to hunt (12).

In many situations, seasonal patterns of depredation events exist. By taking natural patterns such as these into account, producers can be more prepared to ensure that resources can be used most effectively. and efficiently to prevent conflicts.

Being able to predict seasonal occurrences helps to plan prevention efficiently and effectively.

Image courtesy of Joe Englehart©

- Wolf pups are born in April-May which increases wolf energy requirements. During this time calves are young and at the most vulnerable stage of their life-cycle.
- Depredations peak in May in Minnesota which corresponds with newborn calves (9).
- The summer depredation season is largely due to livestock dispersing over the landscape while out on the range rather than at "home" on pastures (Matt Barnes, personal communication).
- During **late summer** wolves also have high energy requirements due to nurturing larger pups and packs before their numbers are reduced by fall and winter mortality. Pups are also learning to hunt at this time.
- In AB during late winter-early spring cold temperatures and deep snow often lead to supplementary feeding of livestock and this is also when most calving occurs. Snow accumulation in winter can add a disadvantage to healthy stock, which is picked up on by predators.

Photo credit Andreanna Moya under Flicker/CC License

Methods to Reduce Risk of Livestock Depredation

Common goals can be viewed as minimizing conflict and optimizing coexistence. Upon reviewing hundreds of reviews and reports about various efforts to reduce conflicts where wolves and livestock overlap, it becomes apparent that success will most likely be met if multiple tools and techniques are used on a situational basis, using methods that are science-based and supported by producers (4). Consider these methods as tools for your toolbox, and adapt them appropriately.

The risk of depredation varies between locations depending upon factors such as forest cover, proximity to natural areas/wildlife interfaces, type and number of livestock, management of natural prey species, etc. Depending upon the location and individual situation of the producer, it will usually be necessary to change anti-predation methods frequently as wolves and other predators can become habituated to one single method. Wolves are highly intelligent animals, making them extremely adaptable as well.

The key is to prevent wolves from being *attracted* to a livestock operation.

Management of Attractants

Remove carcasses immediately.

Managing attractants, such as carcasses, is critical to avoid attracting predators to an area. Failure to do so has been shown to increase chances of future depredations (15). The scent of a carcass can bring wolves and other carnivores in from kilometers away. Predators learn where they have received food rewards in the past and are more likely to return to that area.

- Haul away, burn, or bury body, body parts, and/or body fluids.
- Carcass removal programs may be operated by government or private group (rendering facility/commercial landfill).
- Some municipal landfills will accept dead livestock. Check with your regional district to see if this is an option in your area.
- A carcass pit dug on one`s own property may initially attract predators, but can be effective if not providing a reward (completely enclosed or electric fenced)
- Successful carcass pits are:
  - Located away from stock
  - At least 8 feet deep
  - Regularly burned or carcasses regularly buried
  - Surrounded with fencing to provide more of a barrier

Boneyards and piles of dead livestock have been well documented as a growing problem in parts of Alberta and BC, especially since 2003 when bovine spongiform encephalopathy (BSE or “mad cow disease”) was detected in Canadian cattle. Prior to this outbreak, dead stock was removed by rendering trucks at no cost to producers and used in products such as dog and cattle foods or fertilizer.
After BSE caused concerns in 2003, regulations by the Canadian Food Inspection Agency were changed so that cattle carcasses must now be disposed of separately through burial or incineration, with these expenses now falling to the producer which has resulted in more deadstock being disposed of on the land (15,30).

An attractant management project aimed at reducing conflicts with carnivores has been initiated in Southwestern Alberta through the Waterton Biosphere Reserve in collaboration with landowners. Recognizing that deadstock is a significant attractant to wolves, bears and cougars - especially during the spring calving season- free deadstock removal was initiated within the project area in 2013. With support from local municipalities, landowners and funders, weekly on-site pick-up, or disposal into deadstock bins within high conflict areas was provided during 2013 and 2014 and deemed a success. During this two-year period, more than 1,460 dead livestock carcasses were removed from the 1,235,500 acre (500,000 hectare) project zone (30).

The cost for an individual using a carcass removal program is estimated at approximately 9¢/lb. for ruminants where programs occur in Alberta (2012), with a minimum $75 charge. In one part of Alberta and a few cases in the US, government agencies have contributed to such a program in other ways, such as loaning a truck and/or covering fuel costs.

Funds could be generated at a community level through donations, fundraising events, local taxes, or grants.

When deadstock removal programs are not an option, burying carcasses is a good idea, however pits must be dug deep enough and well covered. In 2012, the first Canadian municipal deadstock composting facility was built in Cardston County, Alberta. Funding for this initiative was achieved through partnership among the County, Alberta Environment and Parks, and Growing Forward. In this situation, carcasses were picked up from properties or deadstock bins by a County employee instead of a rendering company. Within a period of just over 15 months of operation, Cardston County gathered and composted 851 carcasses (30). In addition, some rendering facilities do not accept sheep or goats so composting may be the only option.

If wolves become conditioned to killing livestock on a farm, neighbouring farms are put at risk. Working together with community members to ensure the larger area is attractant free is critical.

Surveillance and monitoring: shepherds, herders, and range riders

Shepherding a flock or herd of any domestic species is an age-old tradition used around the globe where predators and livestock share habitat. It is one of the simplest and oldest methods for deterring predators. Human presence can help detect, determine, and alter behaviour patterns of wolves in an area. Poor surveillance is a large factor associated with livestock losses.

The overall approach might involve the following elements:

Shepherds - individuals used to constantly monitor and care for domestics (typically sheep and goat). The approach is very effective against wolves as mere human presence deters most wildlife.

Herders - individuals that work to keep the flock or herd together so they are easier to monitor and directed to appropriate areas.

A range rider in western Canada. Image courtesy Louise Liebenberg©

Range riders –The term range rider means different things in different places, but typically involves a combination of the following: 1) livestock monitoring, 2) wolf surveillance, and 3) livestock herding (23). Individuals are hired specifically for the spring-fall grazing season. The job is usually carried out on horseback but sometimes ATV's are used. A rider may or may not be a herder.

In all cases, individuals patrol ranchlands at dawn and dusk and other times when wolves are most active. Some riders like to keep the patrol schedule frequent but irregular so that there is no pattern that wolves may become accustomed to.
Effectiveness may be further increased by using dogs which can send a n alert and help cover more land area.

By counting stock regularly, *especially* in rugged terrain where dead livestock may go unnoticed, will help ensure missing animals are located promptly and carcasses are removed to prevent becoming an attractant. Sick or injured animals should be doctored and/or removed from a herd and supervised more closely.

- An established human presence provides other benefits as well. For instance, this person can ensure that deterrents are set.
- Monitor for the health of livestock
- Monitor stock agitation as well as presence of wolves.
    - Lone mother (may be searching for lost calf)
    - Vocal
    - Tight bag
- Begin record keeping to identify patterns (problem areas, time of year, etc.)

Sometimes ATV's are used to cover extensive ground instead of horses.

More on Range Riders

Range riders can improve grazing management and lead to better rangeland health, improved livestock production, and coexistence with wildlife by applying what Matt Barnes, Field Director for Rangeland stewardship at U.S.-based Keystone Conservation describes as "strategic grazing management" (1). Two possible options to help offset costs if extra labour is employed are:

I. Establish cooperatives in which sheep and other livestock can be grouped in bigger single herds to dilute the risk of predation by wolves on individuals (i.e., high density grazing and communal husbandry) (1, 20).

ii. Increase surveillance only during times of known higher risk (e.g., calving and branding seasons).

The keen senses of wolves enable them to recognize when otherwise healthy prey becomes disadvantaged, for example, in deep snow. By noting past record-keeping, monitoring your herd, and knowing what conditions might increase risk, patrol efforts may be increased during these times.

Surveillance of livestock herds is the most common traditional non-lethal method used by livestock producers in many European countries. However, it is labour-intensive, which can be expensive if the producer employs staff to watch over livestock (20).

