

Carnivore Coexistence Annotated Bibliography



Providing the public with accessible and reliable scientific
information on carnivore-livestock coexistence

Created by WildEarth Guardians

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Annotated Bibliography Key:

Search Parameters:

Keywords (not required): Coexistence; Livestock Depredation; Lethal Carnivore Removal; Virtual Fences; Carnivore Culling; Human-carnivore Coexistence; Carnivore Management; Carnivores and Ranching; Carnivore-Livestock Management;

Date Range: 2026 - 2015; plus older cases that are directly applicable or highly cited.

Animals: Gray Wolves, Mexican Wolves, Grizzly Bears, Cougars, Black Bears, Coyotes > European Wolves, Lynx, and Bears > Canada Lynx, Wolverines > South American and Central American carnivores (Pumas, Jaguars, Foxes) > African mammalian carnivores (Painted Dogs, Lions, Leopards)

Locations: USA, Canadian Rockies > North America > Africa, Europe, South America

- These parameters are not an exclusive list: relevant studies will be added even if they do not fit all 4 of these categories.

Organizational Layout & Nomenclature:

- Organized in chronological order, starting with the oldest publications.
- Locations can be global, continents, countries, or states/provinces.
 - For instance, sometimes the location is Europe, Canada, or Montana.
- Animals may be broad, such as “Wolves” or “Bears,” or they may be specific, like “Mexican Wolves.”
- Mountain Lions/Pumas/Cougars → Terms used interchangeably
- Summaries include lightly edited versions of paper abstracts as well as summaries prepared by WildEarth Guardians staff.

Publish Date: January 13, 2011

Animal(s): Mexican Wolves

Location: Arizona, New Mexico

Link

Breck, S.W., Kluever, B.M., Panasci, M., Oakleaf, J., Johnson, T., Ballard, W., Howery, L., and Bergman, D.L. (2011). **Domestic calf mortality and producer detection rates in the Mexican wolf recovery area: Implications for livestock management and carnivore compensation schemes.** *Biological Conservation*, 144: 930-936.

Summary: Conserving large carnivores throughout the world will often require that they share the landscape with livestock. Minimizing depredations and increasing tolerance by livestock producers will be critical for conservation efforts. To investigate factors influencing calf

mortality and producer detection rates (i.e., number of livestock killed by predators, found by producers, and correctly classified as to cause of death), we monitored radio-tagged domestic calves at two sites in the Mexican wolf recovery area (East Eagle [EE] and Adobe Ranch [AR]). Study areas differed in grazing practices, density of predators (mountain lions, black bears, coyotes, and Mexican wolves), and amount of effort spent monitoring cattle. We radiotagged 618 calves over 3.5 years, and 312 calves over 2 years on the EE and AR, respectively. The overall proportion of radioed calves that died was higher on the EE (6.5%) than on the AR (1.9%). Predators (especially mountain lions) accounted for 85% of mortality on the EE and 0% on the AR. Calves selected by predators were on average 25 days younger than the surviving cohort. Our results indicate that year-round calving, especially in areas with high predator densities, are subject to higher losses primarily because calves are exposed to mortality agents for longer periods of time rather than having higher natural rates of mortality. We found a significant difference in producer detection rates between study sites, likely due to differences in the intensity of monitoring cattle between sites. On the EE, the producer detected 77.5% of mortalities and on the AR, the producer detected 33% of mortalities. Our results support changing husbandry practices to limit calving to a seasonal endeavor and that performance payment may be a better compensation strategy than ex post compensation schemes.

Publish Date: 2014

Animal(s): Cattle

Location: Global

[Link](#)

Jachowski, D.S., Slotow, R., and Millsbaugh, J.J. 2013. **Good virtual fences make good neighbors: opportunities for conservation.** *Animal Conservation*, 17:187–196.
doi:10.1111/acv.12082.

Summary: Fences can both enhance and detract from the conservation of wildlife, and many detrimental impacts are associated with creating physical barriers. By contrast, virtual fences can restrict, control or minimize animal movement without the creation of physical barriers, and present key benefits over traditional fences, including: (1) no need for construction, maintenance or removal of traditional fences; (2) rapid modification of boundaries both temporally and spatially based on specific conservation concerns; (3) application of novel conservation approaches for wildlife that integrate monitoring, research and management; and (4) social-psychological benefits that may increase support for conservation. We review the various types of sensory, biological and mechanical virtual fences, and the potential benefits and costs associated with fully integrating virtual fences into protected area management and wildlife conservation. The recent development of real-time virtual fences represents the potential for a new ‘virtual management’ era in wildlife conservation, where it is possible to initiate management actions promptly in response to real-time data. Wide-scale application of virtual fences faces considerable technological and logistical constraints; however, virtual fences are increasingly popular and soon will offer realistic management strategies for both terrestrial and avian wildlife conservation.

Publish Date: May 2014

Animal(s): Jaguars, wolves, lions, bears

Location: Global

[Link](#)

Treves, A., Bruskotter, J.T. (2014) **Tolerance for Predatory Wildlife.** *Science* 344: 476-477.

Summary: The article discusses studies of jaguars, wolves, lions, and bears, concluding that they challenge the conventional view that intolerance for predators and intention to kill predators result primarily from perceived threats to livelihoods. Although monetary incentives for predator tolerance appear to have been successful in several cases, there is evidence that predator-poaching is influenced more strongly by social factors, with peer group norms and government-sanctioned predator-killing affecting people's intentions to poach predators. We therefore recommend caution in legalizing the killing of predators. Experimentally manipulating monetary and social incentives would help conservationists to determine which factors influence poaching, both among individuals and across cultures that have different histories with various predators.

Publish Date: December 2015

Animal(s): Lion, tiger, leopard, jaguar, snow leopard, cougar, cheetah

Location: South America, Asia, Africa

[Link](#)

Khorozyan I, Ghoddousi A, Soofi M, Waltert M. (2015) **Big cats kill more livestock when wild prey reaches a minimum threshold.** *Biol Conserv.* 2015;192:268–75.

Summary: Livestock predation by big cats creates conflicts with humans that challenge biodiversity conservation and rural development. The authors sought to answer the question “at which level of prey density and biomass do big cats begin to kill livestock?” They analyzed meta-data from recent peer-reviewed scientific publications, and determined that the probability of livestock killing by big cats significantly increased when prey biomass fell below certain minimum thresholds: 812.41 kg per square kilometer for cattle, and 544.57 kg per soiree kilometer for goats and sheep. In other words, big cats are much more likely to kill cattle, sheep, and goats when there is less wild prey. The authors suggest that these thresholds represent important landmarks for predicting human–felid conflicts, identifying conflict hotspots, and setting priorities for targeted conservation actions. It is essential to maintain and restore wild prey to forestall local extinctions of big cats.

Publish Date: 2016

Animal(s): Coyotes, Wolves, Bears, Big Cats

Location: North America, Europe

[Link](#)

Treves, A., Krofel, M, and McManus, L. (2016). **Predator control should not be a shot in the dark.** *Frontiers in Ecology and the Environment*, 14(7): 380–388.

Summary: This publication focused on “gold-standard” and “silver-standard” review techniques in evaluating the support, use, and reliability of lethal and nonlethal interventions. The article found that out of the 12 tests that were reviewed, nonlethal techniques (night enclosures, fladry, and LGDs) were significantly more adept at preventing depredation; meanwhile, no lethal removal techniques met the “gold standard” and tended to be unpredictable in their success rate. The article concluded that continuing education in those who manage wildlife and policy is required, and that policy must reflect the best available science. In their view, that meant strong inferences of effectiveness and comparing techniques in order to conclude what is the most effective. In this case, they found that to be nonlethal measures.

Publish Date: June 2017

Animal(s): Coyotes, Wolves, Bears, Big Cats

Location: North America, Europe

[Link](#)

Treves, A., Rabenhorst, M.F. (2017) **Risk map for wolf threats to livestock still predictive 5 years after construction.** *PLoS One* 12(6): e0180043.

Summary: Risk maps are spatial models of environmental hazards such as predation on livestock. We tested the long-term validity of a published risk map built from locations where Wisconsin wolves attacked livestock from 1999–2006. Using data collected after model construction, we verified the predictive accuracy of the risk map exceeded 91% for the period 2007–2011. Predictive power lasting 5 years or more substantiates the claim that risk maps are both valid and verified tools for anticipating spatial hazards. Classification errors coincided with verifier uncertainty about which wolves might be responsible. Perceived threats by wolves to domestic animals were not as well predicted (82%) as verified attacks had been and errors in classification coincided with incidents involved domestic animals other than bovids and verifier uncertainty about which wolves were involved. We recommend risk maps be used to target interventions selectively at high-risk sites.

Publish Date: January 2018

Animal(s): Gray wolves

Location: Upper Peninsula of Michigan, USA

[Link](#)

Santiago-Avila F.J., Cornman A.M., Treves A. (2018) **Killing wolves to prevent predation on livestock may protect one farm but harm neighbors.** *PLoS ONE* 13(1): e0189729.