However, it is imperative to patrol your land and stock to monitor for health, injuries, presence of carnivores, and to aid in the identification and removal of deadstock and poisonous plants.

Cost estimate:

An operation in eastern Alberta annually hires two range-riders to oversee 2500 cow-calf pairs during the spring and summer grazing periods. One is hired full time at $3,000/month and a second hire is paid $120-150/day for part-time work – these wages were reported in spring 2017. Total costs are approximately $24,000/year. Workers are employed from May to October. Work is daily through June and the part-time worker's hours are weaned in July.

Creating Barriers: Fencing & Fladry

Fencing and other barriers can be used effectively to deter predators such as wolves and bears. Electric fences have proven to be particularly effective (20).

Some materials for setting up a portable electric fence.

Fence Characteristics and Considerations

One thing that should be considered when constructing a fence of any type is that it *should be visible to wildlife and livestock*. Wolves are most active at night and should see the fence before they try to pass through to associate the barrier with a visual cue. The visibility can be increased by increasing the thickness of the wire or adding flagging tape.

The bottom of the fence should be less than six inches from the ground to avoid animals crawling under. For permanent set-ups, woven fence can be buried, but it may be just as efficient to ensure that the ground is level. Holes should be filled in. Fences should be checked on a regular basis, because winter ground freezing and thawing can push the posts out of the ground increasing the space between fencing. Electric fencing needs to be maintained to be effective.

Wolves and cougars are jumpers so require a higher fence than bears to be kept out. Wolves have been known to jump heights of 5 feet, and thus *require a minimum fence height of 1.3 meters for permanent set-ups.*

Be mindful that fences will act as a barrier to other wildlife, such as deer or elk. When fencing on slopes, one will need to consider a loss of height if an animal is approaching a pasture from upslope. Objects such as rocks and fallen logs should be removed from the fence because animals can use these as stepping stones to get over the fence.

Permanent Electric Fence

Permanent, high-tensile predator- proof fencing is costly to build and maintain, and is only appropriate for small areas.

Permanent fencing usually needs less maintenance and can handle harsh weather conditions (e.g. snow-load) better than portable temporary fences.

Once properly installed, a permanent electric fence can be used for many years.

What You Need to Build an Electric Fence

- An energizer to deliver power (solar, battery, or plug-in)
- Live wires of high tensile steel for permanent set-up (11-14-gauge wire with a minimum tensile strength of 200,000 psi and a minimum breaking of 1,800 pounds is recommended when also deterring bears) (Masterson 2006)
- Fencing posts (rebar, steel fiberglass, treated wood, cedar, etc.)
- Fence charger
- Grounding system (rod or plate in the earth)

Installation and Maintenance

- Will require a minimum of 5 to 7 strands of wire if also deterring bears.
- Place posts 10 to 12 feet apart, bottom wire (or fence) 5 to 6 inches above ground.
- Galvanized wire is a better barrier than synthetic options (stronger but more expensive).
- Place wire outside of rebar (harder to dislodge).
- Need to maintain fence (no sagging/fraying, less likely to part hairs).
- Check volt meter regularly to ensure working (set up somewhere easy to check often).
- Suggested model SE-4 from Parmak for plug-in

A 7-stranded electric fence design is recommended for preventing coyote depredation (Dorrance and Bourne 1980). Lower strands are placed closer together so that animals cannot get through between strands. Higher strands can be placed farther apart to increase the overall height that the animal must jump over. To deter jumping wolves, the fence should be constructed to be no less than 1.3 m.

Electrified Stucco Wire Fence

Instead of placing and electrifying multiple strands of high tensile steel, Stucco wire can be hung around rebar posts with an electrified top wire. This type of fencing is more expensive; however, it has fewer gaps which is more effective and better for keeping coyotes out.

Temporary Electric Fence

In larger areas, or when livestock is semi-nomadic, producers may consider portable electric fencing which can be set up temporarily and powered by solar energy.

Portable electric fences can be set up quickly and are useful when temporary protection is required, such as during lambing or calving season. Today there are portable electric fences that can be set up to work quickly, and solar-powered systems that can be installed anywhere there is enough daylight to charge the batteries.

One way to use temporary electric fence is for night penning.

- Suggested model Parmak Solar Magnum 12 for solar units.

Using a low-voltage charger may not be effective. Make sure that the charger is appropriate for predators, such as the one shown here.

Photo courtesy of Gillian Sanders.

Extra Tips

- *Use chargers for predators*, not for livestock; 15,000 volts or more are required if also preventing bears (e.g. “Super Energizer 4” 1900 volts, 80-kilometer range)
- If the charge is not high enough a predator will go through the fence (nose shock is best learning experience).
- A plug-in unit has more power than a solar unit.

- A unit must be grounded (want wet earth) to deliver the needed voltage and shock.
- Less charge is transferred to an offender if the earth around the grounder is dry and gravely. Maintain moisture around the ground to increase the shock value (e.g. placing directly under roof drip line can increase voltage by few thousand. Can also sprinkle water).
- Anything coming into contact with wires can create a closed circuit, making the electric fence powerless, e.g. fallen branches or trees, therefore *walk the fence line every day to ensure circuit is kept open and maintained (tight wires).*
- Grass and vegetation growing up to touch the bottom wire lessen the voltage*; keep grass cut low, cover, or remove vegetation from beneath fence.*
- Set up electric fence before livestock enters the pasture. This gives wolves time to approach the fence and learn that it is electric, before the desire to penetrate the fence is established.
- Check daily that the fence charger is on (place in convenient spot) and that batteries are charged if using solar.
- Check voltage weekly with voltmeter.
- Keep battery and fence charger dry and corrosion-free.

You may put up warning signs to alert people that the fence is electric.

Modified Stucco Wire or Woven Sheep Fence with 2 Strands Electric Wire

The Wildlife Damage Centre promotes a modified sheep fence design. Existing woven sheep fence can be made more resistant to predators by adding two electric wires to the system. One would be placed at the bottom of the fence, to prevent an animal from trying to dig under then fence. The other electric wire would be placed about 12 inches above the top of the woven fence to help prevent wolves from jumping over.

Note that a battery powered solar fencer is made to be placed outside to recharge with solar rays, whereas a plug-in fencer must be stored out of the elements and requires a heavy-duty extension cord and grounded electrical outlet.

Cost estimates for electric fence set-up.

Item	Quantity	Approximate Cost
Predator Charger Unit: "Super Energizer IV" 1900 volts, 50-mile range (plug - in) OR Parmak Magnum 6 or 12 - [solar]	1	$250 ($450 if off- grid)
Grounding plate or rod (rebar)	1	$17
Rebar posts every 10-12 feet	Many	$600 to $700 per ton
Tensile steel OR Stucco wire roll OR hot tape or electro plastic netting for temporary set-up	Depends on size of perimeter	$25 per 1/4 mile $80 per 100 feet $200 - $750 for 30 foot X 42 foot
Electric fence tester	1	$5 - $30
Fluorescent flagging and warning signs	2	$20

Ensure that vegetation below electric fence is removed or kept below wires. This is a 5-strand electric fence modified to fit with and existing page-wire fence. Photo courtesy of Gillian Sanders ©

Fladry

Fladry is an old method used to capture wolves that is now used to keep them out of areas for short periods of time. It can be highly effective at acting as a barrier to wolves in specific situations. Fladry consists of a line of bright flags hung from a line outside a pasture, set to deter wolves from crossing the barrier. Plastic flags measure 50 X 10 cm. It is portable and easily installed, although the process is labour-intensive. Set-up requires approximately 31.8 person- hours per kilometer to install (11).

Fladry is not intended for long-term use, because wolves will become habituated to this tool when left in the same area for prolonged periods. Fladry is most useful for temporary prevention when livestock is kept in small pastures (calving, lambing, overnight holding). It may be used in certain open range situations but is best used as mobile protection on a short-term basis.

Many situations where fladry is used also include an electric charge. Turbofladry combines an electric fence with fladry, and can be powered by solar energy. Combining fladry with electric fencing will help to slow down a wolf to ensure they get a charge. Although more expensive, this type of set up has proven very effective at keeping wolves out of a given area. If there is a situation where it is worth setting up fladry, it is worth electrifying the set-up as well.

Fladry fences are moveable and effective for reducing livestock predation on a local and short-term basis. Fladry can be set up around an existing fence. Photo courtesy of Nathan Lance©

In the USA, turbofladry successfully prevented any livestock losses within one month where 1,000 sheep were near denning wolves (Wood River Wolf Project Workshop, 2013).

Fladry provides a visible boundary around livestock.

Fladry was found to be effective in deterring captive and wild wolves for up to 60 days (Musiani, et al., 2003). This research was done in smaller areas < 25 ha and humans were patrolling the fence every few days which may have increased its effectiveness

Fladry can sometimes be ordered through a general-contract sewing company. See Appendix I for resources.

Setup and Maintenance

- Attach flags every 50 cm on a 0.2 cm diameter nylon rope, suspended 50 cm above ground tied to rebar posts that are installed at 30 m intervals
- Fladry must be maintained and will require flag replacement when= warn (i.e. the removal/loss of just one flag was enough to allow wolf crossing in captivity)
- Place flags 2 meters outside conventional fence to prevent cattle from damaging or eating flags.
- Setting up electrified fladry takes approximately 31.8 person hours per km.

Image courtesy of Nathan Lance©

Cost estimate

The cost estimate for electrified fladry is $2303 for the first kilometer, and $2032 per additional kilometer (11). Set-up requires approximately 31.8 person- hours per kilometer to install (11).

Initial costs may appear high, but the effectiveness and longevity for preventing depredations in specific situations should be considered. This is best suited for small pastures.

Note that in some cases, existing fences can be augmented to become more effective at deterring wolves rather than building new permanent fences, which will reduce costs. For example, adding fladry or increasing the height of an existing fence could be a worthy investment.

To lower costs when installing permanent electric fences or fladry, more fiberglass posts can be used instead of T-Bar posts (N. Lance personal comm.)

A cost comparison of different fence designs and their effectiveness as barriers to wolves.

	Basic 4 strand Barbed Wire Cattle Fence	Basic 4 Strand Electric Cattle/Sheep Fence	Basic Woven Sheep Fence	5 Strand Electric Fence	7 Strand Electric Fence	Modified Stucco Wire or Woven Sheep Fence with 2 Strands Electric Wire	Electrified Fladry (Turbofladry)
Wolf Barrier	**Poor**	**Poor**	**Poor**	**Good**	**Good**	Moderate	Good
Cost per kilometer	**$2,730**	**$1,302**	**$3,087**	**$1 ,548**	**$2,597**	**$3,331**	$2,303 1st km., then $2,032/km
Life Span	**20 years**	**25 years**	**20 years**	**15-25 years**	**15-25 years**	15-25 years	15-25 years with replacement of fladry

Fladry photo courtesy Nathan Lance

Extended insulator photo courtesy of Gillian Sanders

Grounding rod photo courtesy of Gillian Sanders

Livestock Guardian Animals

Using domesticated animals as guardians' s is one of the oldest known methods to protect livestock. This method has been used in Eurasia for centuries and in some places documented to be used for thousands of years.

One of the main benefits of using livestock guardian animals is that they are inherently adaptive compared to mechanical tools. There are various types of animals that are used to protect livestock, including specific breeds of dogs, llamas, and donkeys. Although highly effective when used properly, none of the guardian animals offer a perfect solution. There is also a risk that wolves or other natural predators may kill them.

Donkeys and Llamas

Donkeys and llamas have a natural hate of canines. However, they can be susceptible to cougar attacks.

The guardian animals are mostly used with small flocks of sheep.

They have shown to be effective in guarding livestock in some situations, depending upon the predator species and temperament of the individual donkey or llama. There is not much work done on effectiveness against wolves.

Only a couple of donkeys/llamas should be used because they may herd by themselves ignoring the flock. *One per flock recommended.*

The process will require approximately one week for integration; four to six weeks for bonding.

Donkeys and llamas should be placed in stalls beside their flock at first; especially during lambing so the lambs are not stepped on.

With donkeys, stallions are the most aggressive and may not be suitable as they could become aggressive towards the ewes/cows. Mares and geldings are recommended.

Benefits

- No training is required. The behaviour is instinctive.
- Can be introduced to a herd or flock at any age (the younger the better).

Costs and Considerations

- Hay or pasture needed for feed.
- Some terrain that is suitable for sheep may be difficult for donkeys to navigate.
- Donkeys are noisy and will bray loudly which may pose noise problems with neighbours.
- Wolves or other natural predators may kill Guardian animals

Long horned Steers

A few longhorn steers mixed in can also provide better protection for a herd. These animals are among breeds that are more aggressive. See section on Age and Type of Livestock.

Livestock Guarding Dogs

These breeds of dogs are all working dogs. They should be treated with respect and watched cautiously with children and strangers. Training should all be done at a young age with a loving, determined, consistent, and encouraging approach from a dominant leader. They should not be family pets as they may prefer the family over the livestock. These dogs do not herd, only guard livestock.

Livestock guardian dog with sheep. mage courtesy Grazerie Farms ©

Age

Livestock Guardian Dogs (LGDs) must socialize with livestock and bond from a young age. Ideally, the dogs should be raised with stock from birth. Guardian dog pups should be born from working parents. They are born with the flock and spend the first 16 weeks in a primary bonding phase, learning from both parents and siblings. Guardian dog pups should only leave the litter at a minimum of 10 weeks old, preferably later so that the working dog can benefit from learning from its mother how to interact with the stock.

LGDs are naturally intelligent, courageous, protective, and loyal. It is important to put time into researching the various breeds used to find the one that is the most suitable for the size of the ranch, the type of predator(s) on the landscape, and the requirements of the owner in terms of what they want and need in a LGD.

Photo courtesy Grazerie Farms©

Breed

All traditional livestock guardian dogs originate in Europe and through Asia. Every country has their own LGD breed, France the Great Pyrenees, Italy the Maremma, Turkey the Kangal, Kars and Akbash, Balkanss have the Sarplaninac, Poland the Tatra, Romania the Carpathian, Bulgaraia the Karackachan, Bucovina, Hungary has the Komondor and The Asian countries have the Central Asian Ovcharka, Tibetian mastiff, Caucasians etc. This list is far from complete but does give you an idea of some of the breeds and where they originate. Most of these breeds are available in North America, however they are often found with the hobby breeders. It is difficult to find or purchase some of the rare breeds being utilized as full time LGDs.

Climate has had a large effect on the development of various dog breeds, whether they be from cold climates or hot. Environmental factors influence dog coats and physique. Many of the differences among various LGD breeds is due to the requirements of their working environment.

All LGDs were developed to face off with wolves, however many of the countries in Europe have also systematically tried to eradicate wolves, meaning that many of these breeds might not have seen or smelt a wolf in several generations.

The biggest issue is not so much the type of breed but the way that the breeding is taking place. People often cross breed a mixture of breeds together and will sell these animals as LGDs. In some circumstances, people are randomly breeding and selling these dogs to ranchers, however, the genetics have become so watered down in North America that many of these breeds are simply not capable of doing the job necessary. For example, when people advertise a Golden Retriever crossed with a Great Pyrenees as Livestock Guardian Dog, you can understand how the gene pool required is watered down and not functioning to its full potential. Ranchers need to invest and purchase dogs like they do bulls: look for quality working stock, and be prepared to pay a bit more to get good working dogs. The $10 auction pup just does not cut it, and it is unfair to expect it to.