Summary: We evaluated two methods of government intervention following independent events of verified wolf predation on domestic animals (depredation) in the Upper Peninsula of Michigan, USA between 1998–2014, at three spatial scales. We evaluated two intervention methods using log-rank tests and conditional Cox recurrent event, gap time models based on retrospective analyses of the following quasi- experimental treatments: (1) selective killing of wolves by trapping near sites of verified depredation, and (2) advice to owners and haphazard

use of non-lethal methods without wolf-killing. The government did not randomly assign treatments and used a pseudo-control (no removal of wolves was not a true control), but the federal permission to intervene lethally was granted and rescinded independent of events on the ground. Hazard ratios suggest lethal intervention was associated with an insignificant 27% lower risk of recurrence of events at trapping sites, but offset by an insignificant 22% increase in risk of recurrence at sites up to 5.42 km distant in the same year, compared to the non-lethal treatment. Our results do not support the hypothesis that Michigan's use of lethal intervention after wolf depredations was effective for reducing the future risk of recurrence in the vicinities of trapping sites. Examining only the sites of intervention is incomplete because neighbors near trapping sites may suffer the recurrence of depredations. We propose two new hypotheses for perceived effectiveness of lethal methods: (a) killing predators may be perceived as effective because of the benefits to a small minority of farmers, and (b) if neighbors experience side-effects of lethal intervention such as displaced depredations, they may perceive the problem growing and then demand more lethal intervention rather than detecting problems spreading from the first trapping site. Ethical wildlife management guided by the "best scientific and commercial data available" would suggest suspending the standard method of trapping wolves in favor of non-lethal methods (livestock guarding dogs or fladry) that have been proven effective in preventing livestock losses in Michigan and elsewhere.

Publish Date: 2018

Animal(s): Carnivores

Location: Global

[Link](#)

Santiago-Ávila, F.J., Lynn, W.S., Treves, A. (2018) **Inappropriate consideration of animal interests in predator management: Towards a comprehensive moral code.** *In* Large Carnivore Conservation and Management: Human Dimensions and Governance, ed. T. Hovardos, Taylor & Frances, London.

In this chapter, we provide a brief introduction to ethics and its role in establishing and fostering a moral community. We proceed to review the ethical and scientific case for including individual animals in the moral community (a.k.a., 'animal ethics', 'nature ethics', 'interspecies ethics'), which contends that dismissing individual animal interests is arbitrary and ethically inconsistent. With advances in environmental sciences highlighting our interdependence with other animals, and the harmful effects we have on them, have come advances in ethology confirming their commonly appreciated emotional and cognitive abilities. Individual animals have their own lives and interests that can be helped or harmed by human action. This is the root reason why carnivore management is unavoidably a matter of ethics. We provide evidence that current laws and regulations lack appropriate consideration of animal ethics when intervening in the lives of grey wolves.

Publish Date: 2018

Animal(s): Black Bears

Location: USA

[Link](#)

Lackey, C.W., S.W. Breck, B.F. Wakeling, and B. White. 2018. **Human–Black Bear Conflicts: A review of common management practices.** *Human–Wildlife Interactions Monograph* 2:1-68.

Summary: Managers and the public need to understand the available tools to stop human–bear conflict and reduce effects on bear populations. Rhetorically blaming bears for conflicts by labeling them as problem bears or nuisance bears is becoming increasingly unpopular. Ultimately human behavior must change by reducing anthropogenic resources that cause human– bear conflicts. This process requires a different suite of tools and should be the primary focus for bear managers interested in lowering the potential for conflict. Our objective with this monograph is to provide wildlife professionals, who respond to human–bear conflicts, with an appraisal of the most common techniques used for mitigating conflicts as well as the benefits and challenges of each technique in a single document. Notably, the authors concluded that electric fences are effective, and supported guidance efforts for bear fences (such as those by the Montana Fish, Wildlife, and Parks). The writers also supported the use of husbandry practices, such as removing carcasses, utilizing physical barriers, and Livestock Protection Dogs. They also summarized the rare use of compensation programs for black bear-livestock conflicts, and how these programs do not prevent depredation.

Publish Date: September 2018

Animal(s): Carnivores

Location: Global

[Link](#)

van Eeden LM, Eklund A, Miller JRB, López-Bao JV, Chapron G, Cejtin MR, et al. (2018) **Carnivore conservation needs evidence-based livestock protection.** *PLoS Biology* 16(9): e2005577.

Summary: Carnivore predation on livestock often leads people to retaliate. Persecution by humans has contributed strongly to global endangerment of carnivores. Preventing livestock losses would help to achieve three goals common to many human societies: preserve nature, protect animal welfare, and safeguard human livelihoods. Between 2016 and 2018, four independent reviews evaluated >40 years of research on lethal and nonlethal interventions for reducing predation on livestock. From 114 studies, we find a striking conclusion: scarce quantitative comparisons of interventions and scarce comparisons against experimental controls preclude strong inference about the effectiveness of methods. For wise investment of public resources in protecting livestock and carnivores, evidence of effectiveness should be a prerequisite to policy making or large-scale funding of any method or, at a minimum, should be measured during implementation. An appropriate evidence base is needed, and we recommend a coalition of scientists and managers be formed to establish and encourage use of consistent standards in future experimental evaluations

Publish Date: 2019

Animal(s): Puma

Location: Chile

[Link](#)

Ohrens, O., Bonacic, C., Treves, A. 2019. **Non-lethal defense of livestock against predators: Flashing lights deter puma attacks in Chile.** *Frontiers in Ecology and the Environment* 17(1):1-7.

Summary: We present the results of a randomized crossover experimental test of a method to prevent predation on livestock, which to our knowledge is the first such test in Latin America. By relying on a so-called “gold-standard” design, we evaluated the effectiveness of using flashing lights to deter predators. We found that light deterrents discouraged pumas (*Puma concolor*) but not Andean foxes (*Lycalopex culpaeus*) from preying on alpacas (*Vicugna pacos*) and llamas (*Lama glama*), and demonstrated that gold-standard experiments are feasible in large natural ecosystems, contradicting assumptions that people will reject placebo controls and that such systems contain too many confounding variables. Functionally effective non-lethal methods can protect wildlife, livestock, and people. Strong inference is needed for the development of sound policy concerning wildlife management, livestock husbandry, environmental conservation, and biodiversity.

Publish Date: September 2019

Animal(s): Coyote, black bear, brown bear, cougar, red fox, gray wolf, other carnivores

Location: Global literature review

[Link](#)

Khorozyan I, Waltert M. (2019) **How long do anti-predator interventions remain effective? Patterns, thresholds and uncertainty.** *Royal Society Open Science.* 2019;6(9):e190826.

Summary: Human–predator conflicts are globally widespread, and effective interventions are essential to protect human assets from predator attacks. As effectiveness also has a temporal dimension, it is of importance to know how long interventions remain most effective and to determine time thresholds at which effectiveness begins to decrease. To address this, we conducted a systematic review of the temporal changes in the effectiveness of non-invasive interventions against terrestrial mammalian predators, defining a temporal trend line of effectiveness for each published case. We found only 26 cases from 14 publications, mainly referring to electric fences (n = 7 cases) and deterrents (n = 7 cases). We found electric fences and calving control to remain highly effective for the longest time, reducing damage by 100% for periods between three months and 3 years. The effectiveness of acoustical and light deterrents as well as guarding animals eroded quite fast after one to five months. Supplemental feeding was found to be counter-productive by increasing damage over time instead of reducing it. We stress that it is vital to make monitoring a routine requirement for all intervention applications and suggest standardizing periods of time over which monitoring can produce meaningful and affordable information.

Publish Date: May 2019

Animal(s): Coyotes, wolves, black bears, cougars, grizzly bears

Location: North America, Europe, Africa

[Link](#)

Khorozyan I, Waltert M. (2019) **A framework of most effective practices in protecting human assets from predators.** *Human Dimensions of Wildlife.* 2019;24(4):380-94.

Summary: Widespread damage by large mammalian predators to human assets (e.g., livestock, crops, neighborhood safety) requires the application of non-invasive (i.e., without direct contact with predators) and targeted interventions to promote predator conservation and local livelihoods. We compiled 117 cases from 23 countries describing the effectiveness of 12 interventions designed to protect human assets from 21 predators. We found: (a) the most effective interventions were electric fences, guarding animals, calving control, and physical deterrents (protective collars and shocking devices); (b) the most effectively protected asset was livestock; and (c) the most effective interventions being used were to protect assets from cheetahs (*Acinonyx jubatus*), Eurasian lynx (*Lynx lynx*), gray wolves (*Canis lupus*), and lions (*Panthera leo*). In all of these cases, the relative risk of damage was reduced by 50-100%. We combined these outcomes into a novel framework of most effective practices and discussed its structure, practicality, and future applications.

Publish Date: December 2019

Animal(s): Carnivores

Location: Global

[Link](#)

Treves, A., Krofel, M., Ohrens, O., van Eeden, L.M. (2019) **Predator Control Needs a Standard of Unbiased Randomized Experiments with Cross-Over Design.** *Frontiers in Ecology and Evolution* 7:402-413.

Summary: Lack of solid scientific evidence precludes strong inference about responses of predators, people, and prey of both, to various types of predator control. Here we formulate two opposing hypotheses with possible underlying mechanisms and propose experiments to test four pairs of opposed predictions about responses of predators, domestic animals, and people in a coupled, dynamic system. We outline the design of a platinum-standard experiment, namely randomized, controlled experiment with cross-over design and multiple steps to blind measurement, analysis, and peer review to avoid pervasive biases. The gold-standard has been proven feasible in field experiments with predators and livestock, so we call for replicating that across the world on different methods of predator control, in addition to striving for an even higher standard that can improve reproducibility and reliability of the science of predator control.