In the countries where Livestock Guardian Dogs originated, shepherds most often use the one breed of working dog that is available to them. There is no evidence to show that mixing various breeds is more

effective than single breed groups. The dogs will take up the various roles required of them. Roaming is often not a breed trait, but more usually a factor of poor breeding, poor bonding and a rancher who may not understand how to raise these dogs.

Great Pyrenees are the most common LGD breed used in North America, where they have been mostly used to protect sheep from coyotes, however they probably aren't large and/or aggressive enough to consistently protect against wolves or grizzlies (Matt Barnes personal communication).

Number of LGDs required

The number of LDGs required for a single operation has nothing to do with the size of the flock being protected or size of the grazing range. The number of dogs employed has everything to do with the predator load, the landscape and the other husbandry practices being utilized. For example, if a producer has an existing conflict with a predator(s), additional factors such as fencing, landscape visibility (bush vs. prairie), terrain (mountainous vs. flat), husbandry systems, birthing processes, size of acreage and number of livestock are all important in influencing the number and type of LGDs required. There is no simple calculation to determine how many LGDs are required. A single operation usually requires a minimum of two Livestock Guardian Dogs when used for preventing conflicts, however some areas in Australia are using up to 30 – 40 dogs.

Most dogs are used for small pasture rather than large range operations although producers grazing open ranges have also recommended dogs. Most range sheep are herded, so LGDs can work, but often range cattle are too spread out for LGDs to be effective.

LGDs can work on range cattle under specific circumstances; where the cows are bunched up at night, are accustomed to dogs working, and a cowboy or range-rider is present to monitor the situation. Most Canadian farms and ranches are stationary, with some cattle going to community pastures. Many operations have cattle that stay on the home ranch and have defined calving pastures where LGDs can be well implemented.

A great deal of research was done on LGDs in the 70's and 80's, but most of this was focused on range situations. In many parts of Canada, ranching has moved from open range situations to smaller, pastured fields, where Livestock Guardian Dogs can be very well implemented.

Photo courtesy Grazerie Farms©

Process of Training Livestock Guarding Dogs

The goal of training for a livestock guardian dog is for it to learn that its place is with its flock. Instinct will basically do the rest.

Factors affecting success

1. Number of dogs used based on predator load
2. Dog Training
3. Proximity of bedding ground to forest
4. Presence/Absence of shepherds

Benefits

- Reduced predation
- Reduced labour (in cases of needing to confine livestock at night)
- Dog is alarm bell for disturbances on property
- Protection of family members and farm property
- Increased independence in predator management

Costs

- A guard dog can cost anywhere from $250 to $1500
- Average cost of food and annual veterinary expenses is $500 minimum per year per dog
- May be more expenses in the first year with shipping, travel, and any damages caused by the puppy
- Biggest investment in the first year is the time needed in supervision of the dog with its flock in the first few months.
- Biggest investment in the first year is the time needed in supervision of the dog with its flock in the first few months.

Other considerations

- Dogs are not a guaranteed investment
- If not monitored for behavioural problems dogs may turn on the sheep; usually starts as a play behaviour
- Dog may be excessively aggressive towards other people
- Dog may harass other animals
- Time investment required in first year training and supervision
- Cost of veterinarian in cases of injury or illness
- May cause initial stress to livestock
- LGDs can be killed by wolves, especially if there aren't enough of them.

In the USA, there are fewer large parcels of public land used for grazing, so often livestock rearing takes place on public lands where people recreating could bump into a flock or herd with guardian dogs. In such cases, concerns have been raised about dogs potentially attacking people, particularly when they are out on the range and can't be watched constantly, but will inevitably encounter strangers.

In such circumstances, signs should be erected to notify other users of public land that livestock and guardian dogs are in the area.

In Canada, these situations are less likely and can largely be prevented. The key is education. Just as the public are informed in Banff National Park about how to minimize wildlife attractants and behave responsibly around bears, people who recreate in areas frequented by flocks with guardian dogs can and should likewise be educated.

The public need to be warned and properly informed when they are entering an area where flocks and guardian dogs can be found; ideally people are advised to move around and avoid the area. In terms of behaviour, public are advised to remain calm, walk far enough around the flock, leash dogs and avoid trying to pet the guardian dogs.

Signs warning public about the use of Livestock Guardian Dogs should be used in some cases. Photo courtesy of Wolves of the Rockies.

An addition part of the education involves teaching producers that having feral, unhandled dogs in public areas is unacceptable. Dogs can be social to people and still do their job. The shepherd needs to be understand how to work with the dogs; possibly even tying up one or two of the more aggressive dogs during the day. People tend not to hike or recreate in these shared areas at night, where and when the dogs can freely work. Signage and education are important to mitigate these issues.

Seasonal Attractants; Calving, Branding, and Other "Attractive" Times

Calves and other newly born livestock are more susceptible to depredation. Afterbirth can be a strong attractant during the calving or lambing season, further increasing risk. Livestock producers can plan timing, location, and ensure a human presence during birthing. During the calving/lambing season livestock herds are often more dense being kept in close proximity during these times, so when wolf depredations do occur more livestock may be killed at one time.

Many ranchers will calve heifer groups separately from the main herd. These animals are inexperienced as yearlings and more likely to abandon calves, which are likely vulnerable to wolves. Keep cows and heifers together.

Some ranchers have reported success by keeping some bulls as part of the calving herd or introducing other animals with aggressive tendencies such as donkeys (see livestock guardians section). and other aggressive animals to mingle (defend, teach, and toughen up).

Burn, bury, or haul away biological waste.

Seasonal Timing of Calving

Delay the release of newborns onto spring pastures until you can ensure surveillance is provided.

Schedule and manage for a condensed calving season at the community level so that constant human surveillance is easier to accomplish.

Monitor livestock more closely at this time to recognize livestock in vulnerable situations. Increasing human presence will also deter predators.

Remove any biological waste as soon as possible to reduce attractants; burn, bury, or haul it away.

Reduce Vulnerability during Birthing Cycles

Keep it short

In Nature, wild ungulates often have a short birthing cycle which comes as a simultaneous pulse; maximizing the number of new-borns within an interval under shared defense of young. Shortening domestic calving seasons may have a similar effect by reducing the amount of time vulnerable newborns are on the landscape and increasing vigilance and natural defense mechanisms among older animals.

Young calf resting in hay. Photo courtesy of Louise Liebenberg©

Consider Synchronizing

If a shortened calving season can be matched to the birthing cycle of local wild ungulates when natural prey is more abundant, there may be less conflicts due to less opportunity and lower chances for wolves and other carnivores to switch their diet from wildlife to livestock.

Age and Type of Livestock

In some parts of North America, young calves are at the highest risk for wolf depredations. In other areas, yearlings are more prone to be targeted. There may be behavioural characteristics of yearlings,

such as curiosity that leads to wandering alone in steeper country, which makes them more vulnerable to wolves and other predators. If yearlings are naive to wolves and unaccompanied by cattle with more experience they are very vulnerable. It is recommended that if a rancher is running yearlings they should keep a few older cows with them; combining generations may improve herd dynamic defenses.

After researching the effects of wolves on livestock calf survival and movements in Central Idaho, Oakleaf and others (2003) suggest that the maternal age and experience level, as well as birth date of calves, should be thoroughly evaluated when evaluating the possibility of setting up a problem situation by predisposing livestock to encounters with natural predators.

Herd Dynamic

Some domestic livestock breeds are more aggressive towards predators and have stronger maternal tendencies which leads a more defensive behaviour, leading to a more defensive response.

As noted in the Livestock Guardian Animal section, some ranchers will include a few longhorn steers, especially with yearlings. Aggressive breeds include Corrientes and Brahman, although these breeds are not cold-hardy by North American standards.

Mixing It Up

Some promising research shows that bonding sheep to cattle may decrease sheep predation (2, 10, 25). This practice is most relevant for open range situations.