Publish Date: March 2020

Animal(s): Wolves

Location: Germany (with data across Europe & North America)

[Link](#)

Bruns, A., Waltert, M., and Khorozyan, I. (2019). **The effectiveness of livestock protection measures against wolves (*Canis lupus*) and implications for their co-existence with humans.** *Global Ecology and Conservation*, 21: e00868.

Summary: Wolves (*Canis lupus*) can kill domestic livestock resulting in intense conflicts with humans. Damage to livestock should be reduced to facilitate human-wolf coexistence and ensure positive outcomes of conservation efforts. Current knowledge on the effectiveness of livestock protection measures from wolves is limited and scattered in the literature. In this study, we compiled a dataset of 30 cases describing the application of 11 measures of protecting cattle and smaller livestock against wolves, estimated their effectiveness as a relative risk of damage, and identified the best measures for damage reduction. We found that: (1) lethal control and translocation were less effective than other measures, (2) deterrents, especially fladry which is a fence with ropes marked by hanging colored flags that sway in the wind and provide a visual warning signal, were more effective than guarding dogs; (3) deterrents, fencing, calving control and herding were very effective, but the last two measures included only one case each; and (4) protection of cattle was more effective than that of small stock (sheep and goats, or sheep only) and mixed cattle and small stock. In all of these cases, the relative risk of damage was reduced by 50-100%. Considering Germany as an example of a country with a recovering wolf population and escalating human-wolf conflicts, we suggest electric fences and electrified fladry as the most promising measures, which under suitable conditions can be accompanied by well-trained livestock guarding dogs, and the temporary use of deterrents during critical periods such as calving and lambing seasons. Further research in this field is of paramount importance to efficiently mitigate human-wolf conflicts.

Publish Date: 2020

Animal(s): Coyote, Black Bear

Location: Bad River Reservation, Wisconsin, USA

[Link](#)

Fergus, A.R. (2020) **Building Carnivore Coexistence on Anishinaabe Land: Gold Standard Non-lethal Deterrent Research and Relationship Building Between Livestock Farmers and the Bad River Band of the Lake Superior Tribe of Chippewa Indians.** Master's Thesis, University of Wisconsin, Madison.

Summary: We believe that improving carnivore coexistence globally requires both relationship building and gold-standard scientific experimentation. Specific demographics, including farmers, have a disproportionate influence on the survival of carnivores- yet it has been reported in the literature that some farmers are isolated from and in conflict with wildlife professionals (Browne-Nuñez et al., 2015). Farmers may develop negative attitudes toward carnivore coexistence if they feel that wildlife professionals have neglected their need to protect their livestock animals, and perspectives, in turn, can shape actions- including the legal or illegal killing of carnivores (Treves et al., 2013). Finding possible solutions to predation on livestock requires gold-standard experiments involving randomization, cross-over, and transparent discussion of assumptions. Through gold-standard research, we evaluate non-lethal deterrents'

effectiveness in preventing or reducing carnivore visitation to livestock pasture. We tested the efficacy of Foxlights ® and fladry at disrupting wildlife corridors and thus carnivore visitation to livestock pasture land surrounding the Bad River Reservation in what is now known as northern Wisconsin. We found fladry and Foxlights to have insignificant effects on carnivore visitation of treatment areas near livestock pastures.

Publish Date: March 2020

Animal(s): Grizzly Bears, Mexican Wolves, Coyotes

Location: New Mexico, Arizona, Montana, Idaho, Washington, Wyoming, Colorado, Oregon, Nevada, California, Utah - USA

[Link](#)

Lute, M.L. and Carter, N.H. (2020). **Are We Coexisting With Carnivores in the American West?** *Frontiers in Ecology and Evolution.*, 8:48. doi: 10.3389/fevo.2020.00048.

Summary: Questions about how to define coexistence remain and specific goals and methods for reaching coexistence require refining. Co-adaptation, where humans adapt to carnivores and vice versa, is a novel socioecological framework for operationalizing coexistence but has yet to be comprehensively examined. We explored co-adaptation and two additional coexistence criteria through analysis of three case studies involving large carnivores in the American West, each addressing differing approaches on how and what it means to coexist with carnivores: Mexican gray wolves (*Canis lupus baileyi*) in Arizona and New Mexico, grizzly bears (*Ursus arctos horribilis*) in the Greater Yellowstone Ecosystem and coyotes (*Canis latrans*) throughout the American West. We found clear evidence to support land-sharing between humans and coyotes and limited spatial overlap between humans and grizzly bears and Mexican gray wolves. Co-adaptation was variable for wolves, possible with bears and clearly evident with coyotes. Tolerable risk levels are likely achievable for bears and coyotes based on the available literature assessing risk perceptions and tolerance. But disagreement regarding risk management is a driver of conflict over wolves and persistent barrier to achieving coexistence among diverse stakeholders. The common key to coexistence with each considered carnivore may be in more equitable distribution of costs and benefits among highly diverse stakeholders. Better understanding of these three coexistence criteria and innovative tools to achieve them will improve coexistence capacity with controversial carnivores on public and private lands in diverse American West contexts and beyond.

Publish Date: June 2020

Animal(s): Leopard

Location: Northern Iran

[Link](#)

Khorozyan I, Siavash G, Mobin S, Soofi M, Waltert M. (2020) **Studded leather collars are very effective in protecting cattle from leopard (*Panthera pardus*) attacks.** *Ecological Solutions and Evidence.* 2020;1(1):e12013.

Summary: Minimisation of livestock losses caused by big cats and other predators is essential to mitigate conflicts and promote socially acceptable conservation. As big cats usually kill by throat bites, protective collars represent a potentially effective non-lethal intervention to prevent livestock depredation, yet the application and effectiveness estimation of these tools are very limited. In this study, for the first time we measured the effectiveness of studded leather collars in protecting cattle from leopard (*Panthera pardus*) attacks. We conducted a randomised controlled experiment during 14 months to collar 202 heads and leave uncollared 258 heads grazing in forests and belonging to 27 owners from eight villages near three protected areas in Mazandaran Province, northern Iran. Our results show that none of collared cattle and nine uncollared cattle were lost to leopard depredation, meaning that collars caused a zero relative risk of damage and a perfect 100% damage reduction. We suggest that collars can be successfully applied to cattle freely grazing in habitats of leopards or other felids for a long time and thus remaining persistently exposed to depredation. As grazing cattle are usually not supervised by shepherds or dogs, collars can be the only practical protection tool.

Publish Date: August 2020

Animal(s): Gray wolf

Location: Wisconsin, USA

[Link](#)

Santiago-Ávila, F.J., Chappell, R.J., Treves, A. (2020) **Liberalizing the killing of endangered wolves was associated with more disappearances of collared individuals in Wisconsin, USA.** *Scientific Reports* 10:e13881.

Summary: Although poaching (illegal killing) is an important cause of death for large carnivores globally, the effect of lethal management policies on poaching is unknown for many populations. Two opposing hypotheses have been proposed: liberalizing killing may decrease poaching incidence ('tolerance hunting') or increase it ('facilitated poaching'). For gray wolves in Wisconsin, USA, we evaluated how five causes of death and disappearances of monitored, adult wolves were influenced by policy changes. We found slight decreases in reported wolf poaching hazard and incidence during six liberalized killing periods, but that was outweighed by larger increases in hazard and incidence of disappearance. Although the observed increase in the hazard of disappearance cannot be definitively shown to have been caused by an increase in cryptic poaching, we discuss two additional independent lines of evidence making this the most likely explanation for changing incidence among $n = 513$ wolves' deaths or disappearances during 12 replicated changes in policy. Support for the facilitated poaching hypothesis suggests the increase (11–34%) in disappearances reflects that poachers killed more wolves and concealed more evidence when the government relaxed protections for endangered wolves

Publish Date: September 2020

Animal(s): Bears

Location: Primarily North America

[Link](#)

Khorozyan I, Waltert M. (2020) **Variation and conservation implications of the effectiveness of anti-bear interventions.** *Scientific Reports.* 2020; 10:15341.

Summary: Human-bear conflicts triggered by nuisance behaviour in public places and damage to livestock, crops, beehives and trees are among the main threats to bear populations globally. The effectiveness of interventions used to minimize bear-caused damage is insufficiently known and comparative reviews are lacking. We conducted a meta-analysis of 77 cases from 48 publications and used the relative risk of damage to compare the effectiveness of non-invasive interventions, invasive management (translocations) and lethal control (shooting) against bears. We show that the most effective interventions are electric fences (95% confidence interval = 79.2–100% reduction in damage), calving control (100%) and livestock replacement (99.8%), but the latter two approaches were applied in only one case each and need more testing. Deterrents varied widely in their effectiveness (13.7–79.5%) and we recommend applying these during the peak periods of damage infliction. We found shooting (– 34.2 to 100%) to have a short-term positive effect with its effectiveness decreasing significantly and linearly over time. Shooting and translocations were significantly less effective than the best intervention (i.e, electric fences), and can become counter-productive over time, especially if bear attractants are not eliminated or secured.