. Photo courtesy of Sadie Parr©

Property Risk Assessment

It is possible to identify and determine high risk areas on a property and where prevention measures could be focused on (17). Knowing and understanding the surrounding terrain also helps to recognize patterns of predation. For example, wolves and cougars often hunt from forested edges.

On large properties, there may be some areas that pose more of a risk than others being influenced by factors such as distance to a forest edge or slope.

The relative importance of each factor to predicting depredation from highest to lowest:

1. Wild ungulate density
2. Slope
3. Distance to cover

Note that in a study done in Alberta (17), ranchers that practiced wolf culling and/or had yearling cattle herds also had higher rates of depredations.

See Appendix II to assess your own property risk.

Image courtesy of Malcolm Parr©

Large Scale Operations – Strategic Grazing Management

While there are several tools that are effective at accomplishing coexistence, (livestock guardian dogs, night penning, etc.) most of these are of little or no use when livestock are scattered over a large area.

In many parts of Canada, grazing ranges that face higher rates of depredations could simply be characterized as areas within good wolf habitat where cattle are more exposed to natural predators (iv).

A great deal of historical and current efforts are focused on keeping carnivore numbers low and keeping them physically separated from livestock. A growing view, which is more holistic, accepts that carnivores are valuable intrinsically and as part of the natural community. Excessive depredation is not the norm. When it occurs, it can often be linked to management practices that have led livestock to be more easily accessible than wild prey for natural predators (iii).

Most concerns are with newborn calves. It is natural for cows to go away from the herd to calve, during which time they are more vulnerable because the entire cow herd is not present to protect a newborn calf. The cow and calf often stay away for 2 to 5 days, and initially the cow will lay her calf down to go and eat and drink. The calves are very vulnerable then. If calving can be contained to a short period this will likely help prevent mortality.

When tolerance for carnivores is high on ranch lands, large scale operations can provide significant benefits to conservation. Wolves and most carnivores are opportunistic hunters that remain focused on wild prey. When a producer can effectively minimize the opportunistic level of predation of a herd through practices such as planned grazing and herding with low stress livestock handling, additional benefits include improved rangeland health and herd production.

Strategic grazing management is most often accomplished through rotational grazing and herding (i, ii).

Even large-scale operations can use techniques to manage their stock that prevent predation of livestock by focusing management efforts on domestic animals versus wild. Although wolf-livestock conflicts are a relatively minor source of livestock deaths overall, a working landscape that employs herding techniques and range management methods which mimic natural systems and occurrences can potentially prevent predation events as well as carnivore mortalities.

Low stress herding

This practice involves taking a herd of cattle, sheep, goats, or any other livestock, and gaining their trust to make it possible to move the animals from one spot to another in a calm and controlled matter. Too often moving stock is a forced issue during which animals experience an increased heart rate and anxiety, requiring at least 45 minutes to return to normal. In forced situations, cows and calves do not often move together as a pair, sometimes resulting in calves running back to where they had their last feed, which could be where you started if things go bad.

Panic stricken animals display a fleeting prey response, which can trigger predatory attention from wolves, or bears on the landscape.

Suggested practices

- Make sure that all calves are “mothered up” before starting to move the herd.
- Stop as many times as it takes along the way to keep all cow-calf pairs together (e.g. at a watering hole or after moving through a gate)
- Don’t bunch animals too tightly while trailing them. Instead, allow them to string out a little.
- Always stop before cattle are tired. Let them rest for a while.
- Once the destination is reached, put all cattle into a rodear, which is a loose controlled bunch. Then

begin letting cow-calf pairs out of the bunch.

- Once you know that all calves are mothered up make sure that you stop the movement (e.g. stay with them until at least 30% of the herd has laid down. This will not take too long).
- Also provides the opportunity to doctor any sick, lame, or injured animals, saving much work, time, and money, and making sure vulnerable animals are cared for.
- The following day the cattle are usually content.

Cattle will learn that there is safety in numbers and that staying bunched together is a win-win situation for them.

By getting one bunch of cattle from a larger herd starting to move in the in the desired direction and allowing them to drift along, cattle movement will draw more cattle and you can just allow the movement to happen or encourage it if necessary.

*Grazing Management Methods (*as defined by Barnes 2015 for Keystone Conservation):

Rotational Grazing*: the planned movement of a single herd of livestock through a series of pastures within a grazing season. [There are many variations], whether calendar-based or timed according to plant growth rates.*

Cross-Fencing*: [used to] facilitate rotational grazing. Can be done with wildlife friendly electric fencing….typically removed immediately after the grazing period.*

Herding*: generally implies controlling livestock movement without fences, or on a finer scale within a larger pasture.*

Use of large grazing operations in remote areas that are used by carnivores involves advance planning of herd management in order to prevent depredations.

Other tools required often include (iii):

- Cross-fencing for planned grazing
- Range riders or herders practicing low stress handling methods
- Trained herding dogs
- Strategic placement of supplements and rotating access to water sources
- Night pens with electric fencing

US-based organization People and Carnivores recommends that on large-scale operations grazing herds be bunched together and limited to a portion of the landscape at any one time, moving the herd over time. This can facilitate natural anti-predator behaviour, potentially preventing livestock-carnivore conflicts, as well as improve overall land health and grazing capacity. For example, cattle are more like to respond by herding together when a predator approaches versus a wandering individual who is more likely to run from a predator, thus increasing its vulnerability.

"*Grazing at high stocking density creates a context in which all of the other tools can be used, by reducing the spatial scale at any one time to a manageable level",* explains Barnes (iii).

Benefits of high stock density grazing include (i,ii, iii):

- Increased probability that the entire herd is alert to presence of predator
- facilitation of anti-predator behavior (e.g. defending young, standing ground)
- facilitation of group learning and cooperation
- may reduce spatial overlap between livestock and wild prey
- planned grazing facilitates avoidance of high risk areas such as den and rendezvous site

References for this section:

i. Barnes, M. 2015. Livestock Management for Coexistence with Large Carnivores, Healthy Land, and Productive Ranches. A White Paper. Keystone Conservation.

ii. Barnes, M. 2015. Low-stress Herding Improves Herd Instinct, Facilitates Strategic Grazing Management. *Stockmanship Journal*. 4 (1): 34-43.

iii. Barnes, M. 2014. Preventing Predation of Livestock – Livestock Management for Coexistence with Large Carnivores. *In Practice.* 158.

iv. Bradley, E.H. and D. H. Pletscher. 2005. Assessing factors related to wolf depredations of cattle in fenced pastured in Montana and Idaho. *Wildlife Society Bulletin*. 33 (4).

Relocation of Livestock

- **Diversionary feeding:** Defenders of Wildlife (USA) reimbursed ranchers in the Northern Rockies for hay to lure cattle away from wolf den (limited as wolves' habituate)
- Funding for alternative pastures may be included in government stewardship or environmental incentive programs
- Design **livestock watering system** that draws cattle away from denning pack and forest
- Relocation of livestock is usually a last resort, can be temporary or permanent

Photo courtesy of Louise Liebenberg©

Other Options

- **Volunteer program**: volunteers (wolf conservationists and cattlemen) serve as "wolf guardians" to help track wolf pack movements, install fladry and fencing, watch over livestock
- **Cooperatively work and plan** as a team with other livestock producers to share costs and efforts (a written agreement of expectations of roles and responsibilities recommended)
- **Cracker shells and other noise makers** are limited as wolves habituate to them, but initially may be useful at discouraging wolves from remaining in an area.
- **Bean-bag shells and rubber bullets**, paintballs (learn how to use properly or serious injuries can occur)
- **Predator lights** or motion activated noise makers are also available and can be successful for a short amount of time.
- **Radio activated guard (RAG) boxes** are activated by radio-collared wolves that come close; the box emits sounds and lights.
  - Can be very effective, mostly as temporary deterrent
  - Most effective for small pastures (60 acres or less), especially when lambing or calving
  - Works to deter wolves and alert range rider/herder
  - Limited use to radio-collared wolves
  - Powered by 12-volt car battery (recharge few weeks) or solar panel

Radio collars on wolves are required for RAG boxes to be an option. Photo property of Wolf Awareness Inc©

Compensation Programs for Livestock Losses

Compensation programs occur in various parts of North America and cover a wide range of expenses (provincial regulations vary, but all Canadian programs are subsidized at the federal level). Programs sometimes include costs associated with prevention measures. The amount of compensation for loss of an animal or product to a wolf varies from 100% full market value (even if the depredation event occurs in spring) to a fraction of this. In the US, the state of Wyoming pays a multiplier to cover the costs of carcasses never found or impossible to confirm (Matt Barnes personal communication). Obviously, this is controversial. Sometimes there are general limits to the determined economic value of an animal.

Most compensation programs will only provide financial aid to producers proven to practice preventative and responsible husbandry methods. Some of these programs will also help to cover costs associated with prevention measures. Others will refund any veterinary costs associated with wolf-livestock conflicts, or veterinary costs for livestock guardian dogs.

It is imperative to determine whether a depredation event is due to predation or scavenging; this will be verified by the compensators at some level. Most provinces have science-based guidelines to help determine whether dead livestock has been killed or scavenged upon, and producers themselves should learn to distinguish the differences in order to protect the evidence needed to support a compensation claim.

Get there fast! Scavenging and local dogs can quickly obscure the scene. Protect the evidence by covering the carcass and preserving tracks. Use photographs and notes to document the scene. Using fladry (described later in this Guide) is another possible method for temporarily protecting a dead animal from wolves.

Compensation programs do nothing to prevent livestock losses, and there is little evidence to show that compensation programs are effective at improving tolerance levels for wolves. Unfortunately, compensation payments also mean that some individuals are less inclined to take preventative measures and could “encourage a state of permanent conflict” (5).

Compensation programs may alleviate some immediate financial stress but they are not a long-term solution.

Photo courtesy of Louise Liebenberg©

Lethal Management of Wolves - Realities and Consequences

i) Removal of Individual Offending Wolves

Many factors influence the risk of depredation such as landscape and husbandry practices. Lethal control is a common reaction to a depredation event. However, removing the target individual is difficult and it is unlikely that targeted individuals will be selectively removed even by experts.

Biologist Adrian Treves (28) states that "*even if the culprits are targeted selectively, property damage may increase if hunting disrupts carnivore social organization and promotes new individuals or new denser populations of different species of carnivores that, in turn, may have greater impacts on property*".

A review and analysis of 20 years of data found that lethal wolf control is counter-productive and backfires on livestock (31). Their work showed that instead of reducing conflicts by hunting or trapping wolves, the odds of livestock losses increased the following year for each wolf killed.

Minnesota research indicated that the total number of wolves removed did not appear to affect the re-depredation rate (9).

In terms of seeing an immediate reduction in repeated depredation events when all non-lethal options have been applied, it often comes down to whether the offending individuals (and particularly all the offending individuals) are removed, whether through distant translocation or lethal methods (3).

Finally, because wolves are opportunistic hunters they may try to kill livestock whenever the chance presents itself (e.g., separated young animal, sick or injured animal, deep snow, etc.). For this reason, prevention is key even after a "problem wolf" has been removed from the landscape.

ii. Pre-Emptive Killing of Wolves to Manage for Future Depredation

Killing wolves to help decrease livestock depredation rates is corrective, not preventative (21). In other words, people kill wolves as a reaction to depredation, but wolves do not kill less livestock in areas or times when they are hunted down.

Substantial research shows that when wolves are indiscriminately killed, families experience pack disintegration (loss of social stability regardless of population size) which can lead to increased prey killed per capita and more conflicts with livestock (24, 29, 31). Indiscriminate killing is counter-productive as it results in smaller packs and an increase in lone and dispersing wolves, which are less capable of taking down wild prey, especially if they lack experience and group work.

No evidence exists to show that pre-emptive killing of wolves nor indiscriminate killing of wolves works to decrease livestock losses in the long term; depredations still occur in areas that have been practicing lethal control for decades.

In fact, in certain parts of North America, killing wolves indiscriminately may have led to increased depredation rates on livestock the next year (9, 27, 31).

Neighbouring packs or dispersing wolves will recolonize the area that wolves were removed from. Killing an individual wolf may help reduce severe cases where the individual or pack offend repeatedly, as this may help rid genetic or behavioural traits conducive to depredation (21). However, this will not reduce the rate of occurrence if husbandry and environmental conditions are not changed.

There was no evidence found during 20 years of research to indicate that removal of wolves by trapping decreased the rate of depredation the next year at state or local levels in Minnesota for cattle and sheep (9).

- Researching the correlations between trapping and depredations in the following years for all periods, areas, and livestock at both the individual scale and at a combined level showed either more depredations the next year or non-significant changes when wolves were killed by trapping (9, 31).

- Unsuccessful trapping reduced the rate of recurrence more than successful trapping or no trapping, indicating that human presence may have been the best deterrent with the possible exception of removing the breeding adult male (9).

Harper and others (9) showed that "*as more wolves were killed one year, the depredations increased the following year"*. A recent review of data from various studies performed over 20 years in the Northern Rocky Mountains (USA) supported this finding (31). Musiani and others (21) reviewed this dataset in addition to information from Alberta, and found that wolf removal did not decrease livestock depredations at the regional scale.

> *"As more wolves were killed one year, the depredations increased the following year".*
>
> -Harper et al. 2008.

- There may be more wolves present in these areas or possibly wolves avoiding traps had learned to prey on livestock, and become more dependent as their pack mates were removed (killed off).
- This study suggests that daily visits simulating trapping activities (human presence, foreign scents, and objects) may be more cost-effective than trapping and killing wolves, especially where ranches are far from control personnel.

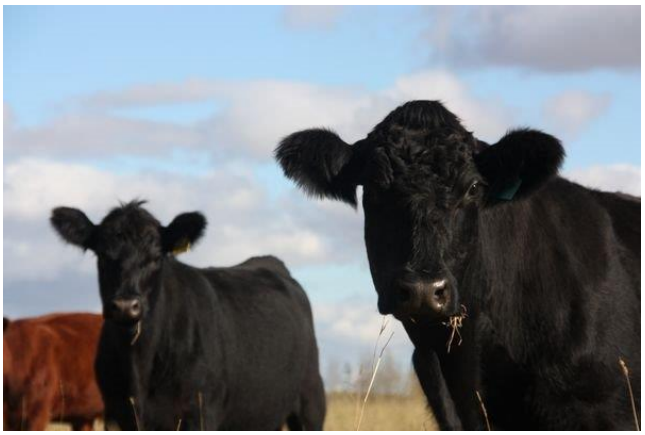


Photo courtesy of Louise Liebenberg©

Coyotes and Livestock

Coyotes are recognized for filling an important ecological niche that contributes to healthy and balanced landscapes. Ecologically, this intelligent, socially complex and highly adaptive canid brings many benefits to farmers and ranchers. Successful farm/ranching with coyotes, as with other carnivores, bring similar challenges for producers. Many of the strategies and methodologies outlined in this guide can also be applied and practiced to minimize and prevent coyote predation on livestock. It is important to avoid food conditioning coyotes to deadstock left in the pasture.

Photo of coyote "mousing" in field courtesy of Nick Lanfear©

Discussing What Works and Sharing These Practices with A Larger Audience

Interviews with ten producers were conducted from various locations across Canada and the United States by Coyote Watch Canada to identify the presence or absence of common attitudes and perceptions about predation by coyotes. Day to day living experiences and characteristics describing landscape, flora and fauna and type of stock (dairy/meat cattle, organic dairy cattle, sheep, chickens, horses, poultry and geese) were generously shared by each family. All ten producers identified and acknowledged the importance of coexisting with coyotes and stated that in regards to their resident coyote family, they were 'happy, thrilled, welcomed, and respected'.