Publish Date: July 2021

Animal(s): Gray Wolves

Location: Wisconsin, USA

[Link](#)

Treves A., Santiago-Ávila, F.J., and Putrevu, K. (2021). **Quantifying the effects of delisting wolves after the first state began lethal management.** *PeerJ*, 9:e11666

Summary: On November 3, 2020, wolves were federally declared recovered and no longer required the protections of the ESA. This article evaluates the conservation management plans implemented by Wisconsin, the first state to authorize permitted wolf hunting, after this delisting. The article concluded that with natural, legal, and illegal wolf mortalities, Wisconsin wolf populations would decrease by 27 to 33% based on their new wolf management plans. For the first hunting season, hunters over-shot the max quota of wolf kills by 83%. The authors recommend greater rigor and independent review of the science used by agencies to plan wolf hunting quotas and methods. We recommend clearer division of duties between state wildlife agencies, legislatures, and courts. We recommend federal governments reconsider the practice of sudden deregulation of wolf management and instead recommend they consider protecting predators as non-game or transition more slowly to subnational authority, to avoid the need for emergency relisting.

Publish Date: September 2021

Animal(s): Gray Wolves

Location: American West (Washington, Oregon, California, Montana, Idaho, Colorado, Utah, Wyoming)

[Link](#)

Martin, J.V., Epstein, K., Anderson, R.M., and Charnley, S. (2021). **Coexistence Praxis: The Role of Resource Managers in Wolf-Livestock Interactions on Federal Lands.** *Frontiers in Conservation Science*, 2:707068.

Summary: This publication looked into the view that western USFS managers have on the various definitions of “coexistence” and how those align with actual practices and perceptions. The first was that coexistence is the opposite of conflict, and that it means for livestock grazing and wolves to adjust and learn to coincide. Others saw coexistence as a term of idealism, unachievable when practically applied; meanwhile, others saw it as a large-scale concept that can only be achieved on a location-by-location basis. Many more found the idea more as coexistence between human conflict, with each side of the battle coming to a compromise in livestock and wolf management. Some rangers also saw issues with managing wildlife as a whole, stating it is the federal government's job to “stay in its lane” and leave wildlife management up to the states.

Publish Date: September 2021

Animal(s): Mammalian predators

Location: Global

[Link](#)

Khorozyan I. (2021) **Defining practical and robust study designs for interventions targeted at terrestrial mammalian predators.** *Conservation Biology* 2022;36:e13805

Summary: Conflicts between humans and mammalian predators are globally widespread and increasing, creating a long-lasting challenge for conservation and local livelihoods. Protection interventions, which are essential to conflict mitigation, should be based on solid evidence of effectiveness produced by robust study designs. Yet, it is unclear what study designs have been used in predator-targeted interventions and how they can be improved to provide best practices for replications. I examined how applications of five study designs (before-after, before-after-control-impact, control-impact, crossover [i.e., the same randomly assigned study units acting as treatments and controls during alternating trials], and randomized controlled trial) have changed over time and how these changes are related to authors, predator species, countries, and intervention types (aversion, husbandry, mixed interventions, invasive management, lethal control, and noninvasive management). Less reliable before-after and control-impact studies were the most common (47.7% and 38.2% of cases, respectively), and their use increased over years as did all interventions. The contribution of the most robust before-after-control-impact (7.4%), randomized controlled trial (5.3%), and crossover designs (1.4%) remained minor over time. Crossover is suitable for aversion, most husbandry techniques, and a few other interventions, but crossover interventions also have the most limitations in terms of applicability. Randomized controlled trial is generally applicable, but impractical or inappropriate for some interventions, and before-after-control-impact appears to be the most widely applicable study design for predator-targeted interventions. My results clearly demonstrated that less reliable study designs, such as before-after and control-impact, are still widespread in predator-targeted intervention applications globally and their use has increased over time, along with all interventions. In contrast, robust designs, including BACI,

crossover, and randomized controlled trial, have been applied rarely and made only a minor contribution to evidence building in regard to predators

Publish Date: October 2021

Animal(s): Gray Wolves

Location: Washington, USA

[Link](#)

Bogezi, C., Eeden, L.M., Wirsing, A.J., and Marzluff, J.M. (2021). **Ranchers' Perspectives on Participating in Non-lethal Wolf-Livestock Coexistence Strategies.** *Frontiers in Conservation Science.*, 2:683732.

Summary: The Washington Department of Fish and Wildlife set up a Damage Prevention Cooperative Agreement (DPCA) that allows for cost sharing between ranchers who have lost livestock due to wolf predation. This article interviewed ranchers about perceptions on wolves, mitigation strategies, and what discourages and motivates ranchers to participate in non-lethal techniques. The primary motivator for nonlethal techniques was prior familiarity with certain techniques, as ranchers wanted as little to change in their operations as possible. The primary reason ranchers chose not to participate in the DPCA was a shared belief that nothing positive would be gained from doing so, and it would mean increased regulations and government intervention. To compensate for this, the writers of the article recommended wildlife managers must address the intangible costs pushing ranchers away from the DPCA and a bottom-up mitigation system that utilizes rancher subgroups and entities trusted by all sides.

Publish Date: February 2022

Animal(s): Pumas, Jaguars

Location: Honduras, South America

[Link](#)

Chinchilla, S., Berghe, E., Polisar, J., Arévalo, C., Bonacic, C. (2022). **Livestock-Carnivore Coexistence: Moving beyond Preventing Killing.** *Animals*, 12, 479.

Summary: In Latin America, both jaguar and puma are known to prey on livestock, yet studies in Mesoamerica have been scattered and few have been carried out in Honduras. We interviewed ranchers in a biosphere reserve where jaguars and pumas are present. Local indigenous communities reported livestock predation (average annual loss of 7% from 2010–2019), with preventive and retaliatory killing as their main actions against predation by the jaguar and puma. Other sources of cattle loss included diseases and theft. The extensive management system (free grazing) lets cattle access forests where predators are more common. We found that livestock predation is not random, but rather, related to landscape variables and human influence. Sites farther from human influence and closer to forest cover were more susceptible to predation. We propose management practices to mitigate livestock predation in the presence of large carnivores based on examples of proven human–carnivore coexistence in Venezuela, Brazil, Paraguay, and Nicaragua, such as improving the spatial arrangement of livestock (maintaining a distance from forest areas) and the incorporation of confinement pens

for young calves (at least the first three months of life) and their mothers. If the pens are built close to the property's house and have constant surveillance and/or dogs, the results are likely to be more effective. Deploying these proven tools may help change the current negative perception of ranchers towards large carnivores that is essential to conservation.

Publish Date: February 2022

Animal(s): Gray Wolves

Location: Germany, Denmark

[Link](#)

Mayer, M., Olsen, K., Schulz, B., Matzen, J., Nowak, C., Thomsen, P.F., Hansen, M.M., Vedel-Smith, C., Sunde, P. (2022) **Occurrence and Livestock Depredation Patterns by Wolves in Highly Cultivated Landscapes.** *Frontiers in Ecology and Evolution*, 10:783027.

Summary: This article analyzed wolf populations, settlement, and depredation rates on a peninsula in Northern Germany and Denmark. The results indicated that wolves mostly killed livestock as a context-dependent response, i.e., being dispersers in agricultural areas with low availability of wild ungulate prey and high livestock densities, and not because of behavioral preferences for sheep. Moreover, the livestock depredation was lower in areas with livestock protection measures (implemented in areas with established pairs/packs). The researchers found that the EU's method of allowing lethal removals for specific, abnormally aggressive wolves may be ineffective in reducing depredation. They concluded that coexistence measures should be more focused on geospatial patterns, such as forest cover and awareness of nonresidential wolves, and that nonlethal techniques are effective in reducing livestock depredation.

Publish Date: May 2022

Animal(s): Gray Wolves, Mexican Wolves

Location: North America

[Link](#)

Hill, J.E., Boone, H.M., Gantchoff, M.G., Kautz, T.M., Kellner, K.F., Orning E.K., Parchizadeh, J., Petroelje, T.R., Wehr, N.H., Finnegan, S.P., Fowler, N.L., Lutto, A.L., Schooler, S.L., Bosch, M., Perez, A.Z., Belant, J.L. (2022). **Quantifying anthropogenic wolf mortality in relation to hunting regulations and landscape attributes across North America.** *Ecology and Evolution*, 12:e8875.

Summary: The impacts that geographic variables have on wolf hunting and anthropogenic mortality (human-caused) is relatively unknown due to the difficulty in finding and identifying wolf deaths. Interestingly, these researchers found that anthropogenic mortality of wolves increased in areas where hunting was completely prohibited, where mixed hunting regulations were used, and where there was less plant coverage. There was no clear support that anthropogenic mortality increased in areas with an opening hunting season for wolves or with increased road density. Wolf management mortality did decrease where there was legal hunting, but that mortality did not go down in areas where illegal hunting occurred and wolf hunting was

prohibited. The researchers recommended that for lethal removals, locals should be involved as to help them accept the fact that wolves are a part of the land in North America moving forward, and that regulations have more impacts than just reducing numbers, such as changing wolf behavior patterns.

Publish Date: Summer 2022

Animal(s): Cougar, Gray wolf

Location: Global

[Link](#)

Treves, A., Elbroch, L.M. (2022) **Does killing wild carnivores raise risk for domestic animals?** *Wild Felid Monitor, the newsletter of the Wild Felid REsearch & Management Association.*

Summary: People sometimes kill wild carnivores when they are perceived to pose a threat. Typically, that threat can be to people or domesticates. The common presumption underlying such killing is that harming the culprit carnivore will prevent future threats. Yet, some studies of cougars (*Puma concolor*) and gray wolves (*Canis lupus*) suggest the opposite outcome. Namely, that killing one or a few cougars or wolves can raise the risk of future injury or death for cattle or sheep. Although many of these studies used data collected for other purposes, they provided stronger than correlational evidence. The variability of outcomes reported in these studies mirror results of systematic reviews and meta-analyses that report a range of outcomes of lethal interventions against wild carnivores, with no effect being the most common outcome. Here, we articulate four non-exclusive, and likely additive, hypotheses for the biological mechanisms that might explain an increase in the risk to domesticates, following lethal removal of a carnivore. The hypotheses highlight the importance of integrating behavioral ecology into managing conflicts with carnivores

Publish Date: February 2023

Animal(s): Grizzly Bear

Location: Montana, USA

[Link](#)

Nesbitt, H.K., Metcalf, A.L., Metcalf, E.C., Costello, C.M., Roberts, L.L., Lewis, M.S., Gude, J.A. (2022). **Human dimensions of grizzly bear conservation: The social factors underlying satisfaction and coexistence beliefs in Montana, USA.** *Conservation Science and Practice.* 2023;5:e12885. <https://doi.org/10.1111/csp2.12885>.

Summary: In 2019, we administered a survey of Montanans to investigate factors influencing normative beliefs about grizzly bear population sizes and quantify the relationship between these beliefs and satisfaction with grizzly management in the state. We found that residents with positive attitudes and emotional dispositions toward grizzlies or who trusted the agency were more likely to believe grizzly populations were too low. Residents who believed hunting should be used to manage conflict, were themselves hunters, had vicarious wildlife experience with property damage, believed grizzly populations were expanding, or were older were more likely to

believe populations were too high. We found a negative quadratic relationship between normative grizzly bear population size beliefs and satisfaction with management, suggesting an optimal “Goldilocks” zone where coexistence is most possible. In practice, if observed Goldilocks zones are incompatible with population numbers required to meet conservation goals, considering factors influencing these beliefs may help bolster acceptance of larger population sizes. The article concluded by recommending that campaigns and changes should focus on emotional perspectives of grizzlies, and that a shift towards wider knowledge of successful coexistence stories will shift the public perception on grizzly management.

Publish Date: February 2023

Animal(s): Grizzly Bears, Black Bears, Pumas, Coyotes, Gray Wolves

Location: Southwest Alberta, Canada

[Link](#)

Louchouart, N., Treves, A. (2023). **Low-stress livestock handling protects cattle in a five-predator habitat.** *PeerJ*, 11:e14788

Summary: This article is an analysis on the effectiveness of low-stress livestock handling (L-SLH), a non-lethal coexistence technique that utilizes range riders and lowers livestock stress levels. The experiment found that L-SLH was highly effective in reducing predation and that single variable changes in number and experience level of range riders had no noticeable effect. The researchers emphasized that having attentive riders allows for in-the-moment knowledge of livestock deaths and importance of removing livestock away from carcasses and poisonous plants. There was no difference in predator sightings between herds that were less-protected and those with more protection, contrary to known impacts of lethal removal. The other notable conclusion is that wolves were more active in the autumn, either because that is the time of year pups have grown big enough to start hunting or strictly based on wolf curiosity with new range riders.

Publish Date: May 2023

Animal(s): Carnivores

Location: Global

[Link](#)

Elbroch, L.M., Adrian, T. (2023) **Perspective: Why might removing carnivores maintain or increase risks for domestic animals?** *Biological Conservation* 283:110106.

Summary: Human-carnivore conflict is still characterized by lethal control, even while some evidence suggests that carnivore removal may not affect the likelihood of future livestock predation, or that it may even exacerbate the problem. Here we propose five non-exclusive, and likely additive, hypotheses for why lethal removals could fail to mitigate livestock-carnivore conflict. We also propose a methodological change in the scale of conflict analyses from populations to smaller social networks, and encourage public education that includes discussions about the potential consequences for communities with livestock following the

killing of carnivores, in addition to broader outreach about both the costs and benefits of living with carnivores.

Publish Date: May 2023

Animal(s): Wolves

Location: Latvia

[Link](#)

Šuba, J., Žunna, A., Bagrade, G., Done, G., Ornicāns, A., Pilāte, D., Stepanova, A., and Ozoliņš. (2023). **Does Wolf Management in Latvia Decrease Livestock Depredation? An analysis of Available Data.** *Sustainability*, 15, 8509. <https://doi.org/10.3390/su15118509>.

Summary: In Latvia, livestock depredation by wolves has increased during the last two decades. Most of the attacks occur in summer and autumn during wolf hunting season. Use of effective preventive measures in Latvia is low, and farmers primarily rely on wolf hunting as a depredation reduction measure. The total numbers of wolf attacks and number of affected sheep per year in regional forest management units were analyzed in relation to the estimated wolf density, extent of culling, and proportion of juveniles, as well as the sheep density and estimated number of wild prey animals. The article states that hunting/culling does reduce depredation; however, this is only a short-term impact that does not cure the issue in the long-term and in some scenarios leads to an increase in depredation due to impacts on wolf behavior and reproduction rates. The researchers also found that increases in wild prey led to impacts on wolves, depending on the prey. Depredation went up as numbers of large, red deer went up due to the red deer out competing the wolves primary target, the smaller roe deer, for shared resources. The article concluded by emphasizing the need to change perspectives of herders and ranchers, which should be pioneered by the introduction of more practical and nonlethal coexistence measures.

Publish Date: September 2023

Animal(s): Cattle

Location: USA, UK, Norway, New Zealand

[Link](#)

Waterhouse, T. (2023) **Virtual fencing systems: balancing production and welfare outcomes.** *Farm Practice*, 28:5.

Summary: Virtual fences (VFs) are a technology growing exponentially within the livestock world, with four major producers around the globe. VFs have been shown to be effective in controlling small paddock or strip grazing systems, such as cattle, sheep, and goats. The techniques for using VF are not as labor intensive as physical electrical wires, and the use of mobile phone apps have increased this. Errors do occur, but since every head of livestock has its own virtual fence, ranchers don't lose the entire herd when one of the collars malfunction. Herding is a bit more complicated and the specific technique depends on the VF manufacturer. That said, VFs can change in real-time, allowing for high manipulation.

Publish Date: October 2023

Animal(s): Lions, Cheetahs, Hyenas, Leopards, Painted Dogs

Location: Zimbabwe

[Link](#)

Kuiper, T., MacDonald, D., Sibanda, L., Mathe, L.J., Mahdlamoto, D., Loveridge, A. (2024) **The behaviours of different carnivore and livestock species shape spatial patterns of humans - carnivore conflict.** *British Ecological Society: People and Nature*, 6 (3): 1248-1261.

Summary: This paper focused on livestock predation spatial patterns of large carnivores in rural communal areas near a national park in Zimbabwe. The article stated predation increases as livestock get closer to areas of higher carnivore concentration. The authors determined there were more predator attacks on livestock closer to humans because there were more livestock, but that livestock in grazing pastures were more likely to be killed due higher densities of predators and lower densities of livestock. The article also discussed how herding patterns can be adjusted based on the time of year and hunting behaviors of specific predators. The authors emphasized that more coexistence measures are required for those who live and have their livestock closer to areas of higher predator concentration, such as grazing pastures.

Publish Date: October 2023

Animal(s): Wolves

Location: Slovakia

[Link](#)

Kutal, M., Dul'a, M., Selivanova, A.R., López-Bao, J.V. (2024). **Testing a conservation compromise: No evidence that public wolf hunting in Slovakia reduced livestock losses.** *Conservation Letters*, 17:e12994. <https://doi.org/10.1111/conl.12994>

Summary: Variation in the legal status and management of wolves (*Canis lupus*) across EU Member States provides a good opportunity to test the effectiveness of different practices to reduce livestock losses. This opportunity for testing is particularly useful for lethal interventions, as they are among the most controversial actions within the large carnivore management toolbox. We aimed to test a conservation compromise adopted in Slovakia, based on a public wolf-hunting scheme and annual hunting quotas between 2014 and 2019, and partially justified to reduce livestock losses. We assessed whether this hunting scheme influenced livestock depredation levels (at the district level). Wolves in the area fed mainly on wild ungulates (98.9% of consumed biomass). While domestic sheep comprised only 0.5% of the diet, they were dominant among the reported livestock killed by wolves (91.1%). Using two different approaches, we did not observe a relationship between the number of killed wolves and livestock losses. Alternatively, a negative relationship between wild prey biomass and livestock losses was found. Since 2021, public wolf hunting has not been conducted in Slovakia, and there is no merit in the previous justification for this conservation compromise to reduce livestock losses.

Publish Date: December 2023

Animal(s): Pumas, Jaguars

Location: Colombia

[Link](#)

Valderrama-Vasquez, C., Hoogesteijn, R., Payán, E., Quigley, H., and Hoogesteijn. (2023). **Predator-friendly ranching, use of electric fences, and creole cattle in the Colombian savannas.** *European Journal of Wildlife Research*, 70:1

Summary: Jaguars and pumas are federally protected in Colombia, yet the primary cause of death is illegal killings by ranchers fearful of the large carnivores killing their cattle. This publication found predation mitigation methods (PMMs) to be both highly effective in reducing depredation by pumas and jaguars and at a low cost, regardless of the PMM or type of livestock. The involved ranchers supported the use of creole cattle and electric fences, and stated that lethal removal had no impact on depredation. The researchers also stated that due to the ranchers overall support for preserving the large carnivores, plus the low cost and effort of the utilized PMMs, the ranchers were highly supportive of implementing PMMs.