Most of these family-run farms were multi-generational; the longest being over forty years. Coexistence through farming practices were passed down from one generation to the next.

After summarizing and identifying similar opinions provided by each of the farmers as to why they had no issues with coyote predation, this is what we discovered:

1. There was an abundance of natural prey species in the pastures and fields. None of the farms practiced any form of lethal removal (including trapping and poisoning) of small mammals and/or rodents.
2. The hunting of coyotes was prohibited.
3. Each farm was aware of the benefits coyotes provide by preying on rodents, rabbits and other small mammals.
4. Each farm was part of a larger territory where stable coyote families lived and raised their pups.
5. Recognition that allowing coyote families to remain stable was an important part of a conflict-free environment.
6. A variety of livestock were grazing in pastures; cattle, sheep and horses.
7. Dead livestock was addressed in a timely manner.
8. A human presence was paramount to maintain effective husbandry, care and to monitor the wildlife in the landscape.
9. All of the farmers acknowledged the importance of diligent husbandry and presented a deep reverence for working with the land and wildlife, not against it. Understanding the connectedness of nature and their role as stewards of the land provided predation-free results that are measurable.
10. Domestic dogs harassing, attacking, and killing livestock was noted as a significant issue at each property.

There is great prospect and importance to share other successful farming testimonials that has yet to be fully utilized. Incentive programs that celebrate predator friendly farming and ranching can shift the focus from what is not working to what is working. Fostering coexistence is a strong platform when the information comes directly from the farming and ranching community.

Appendix I- Suppliers and Resources

Electric Fence Suppliers

Margo Supplies Ltd. – High River, Alberta
Website: www.margosupplies.com
Email: info@margosupplies.com
Phone: 403-652-1932

Kane Veterinary Supplies – Edmonton, Alberta
Website: www.kanevet.com
Toll-free: 1-800-252-7547

R & S Powerfence – Penticton, British Columbia
Website: www.powerfence.ca
Email: rprs@vip.net

Score Construction Ltd. Revelstoke, British Columbia
Website: www.scorefencing.com
email: score@telus.net

Gallagher Animal Management Systems Inc. - Owen Sound, Ontario
Website: www.gallagher.ca
Email: info@gallagher.ca

Premier 1 Supplies – Washington, Iowa
Website: www.premier1supplies.com/c/fencing/
Toll-free: 1-800-282-6631

Fladry General Contract Sewers:

Jonco Industries, USA
website: joncoind.com/sew.html
Email: info@joncoind.com
Phone: 414-449-2000
Address: 2501 West Hampton Ave. Milwaukee, Wisconsin USA 53209

Backyard Deterrents:

Margo Supplies Ltd. – High River, Alberta
website: www.margosupplies.com
Email: info@margosupplies.com
Phone: 403-652-1932

Kodiak Security Products
website: www.kodiakcanada.com

Livestock Guardian Dog Breeders:

Louise Liebenberg and Erik Verstappen Grazerie Farms – High Prairie, Alberta
website: www.grazerie.com
Email: info@grazerie.com

Reports LGD breeds - Working Dog Web:
http://www.workingdogweb.com/wdbreeds.html

Flock & Family Guardian Network
www.flockguard.org

Useful Website Resources:

Interactive discussion group to join on Facebook titled "Predators and ranching: finding solutions to reduce conflicts". Group hosted by Alberta-based Certified Predator Friendly Louise Liebenberg.

People and Carnivores
Website: peopleandcarnivores.org
Click on Publications > By Us

- Wolves on the Landscape

- Managing Conflict: Coexistence with Grizzly Bears, Cougars and Wolves

- Fladry Manual for deterring wolves, a best practices guide

- Livestock Management for Coexistence with Large Carnivores, Healthy Land and Productive Ranches. A White Paper by Matthew Barnes

- Low-stress Herding Improves Herd Instinct, Facilitates Strategic Grazing Management. Stockmanship Journal. By Matthew Barnes

- Preventing Predation of Livestock—Livestock Management for Coexistence with Large Carnivores. In Practice. By Matthew Barnes

Defenders' of Wildlife
http://www.defenders.org/publications/livestock_and_wolves.pdf

An international accredited organization
www.predatorfriendly.com

Appendix II - Risk Assessment:

Assess your risk by circling the category that best describes your situation and then tallying results.

Risk			Low	Med	High	Score
Ranch Characteristics		Pasture Size	Small	Medium	Large	
		Distance to Human Dwellings	Small	Medium	Large	
		Vegetation	Open	Partly Forested	> 50% Forested	
		Terrain	Flat	Rolling Hills	Rugged	
Livestock	Sheep/Goats	Sheep		Rams	Ewes and Lambs	
		Number of Sheep	Small	Medium	High	
		Season			Lambing Season	
	Bovine	Bovine	Bulls	Cow/Calf Pairs	Yearlings	
		Number of Bovine	Small	Medium	High	
		Season	Feb - April	Oct - Jan	May - Sept (calving & grazing)	
Natural Prey					Abundant or Reduced Quickly	
Wolf Pack Characteristics		Season	No pups		Late Summer with Pups	
Total Score						

Appendix III - Livestock Producers Best Management Practices Checklist

Adopted from "Wild Predator Loss Prevention Best Management Practices for Cattle" as prepared for the BC Cattleman's Association.

General Husbandry Practices

- Pasture and areas surrounding fence are clear of vegetation where predators can hide
- Old farm equipment and other items are stored in a defined location away from where cattle are kept
- Breeding seasons are defined
- Afterbirth from calving is removed
- Calves are given enough time to heal from branding and castration before being put to pasture/rangeland
- Dead livestock are removed quickly
- Dead livestock are buried deep enough so that the carcass is covered by at least 1 metre of soil
- Record keeping is done frequently and is up to date
- Herd is inspected regularly
- Watering locations are safe
- Herd is grouped

Predator Deterrents/Scare Devices

- Bells
- Radios
- Lights

Guardian Animals

- Livestock Guardian Dogs
- Longhorn Steers

Predator-Resistant Fencing

- Permanent
- Portable
- Electric: ample voltage
- Taught wires
- Fladry: maintained

Appendix IV- Cost Comparison of Wolf Bounty in Big Lakes AB 2010 – 2016 vs. Prevention

These cost comparisons were made using information from the County of Big Lakes, Alberta; personal communication with producers in Western Canada, Waterton Biosphere Reserve Large Carnivore Attractant Management Project costs for Southwestern Alberta; and John A. Shivik from US Department of Agriculture.

$242,750 spent in 7 years on Alberta Wolf Bounty in Big Lakes Alberta and conflicts continue. Preventative husbandry practices can save producers both money and livestock losses in the long term.

Livestock Guardian Dogs:

Cost estimate $300 - $1000 initial cost, then $500 per year. Could have purchased 303 guardian dogs (at $800 each). Or could have purchased 50 guardian dogs (at $800/LGD) in 2010 and maintained them each at $500/year for 8.1 years. Duration of effectiveness is approximately the lifespan of guard animal, typically years.

Carcass Removal Programs:

Big Lakes County is 1,213,056 hectares. Using data from Southwestern Alberta Waterton Biosphere Reserve Project where $71,854 was spent to remove over 1,460 deadstock carcasses from a 500,000 ha zone during 2013 and 2014, we estimate that $242,750 could have paid for the removal of 4935 carcasses over an area of 1,690,000 ha. If fewer carcasses require removal the time period of removal program could be extended.

Fladry: Cost estimate $781/km. Could purchase 310.8 km of fladry. Duration 60 days

***Turbofladry*:**

Cost estimate $2,303 for the 1st km, then $2,032/km. Could purchase 119 km. for $242,750 Duration of effectiveness is unlimited if fence was properly constructed and maintained.