Publish Date: February 2024

Animal(s): Wolves, Lynx

Location: Europe

[Link](#)

Barroso, P., Gartázar, C. (2024) **The coexistence of wildlife and livestock.** *American Society of Animal Science*, 14 (1). <https://doi.org/10.1093/af/vfado64>

Summary: Livestock impacts on the environment are positive or negative depending on the region, timeframe, stocking rate, and farming system. Wildlife can impact livestock farming through infection maintenance, predation, and competition. Thus, the coexistence of wildlife and livestock has multiple facets. Livestock grazing can cause woodland destruction or favor habitat diversity by generating and maintaining lentic waterbodies and limiting woody encroachment. In turn, woodland expansion can negatively affect livestock farming due to pasture loss and wild ungulate overabundance. Rangelands are valuable habitats that are vulnerable to fragmentation and land use change, with effects on their suitability for grazing-based livestock farming and on their contribution to biodiversity. Sources of wildlife-livestock conflict include shared infections, large predators and obligate scavengers, competition for food and water, and fencing. Mitigating these conflicts requires considering the interests of the relevant sectors, i.e., the human factor. Intervention options include zoning and land use planning, diversifying community livelihoods and lifting restrictions on wildlife harvest, establishing damage compensation and pasture fencing schemes, deploying biosafety measures to reduce wildlife-livestock contacts, and manipulating livestock densities and wild herbivore populations through farming and hunting for targeted use of chronic disturbance to improve ecosystem patterns and processes. We conclude that wildlife-livestock coexistence is a must, considering global concerns about food security, biodiversity, and diseases, and that more

research in this field is needed.

Publish Date: February 2024

Animal(s): Gray wolf

Location: USA

[Link](#)

Treves A, Bruskotter JT, Elbroch LM. (2024) **Evaluating fact claims accompanying policies to liberalize the killing of wolves.** In: Proulx G, editor. *Wildlife Conservation & Management in The 21st Century-Issues, Solutions, and New Concepts.* Canada: Alpha Wildlife Publications; 2024. p. Chap. 6, pp 159-80.

Summary: Worldwide consensus among ecologists provides strong evidence that predators can support ecosystem health and diversity out of proportion to their numerical abundances (Estes et al. 2011; Peterson et al. 2014; Ripple et al. 2014). For example, increasing evidence suggests that grey wolves (*Canis lupus*) play disproportionate roles in influencing deer (*Odocoileus* spp.) behavioral ecology, forest diversity and ecology, and perhaps even disease ecology and deer-vehicle collisions (Hebblewhite et al. 2005; Wild et al. 2011; Callan et al. 2013; Waller and Reo 2018; Tanner et al. 2019; Raynor et al. 2021), withstanding an ongoing debate over the strength of wolves' effects in Yellowstone National Park. Perhaps related, the U.S. public has become more positive about wolves over the past half century (George et al. 2016; Slagle et al. 2017). Nevertheless, in 2021, some U.S. state governments began pursuing rapid efforts to reduce wolf populations through programs that included incentivized hunting (e.g., bounties) and liberalized (even unlimited) hunting, trapping, and hounding seasons. These policies differ from previous policies that balanced different interests in living and dead wolves, and which allowed wolves to maintain and sometimes increase their populations (Brown 2008; Bruskotter et al. 2010, 2011, 2013). For example, Wisconsin reduced its wolf population by >27% in <1 yr and then proposed a second wolf-hunt in the same year (Treves et al. 2021a; Treves and Louchouart 2022); Idaho, Montana, and Wyoming politicians articulated a goal to reduce their wolf populations even more; for Idaho by 90% (Oppie 2021) and enacted policies to help to reach that goal in 2021 and 2022 (Brown and Samuels 2021). Here we address 4 fact claims (assertions of fact) commonly provided in policies for permitting or encouraging an increase in the legal killing of wolves and other large carnivores: (1) increasing human safety, (2) raising human tolerance for surviving wolves, (3) preventing livestock loss, and (4) increasing wild ungulate populations. We evaluate the fact claims (hereafter 'claims') by summarizing published scientific meta-analyses and systematic reviews in addition to reviewing >36 newer scientific studies on the social and ecological effects of killing wolves.

Publish Date: March 2024

Animal(s): Carnivores

Location: Global

[Link](#)

Treves A, Fergus A.R., Hermanstorfer S.J., Louchouart N.X., Ohrens O., Pineda Guerrero A.A. (2024) **Gold-standard experiments to deter predators from attacking farm animals.** *Animal Frontiers*. 2024;14(1):40-52.

Summary: Humans respond to real and perceived threats from carnivores with lethal action and with sociopolitical pressure against protecting the last remaining carnivores. Therefore, interest groups and individuals focused on preserving carnivore populations and minimizing harm to individual carnivores have prioritized non-lethal methods to prevent conflicts between humans and carnivores in recent years. In addition to reducing damage to human property by carnivores, non-lethal methods offer potential benefits to many actors involved, by saving animal lives and benefiting human health, safety, and income. Here we describe lessons learned from gold-standard, randomized, controlled trials (RCTs) with crossover designs, which we have conducted in four countries to protect farm animals from wild carnivores of many species. We synthesize lessons learned in four categories: experiences with randomized, controlled trials (RCTs), design recommendations, effectiveness of nonlethal methods to prevent wild carnivore predation on farm animals, and conclusions. We place these in a global context with similar trials. We discuss gaps in evidence that should motivate investments in research and precautions among decisionmakers at all levels. We dismiss the long-held belief that randomized, controlled trials (RCTs) are impossible in wild ecosystems with working livestock. Non-lethal methods can be effective in preventing carnivore approaches and attacks on farm animals in fenced pastures or open rangelands. The relationship between approaches and attacks remains uncertain. Lethal methods of predator control have been subjected to less robust study designs that suggest mixed results including increases in livestock losses. Nonlethals promise the elusive triple-win for wildlife, domestic animals, and livelihoods.

Publish Date: March 2024

Animal(s): Wolves

Location: Italy

[Link](#)

Primi, R., Viola, P., Girotti, P., Danieli, P.P., Ronchi, B., and Spina, R. (2024) **Performance evaluation of a prototype for the defence against wolves on livestock animals.** *ACTA IMEKO*, 13 (1): 1-7. doi: 10.21014/actaimeko.v13i1.1650

Summary: This study seeks to evaluate the effectiveness of a prototype of an acoustic microphone system in safeguarding livestock against wolf attacks. With an increasing imperative to protect livestock from predation, the prototype's performance was systematically examined under diverse conditions. The study primarily aimed at assessing the prototype's ability to detect wolf attacks by analyzing noise variations inherent to predator assaults. Simultaneously, the prototype aimed to mitigate livestock casualties and foster coexistence between wolves and livestock. A series of controlled experiments were meticulously carried out, replicating real-world wolf encounter scenarios. The team ultimately found the calibration of the system to routine noises to be more challenging than expected, but concluded the project very optimistic with future implementation of artificial intelligence and technology that utilizes more

than just sound.

Publish Date: March 2024

Animal(s): Gray Wolves, Mexican Wolves

Location: California, Idaho, Wyoming, Montana, Washington, Oregon - USA

[Link](#)

Anderson, R.M., Charnley, S., Martin, J.V., and Epstein, K. (2024). **Large, rugged and remote: The challenge of wolf-livestock coexistence on federal lands in the American West.** *British Ecological Society: People and Nature*, 00:1 -13.

Summary: The study analyzed how geographic features within USFS allotments across the western US impacted the effectiveness of wolf-livestock lethal and non-lethal coexistence measures. The study determined that the most effective coexistence measures were combinations of lethal, husbandry, and non-lethal measures. They emphasized human presence was significantly more effective and practical over stationary technology, and that reducing livestock vulnerability and manipulating behavioral deterrents appeared to make a larger impact over “complete prevention of attacks.” The article recommended larger changes in husbandry techniques implemented in permitting could have significant impacts, and that increasing flexibility along with “fostering adaptive grazing management” could greatly impact the use of husbandry practices. They ended by emphasizing the importance of social views, and that coexistence techniques must be based on a case-by-case basis.

Publish Date: March 2024

Animal(s): Grizzly Bears

Location: Montana, USA

[Link](#)

Young, J.K., Sarmiento, W. (2024). **Can an old dog learn a new trick? Efficacy of livestock guardian dogs at keeping an apex predator away from people.** *Biological Conservation*, 292: 110554. <https://doi.org/10.1016/j.biocon.2024.110554>

Summary: This article expanded upon the effectiveness of livestock guard dogs (LGDs) and their impacts to grizzly activity in farmsteads of Central Montana. The researchers found that the LGDs were highly effective in deterring grizzlies, in that their presence reduced activity from grizzlies by 95%. They noted that the LGDs were not hostile towards pets of the farmsteads (even forming bonds with them) and continued to protect the farmsteads through each night. Both of these were concerns by the homestead owners. Since the researchers had multiple bears with GPS collars, they were able to log how close the bears got to the homesteads, and concluded that the bears learned which homesteads had LGDs and which did not (the control homesteads).

Publish Date: March 2024

Animal(s): Wolves, Coyotes

Location: USA, Canada

[Link](#)

Plotsky, K., Alexander, S.M., and Musiani, M. (2024). **Canid livestock predation research has become robust, but gaps remain.** *Global and Ecology and Conservation*, 51: e02923.

Summary: This article analyzed the history and robustness of research and predation prevention technique evaluations on livestock predation by canids (wolves, coyotes, and foxes) in the US and Canada. They found that research publications on both lethal and nonlethal were very inconsistent, with an even amount of publications saying either lethal or non-lethal predation prevention had positive outcomes. Additionally, half of all the strategies that had been researched or evaluated were never evaluated more than a second time. There were four strategies that had been evaluated six or more times: fencing, combination lethal removal, conditioned taste aversion, and livestock protection dogs. The article concluded that many of the reasons for research inconsistencies stem from both scientific and personal biases.

Publish Date: April 2024

Animal(s): Grizzly Bears

Location: Montana

[Link](#)

Smith, A.P., Sundstrom, A., and Burnham, M. (2024). **Understanding diverse perspectives on grizzly-livestock conflict and conflict-reduction tools across southwest Montana ranching communities.** *The Journal of Wildlife Management*, DOI: 10.1002/jwmg.22709.

Summary: This article interviewed ranchers in Greater Yellowstone and Northern Continental Divide grizzly recovery areas, looking into the social framework of livestock-grizzly conflict and coexistence measures. Three distinct perspectives arose, ultimately emphasizing how polarizing range riders are and the need for more research. The first perspective is that the major issues driving conflict are disputes arising from a social divide among ranchers, and how constant changes in land ownership means constant changes in how wildlife should be regulated. Their second perspective pertains to the idea that governance of land in Montana should be left to the state, that the federal government has too much control, and that “effective” tools (like hunting and lethal removal) are being restricted. The final perspective is based in a belief that solutions must be multifaceted and “require consideration of the entire ecosystem.”

Publish Date: May 2024

Animal(s): Gray Wolves

Location: Idaho, Montana, California, Colorado - USA

[Link](#)

Martin, J.V. (2024). **Conservation and conviviality in the American West.** *Elementa Science of the Anthropocene*, 12:1. DOI: <https://doi.org/10.1525/elementa.2023.00073>

Summary: This article highlights the divide between the livestock industry and the growing support in replenishing biodiversity in the West. Numerous modern factors, such as shrinking grazing lands for golf courses and increased taxation, are driving uncomfortability and

frustration for farmers and herders. Top-down regulations have acted as a catalyst in driving a wedge between environmentalists and ranchers, and the political differences in governmental regulation have allowed this wedge to expand into a crater. The article states this political conflict must be attacked head on, and that the author recommended “commoning” as a means to bridge the crater that divides the West. “Commoning presents a bottom-up, hybrid alternative to enclosure, private property, and market relations, as well as a means for producing commoners: those with intimate relationships with the commons as more-than-human, life-sustaining systems.”

Publish Date: August 2024

Animal(s): Patagonian Foxes

Location: Chile

[Link](#)

Ugarte, C.S., Saavedra, C., Simonetti, J.A. (2024). **Olfactory repellents as perceptual traps for mesocarnivores immersed in livestock systems.** *ELSEVIER: Perspectives in Ecology and Conservation*, 22(3): 232 - 239. <https://doi.org/10.1016/j.pecon.2024.04.005>.

Summary: This article examined the use of whole-body odor (WBO) from livestock guardian dogs (LGD) to lower Patagonian fox predation on sheep. The goal was to correlate livestock with fear in the brains of predators in order to lower predation. The survey found that the olfactory “traps” did decrease predation, and the decrease correlated with increases in plant coverage. The article concluded that this technique is effective, but has limitations based on coverage in a requirement that predators already be familiar with LGDs. It is yet another instance of the importance of creating coexistence strategies that are specific to the region, predator, and livestock.

Publish Date: September 2024

Animal(s): Cattle

Location: USA

[Link](#)

Hoag, D., Vorster, A.G., Ehlert, K., Evangelista, P., Edwards-Callaway, L., Mooney, D.F., and Virene. (2024). **Beef Cattle Producer Perspectives on Virtual Fencing.** *Rangeland Ecology & Management*, 96. 143–151.

Summary: Livestock owners see a lot of value in virtual fencing (VF), but there is hesitance within the community on VF cost efficiency. There seems to be a 50/50 split on VF cost over physical fences. Whether VF is less expensive hinges on a multitude of factors, including (but not limited to) infrastructure conditions, terrain, business model, recent events (e.g., wildfire), and property size. Livestock owners voiced support that VF could be highly useful in predator management and protecting critical habitat and ecologically sensitive areas. Nonusers were concerned about cost and reliability. Both groups had concerns on topography impacts, wildlife interactions, and controlling livestock behavior.

Publish Date: September 2024

Animal(s): Cattle

Location: USA, New Zealand, Australia

[Link](#)

Wätzold, F., Jauker, F., Komainda, M., Schöttker, O., Horn, J., Sturm, A., Isselstein, J. (2024). **Harnessing virtual fencing for more effective and adaptive agri-environment schemes to conserve grassland biodiversity.** *Biological Conservation*, 297. 110736.

Summary: Virtual fencing (VF) is an emerging technology that creates virtual boundaries for livestock. Collars equipped with positioning systems, such as GPS, emit acoustic warning signals if an animal approaches the virtual fence and an electric impulse if it continues to move forward, deterring it from crossing the virtual fence. Compared to physical fences, virtual fences, combined with positioning systems, enable precise tracking of individual animals and fencing out small areas within pastures at high spatio-temporal resolutions and low cost. This study considered electrical collars on grazing livestock in European pastures. This system worked best with cattle and sheep. VF was found to be more cost effective and less labor intensive than agri-environment schemes (AES) (traditional methods in conserving the environment on grazing land). A key characteristic was that VF costs are almost entirely upfront, with no cost on changing pasture boundaries. Additionally, the flexibility of VFs is well suited for wildlife corridors and connected habitats. Issues with VFs are worse if ranchers are not employing AES's, as the initial cost is considerable. Additionally, blackouts do occur and the legal system has yet to adjust for the regulation of such technology and liability for negative consequences that stem from VFs.

Publish Date: September 2024

Animal(s): Pumas, Foxes, “Wildcats”

Location: Northern Chile

[Link](#)

Núñez, C., Roco, L., and Moreira, V. (2024). **Factors Affecting the Adoption of Anti-Predation Measures by Livestock Farmers: The Case of Northern Chile.** *Diversity*, 16, 567. <https://doi.org/10.3390/d16090567>

Summary: This article considered what factors positively or negatively impact ranchers and herders choices in implementing/changing coexistence techniques. They found that the more livestock present, the more difficult it was to implement coexistence measures. The publication also found that age, gender, and memberships in organizations (such as breeding committees) of ranchers had no impact; however, revenue and workforce had positive correlations to implementing new techniques. Additionally, farms and ranches with more livestock and higher predation were more likely to have more coexistence measures, but that did not mean they were more willing to implement new measures. Finally, veterinary advice and management negatively influenced both the adoption and the intensity of the measures, likely because healthy animals are less likely to be targeted by predators or the fact that ranchers who can afford veterinary assistance have the funds to implement coexistence measures.

Publish Date: November 2024

Animal(s): Grizzly Bears

Location: Washington, USA

[Link](#)

Easter, T.S., Santo, A.R., Sage, A.H., Carter, N.H., Chan, K.M.A., and Ransom, J.I. (2024). **Divergent values and perspectives drive three distinct viewpoints on grizzly bear reintroduction in Washington, the United States.** *People and Nature*, 7: 127-145.

Summary: The authors sought to answer the question: ‘what are the diverse viewpoints that exist surrounding apex carnivore recovery and what kinds of emotional, analytical and values-based judgments might people use to construct their viewpoints?, in the context of a proposal to reintroduce grizzly bears to the North Cascades Ecosystem, in Washington state. The authors found three distinct viewpoints among 67 respondents. Two of these viewpoints represent essentially polarized perspectives corresponding to deeply normative notions about grizzly bear recovery, where one views reintroducing bears as a moral requisite, and the other views it as inappropriate and risky. These viewpoints primarily diverged on their perceptions of risk and perspectives about our collective responsibilities to and appropriate relationships with others (i.e. ‘relational values’). The third viewpoint was distinguished by its prioritization of practical considerations and views reintroducing bears as impractical and not sensible. The analysis underscores the need to identify and attend to latent viewpoints that may be overlooked in the polarized public discourse as well as the multiple value systems and perceptions of risk that are integrated in perspectives on grizzly bear reintroduction. Additionally, the broadly defined identity groups were of very little utility in predicting viewpoints in this study, highlighting the importance of avoiding assumptions about people's views based on their identities and interests.

Publish Date: January 2025

Animal(s): Wolves

Location: Europe (Netherlands, Germany, Slovakia, etc.)