***Electric Fencing*:**

Cost estimate -$250 for Super Energizer IV voltmeter- 50 mile range (if off grid $450)

- Grounding plates $17 or rods (rebar)
- rebar posts every 10-12 feet ($600 to $700 per ton)
- stucco wire roll 100 feet $80, or ¼ mile tensile steel $25

Could purchase 971 voltmeters or 14,279 grounding plates or 373 tons of rebar posts or 303,438 feet of stucco wire or 2427 miles of tensile steel.

Duration of effectiveness would be unlimited if fence was properly constructed and maintained.

Range Riders:

Two range-riders (for 2500 cow-calf pairs) one full time at $3,000/month and a second at $20/hour for part-time work. Six months of hiring costs approximately $24,000; or $9.60 per cow-calf pair for 6 months of range-rider supervision. $242,750 could have provided range riders for more than 25,000 cow-calf pairs (several ranches) for a period of six months, or for 2,500 cow-calf pairs for six months over 10 years. Duration of effectiveness is ongoing while range-riders are in use.

NOTE: Between 2010 – 2016 a total of 756 wolves were killed and turned in to the County of Big Lakes. Each bounty payment was $250/wolf, costing local taxpayers a total of $242,750 in bounty payouts since 2010.

Work Cited

1. Barnes, M. (2015). Low-stress Herding Improves Herd Instinct, Facilitates Strategic Grazing Management. Stockmanship Journal. 4(1):34-43
2. Breitenmoser, U., Angst, C., Landry, J. M., Breitenmoser-Wursten, C., Linnell, D. C., & Weber, J. M. (2005). Non-lethal techniques for reducing depredation. In R. Woodroffe, S. Thirgood, & A. Rabinowitz (Eds.), *People and Wildlife, Conflict or Coexistence?* The Zoological Society of London: Cambridge University Press.
3. Bradley, E., Robinson, H.S., Bangs, E.E., Kunkel, K., Jiminez, M.D., Gude, J.A. and T. Grimm. (2015). Effects of Wolf Removal on Livestock Depredation Recurrence and Wolf Recovery in Montana, Idaho, and Wyoming. *The Journal of Wildlife Management.* 79 (8). 1337–1346
4. Breck, S., Clark, P., Howery, L., Johnson, D. Kluever, B., Smallidge, S., and C. Cibils. (2012). A perspective on livestock-wolf interactions on western rangelands. *Society for Range Management.* 10, 6 – 11.
5. Ciucci, P. and L. Boitani. (1998b). Wolf and dog depredation on livestock in central Italy. *Wildlife Society Bulletin. 25. 504-14.*
6. Dorrance, M. J., & Bourne, J. (1980). An evaluation of anti-coyote electric fencing. *Journal of Range Management.* (33), 385-387.
7. Fritts, S. H.-3. (2003). *Wolves: Behavior, Ecology, and Conservation.* University of Chicago Press.
8. Green, J. S., & Woodruff, R. A. (1988). Breed Comparisons and characteristics of use of livestock guarding dogs. *Journal of Range Management*. 249-251.
9. Harper, E., William, P. J., Mech, L. D., & Weisberg, S. (2008). Effectiveness of Lethal, Directed Wolf-Depredation Control in Minnesota. *The Journal of Wildlife Management. 72* (3), 778-783.
10. Hulet, C.V., Anderson, D.M., Smith, J.N. and W.L. Shupe. (1987). Bonding of Sheep to Cattle as an Effective Technique for Predation Control. *Applied Animal Behaviour Science. 19: 19-25.*
11. Lance, N. J., Breck, S. W., Sime, C., Callahan, P., & Shivik, J. A. (2010). Biological, technical, and social aspects of applying electrified fladry for livestock protection from wolves (Canis lupus). *Wildlife Research. 37*, 708-714.
12. MacKay, A. (2005). *Mitigating Cattle Losses Caused by Wild Predators in British Columbia, A Field Guide for Ranchers.* Agriculture and Agri-Food Canada, [British Columbia Cattleman's Association], British Columbia Ministry of Agriculture & Lands.
13. Mech, L.D. and L. Boitani (Eds.) (2003). *Wolves; Behaviour, Ecology, and Conservation.* Chicago, USA: University of Chicago Press
14. Mech, L.D., Harper, E.K., Meier, T.J. and W.J. Paul. (2000). Assessing factors that predispose Minnesota farms to wolf depredations on cattle. *Wildlife Society Bulletin*. 28:623-29.
15. Morehouse and Boyce. (2011). From venison to beef: seasonal changes in wolf diet composition in a livestock grazing landscape. *Frontiers in Ecology and the Environment*. 9(8): 440–445.
16. Muhly, T.B. and Musiani, M. (2009) Livestock depredation by wolves and the ranching economy in the Northern US. *Ecological Economics*. 68, 2439-2450.
17. Muhly, T., Gates, C. C., Callaghan, C., & Musiani, M. (2010). In Musiani, Boitani, & Paquet (Eds.), *The World of Wolves: new perspectives on ecology, behaviour and management.* (pp. 242-273). Calgary: University of Calgary Press.
18. Musiani, M., Boitani, L., & Paquet, P. (Eds.). (2009). *A New Era for Wolves and People. Wolf Recovery, Human Attitudes, and Policy.* Calgary: University of Calgary Press.
19. Musiani, M., Mamo, C., Boitani, L., Callaghan, C., Cormack, G., Mattei, L., et al. (2003). Wolf Depredation Trends and the Use of Fladry Barriers to Protect Livestock in Western North America. *Conservation Biology.* 1538-1547.
20. Musiani, M., Muhly, T., Callaghan, C., & Gates, C. (2004). Recovery, conservation, conflicts and legal status of wolves in western North America. N. Fascione, A. Delach, & M. Smith (Eds.), *Predators and People: From Conflict to Conservation* (pp. 51-75). Washington, D.C., USA: Island Press.
21. Musiani, M., Muhly, T., Gates, C. C., & Callaghan, C. (2005). Seasonality and reoccurrence of depredation and wolf control in western North America. *Wildlife Society Bulletin. 33* (3), 876-887.
22. Oakleaf, J.K., Mack, C., and D. Murray. (2003). Effects of wolves on livestock calf survival and movements in Central Idaho. *Journal of Wildlife Management*. 67(2): 299 – 306.
23. Parks, M. (2015). "Participant Perceptions of Range Rider Programs Used to Mitigate Wolf-Livestock Conflicts in the Western United States". Graduate Theses and Dissertations. Paper 4444.
24. Rutledge, L.Y., B. R. Patterson, K. J. Mills, K.M. Loveless, D. L. Murray, B.N. White (2009). Protection from harvesting restores the natural social structure of eastern wolf packs. Biological Conservation 143 (2010): 332–339.
25. Senft, D. and J. Corliss. (1991). Cattle and Sheep Together: Partners in Grazing Agricultural Research; Washington. 39.12 : 14.
26. Shivik, J. A. (2006). Tools for the Edge: What's New for Conserving Carnivores? *BioScience*.
27. Treves, A.,.Krofel, M., and J. McManus. (2016). Predator control should not be a shot in the dark. *Front Ecol Environ.* 14(7): 380–388.
28. Treves, A. (2009). Hunting for large carnivore conservation. *Journal of Applied Ecology. 46*, 1350-1356.
29. Wallach A.D., E. R. (2009). More than Mere Numbers: The Impact of Lethal Control on the Social Stability of a Top-Order Predator. *PloS ONE.* 4 (9): 1-7.
30. Waterton Biosphere Reserve. (2017). Report: Large carnivore attractant management projects in southwestern Alberta 2013 – 2014.
31. Wielgus RB, Peebles KA (2014). Effects of Wolf Mortality on Livestock Depredations. PLoS ONE 9(12).
32. Wilson, S.E., Madel, M.J., Mattson, D.J., Graham, J.M., Merrill, T. (2006). Landscape conditions predisposing grizzly bears to conflicts on private agricultural lands in the western USA. Biological Conservation. 130 (1), 47–59.