[Link](#)

Ostermann-Myashita, E., Kirkland, H., Eklund, A., Hare, D., Jansman, H. A., Kiffner, C., Linell, J. D., Rigg, R., Stone, S. A., Uthes, S., von Arx, M., & König, H. J. (2025). **Bridging the gap between science, policy and stakeholders: Towards sustainable wolf-livestock coexistence in human-dominated landscapes.** *British Ecological Society: People and Nature*, 00: 1-8. <https://doi.org/10.1002/pan3.10786>

Summary: While the return of wolves (*Canis lupus*) to many European countries is a conservation milestone, the negative impacts are unevenly distributed across society, placing high pressure on livestock grazing systems. For this perspective, scientists from diverse disciplines and geographical backgrounds reflect on the state of livestock–wolf interactions in Europe and formulate recommendations for enabling wolf–livestock coexistence. We argue that co-designing, co-implementing and co-disseminating research with key stakeholders, such as

livestock farmers, is a productive approach to developing and implementing locally appropriate coexistence strategies. Decision-making should be informed by scientific evidence. We recommend that ecological data on wolves and livestock are collected and shared across borders. Evidence from the social sciences is important for understanding the human dimension of wolf–livestock interactions.

Publish Date: February 2025

Animal(s): Gray wolf

Location: Northern Rockies, USA

[Link](#)

Merz, L., Bergman, N.T., Brown, C.L., Martin, J.V., Wardropper, C.B., Bruskotter, J.T., Carter, N.H. (2025) **State-level variation drives wolf management in the northwestern United States.** *Environmental Research: Ecology*, 4:015008

Summary: Recovered and recovering carnivore populations in Europe and North America can pose risks to some human livelihoods like livestock ranching. These risks can motivate wildlife managers to lethally remove carnivores—decisions that are often controversial and poorly understood. We used a 13-year dataset on gray wolves (*Canis lupus*) in the northwestern United States (Montana, Idaho, Washington, and Oregon) to analyze how social, demographic, and environmental variables influence lethal removal of wolves at the county and state levels. We found that state-level differences are a major driver of lethal removal decisions at the county level. The percentage of federally owned and protected lands was also positively correlated with lethal removal. Predation of livestock by wolves was not significantly correlated with wolf removals in Idaho, but was in Montana, Washington, and Oregon. Our results stress the need to make transparent the process by which recovering populations of carnivores are managed to enhance the legitimacy of management policies.

Publish Date: February 2025

Animal(s): Gray Wolves

Location: Michigan, Montana, Oregon

[Link](#)

Brooke Jacobs, Peter Kareiva and Christopher Schachtschneider, **The expanding use and effectiveness of nonlethal methods for mitigating wolf-cattle conflict**, *Rangelands*, <https://doi.org/10.1016/j.rala.2025.02.002>.

Summary: We evaluated the efficacy of both lethal and non-lethal wolf-livestock conflict mitigation methods and found nonlethal methods achieved more significant risk reduction for cattle. We focused on wolf-cattle conflict mitigation, as US Department of Agriculture Wildlife Services (USDA WS) reports most wolf-livestock conflicts in the United States involve cattle. We examined the USDA WS Nonlethal Initiative, which indicated a growing shift toward nonlethal wolf management. We found nonlethal methods, such as range riding, harassment, deterrents, and electric fencing showed promise, but their use varied geographically. Nonlethal livestock protection methods may effectively reduce conflicts while addressing the needs of ranchers,

conservationists, and animal rights advocates. They deserve more significant investment and research, beginning with the USDA WS. We developed a toolkit for ranchers and rangeland managers interested in nonlethal livestock protection, which offers information and resources for implementing conflict mitigation techniques.

Publish Date: June 2025

Animal(s): Wolf

Location: USA

[Link](#)

Beggen, K., York, R. (2025) **Colonizing *Canis lupus*: Wolf Management as a Settler Colonial Project**, *Rural Sociology*, Vol. 90, Issue 3

Summary: The hostility to wolves by segments of agribusiness and the general public in the United States is a puzzle, given that wolf predation is not responsible for a large number of cattle and sheep losses and has only a very modest economic effect on the livestock industry. Thus, the logic of profit-seeking in capitalism, although playing a role, is insufficient to explain the outsized and partisan opposition to wolf recovery. We argue that the logics of settler colonialism are a foundational force that shapes the politics and management of wolves in the United States. We explain how settler colonialism seeks to eliminate both Indigenous people and wolves to appropriate and reshape landscapes for settler use. Contemporary wolf policy and management at the state and federal levels continue to reflect settler colonial logics. Our general aim is to show how theories of settler colonialism complement other prominent sociological theories and enhance our understanding of the forces leading to ecological crises. We conclude by highlighting examples of more just approaches to wolf management that include Indigenous kinship and relational values.

Publish Date: August 2025

Animal(s): Gray Wolves

Location: Northwestern USA

[Link](#)

Merz, L.M., Clemm von Hohenberg, B., Bergmann, N.T., Bruskotter, J.T., and Carter, N.H. (2025). **Elusive effects of legalized wolf hunting on human-wolf interactions.** *Science Advances* 11, eadu8945.

Abstract: Public wolf hunting is a highly contentious strategy for mitigating risks of livestock predation, yet few empirical studies examine its effectiveness in doing so. Here, the authors investigated the effects of legalized wolf hunting on two aspects of human-wolf interactions: (i) livestock depredation by wolves and (ii) the lethal removal of wolves by government agencies from 2005 to 2021 in four states in the northwestern US—Idaho, Montana, Oregon, and Washington. The authors compared these effects with Oregon and Washington, states where wolf hunting has not been legalized on non-tribal lands. Using difference-in-differences and structural equation modeling of data from the northwestern US between 2005 and 2021, we analyzed impacts of wolf hunting on livestock predation by wolves and government removal of

wolves in the same year and with a 1-year time lag while controlling for social and environmental variables. The authors found that public wolf hunting had a small negative effect on livestock predation but had no effect on government lethal removal of wolves in the same or subsequent years. The authors concluded that their findings challenge the assumption that wolf hunting is an effective management strategy for reducing livestock predation and lethal removal.

Publish Date: October 2025

Animal(s): Gray Wolves

Location: Lower 48 States, USA

[Link](#)

Vucetich, J. A., & Bruskotter, J. T. (2025). **Attitudes toward the continued protection of gray wolves under the Endangered Species Act.**

Retrieved from: <https://digitalcommons.mtu.edu/michigantech-p2/2055>.

Summary: This is a survey on the public's opinion on gray wolf conservation and review of possible correlations to political statuses or relationship with the outdoors. The article found that a vast majority of those who partook in the survey supported continued protection for wolves regardless of self-identification. Participants were asked about their political affiliation, and whether they would consider themselves as a hunter, rancher, environmentalist, or animal advocate. Support for wolves was positive amongst every demographic and surprisingly also among rangers, farmers, and hunters (although lower percentage wise than other groups). Participants were also asked about wolf hunting and the killing of wolves, of which there was a strong response against both.

Publish Date: November 2025

Animals: Black bears, coyotes, mountain lions

Location: California, USA

[Link](#)

Calhoun, K.L., Smith, J.A., Tingley, M.W., Heeren, A., Van Scoyoc, A., Serota, M.W., Brashares, J.S. Furnas, B.J., (2025) **Human-wildlife conflict is amplified during periods of drought.** *Science Advances*, 11, eadx0286

Summary: The authors concluded that intensifying droughts driven by climate change are likely to lead to worsening conflicts with carnivores, which already face a disproportionate number of conservation threats related to human-wildlife conflict. This study used an extensive dataset of community-derived human-wildlife conflict incidents to examine the influence of drought on conflict reporting. The study showed that prolonged decreases in precipitation are significantly associated with increased conflict with carnivore species in particular. Reported wildlife conflicts significantly increased in association with reduced precipitation. The authors noted that they don't know the exact mechanism by which drought changes wildlife behavior, and that when people face additional stress because of drought, they may be more likely to classify an animal as causing a conflict, including livestock owners who are impacted by drought in numerous ways who may be seeking compensation. However, drought may also increase the

likelihood of overlap between carnivores and livestock by pushing carnivores to expand their ranges. This study strengthens the link between human-wildlife conflict and international climate policy.

Publish Date: In Review 2026

Animal(s): Gray wolf

Location: USA, Israel, Latvia, Slovakia, Slovenia

[Link](#)

Treves, A., Ben-Ami, D., Cornman, A.M., Dul'a, M., Khorozyan, I., Krofel, M., Kutal, M., López-Bao, J.V., Valency, R.N., Preiss-Bloom, S., Santiago-Ávila, F.J., Šuba, J., Žunna, A. (In Review 2026) **Removing wolves did not reliably prevent domestic animal losses.**

Summary: Humans usually kill wild animals that they perceive as threats. However, many scientific findings have raised doubts that killing solves wildlife damage to property. With scant, low-quality data, uncertainty persists. We reviewed recent studies of killing gray wolves to protect domestic animals. Our inclusion criteria set a minimum threshold for robust study design and transparent data sharing. In five studies in five countries, killing wolves typically had no effect, may have had the desired effect but more often wolf-killing had the counterproductive undesirable effect of elevating domestic animal losses. We quantified the relative rates of the three outcomes and found the balance in favor of no effect to undesirable effects. We discuss potentially confounding variables and the need for an unbiased, reproducible, transparent randomized, and controlled trial of predator removal. We find and summarize similarities to other situations from disease transmission to crop damage.