The other tools for wolf management

Non-lethal options are being studied by researchers at the National Wildlife Research Center. But do they really work?

by John A. Shivik, Ph.D.

Four wolves trotted, their loping locomotion twice as efficient as that of a biped. Their senses were tuned to kill. The scent of vulnerable prey wafted into an olfactory system thousands of times more sensitive than a human's. Upright pinnea focused lowing into ears so acute that the wolves already knew the location of the cattle and that there were young, vulnerable animals among them. It was time to hunt.

photo: Monty Sloan

Tristan wading in Wolf Park's Turtle Lake.

All became quiet as the wolves approached the pasture. They had killed here before, and the taste of Hereford was a recent gustatory memory. The old male alpha took the initiative; he peeled away from the pack and crouched toward the fence. Focused on the hunt, he slid cleanly between the strands. To him, the barbs were as imperceptible as his radio-collar; he was long-habituated to the worn belt of leather, electronics, and epoxy that gave him a frequency for a name.

The young pack mates followed the dark male's lead. They spread around him, bowing and prancing playfully, excited by the blood of afterbirth that imbrued the pasture and permeated the air. The waxing moon was low, but its light reflected off of a soft spring snow, and the wolves' black and white world was like an Ansel Adams panorama of every shade of clean white, deep black, and obscured penumbra. It was time to kill.

Then, all hell broke loose.

The valley lit up with blinding flashes of light. The wolves froze and squinted at bursts like lightning coming from the center of the pasture instead of the sky. Seconds later, the reverberations of gunfire, humans yelling, helicopters swooping, and horses galloping pierced the air. The cacophony of sound panicked the wolves who were already disoriented from the strobing lights. They ran, each in a different direction, flying through the fence. Completely routed, they scattered into the woods. Then the small box with speakers like ears and a strobe light for a cap could not detect the collared alpha's signal any longer. It turned off its light and sound stimuli and became quiescent, resetting and waiting for the next intrusion into the pasture.

Such was a successful deployment of a new technology, a non-lethal tool for managing wolf predation. The device was called the ASC 9000 by Avian Systems, the company that built it, called the 'radio activated guard,' or RAG box, by the Wildlife Services Specialist that promoted and installed it, and called the 'behavior contingent disruptive stimuli device' by the scientists at the National Wildlife Research Center that guided its development and application. All involved, including Defenders of Wildlife, who helped fund its construction, but especially the rancher who devised the concept, were excited about the device's prospects, no matter its name. Not to mention it had just saved a calf.

The RAG box is just one of many non-lethal methods for managing wolf predation being developed and tested at the National Wildlife Research Center (NWRC). The Center (the research branch of Wildlife Services and formerly called the Denver Wildlife Research Center, but now with new headquarters in Fort Collins, Colorado), has long been the leader in the research and development of predation management methods. Indeed, the NWRC is a one of a kind, state of the art facility with the sole purpose of developing and evaluating methods of mitigating adverse interactions between humans and wildlife. Scientists at the Center have developed and/or tested nearly every predation management technique currently available, from guard animals and fences to electronic and chemical repellents, and they continue to develop and test new non-lethal techniques.

As leader of the NWRC project assigned the task of developing and evaluating non-lethal methods for predation management, I have become well-versed in the many issues surrounding this important, but often misunderstood field. I have found,

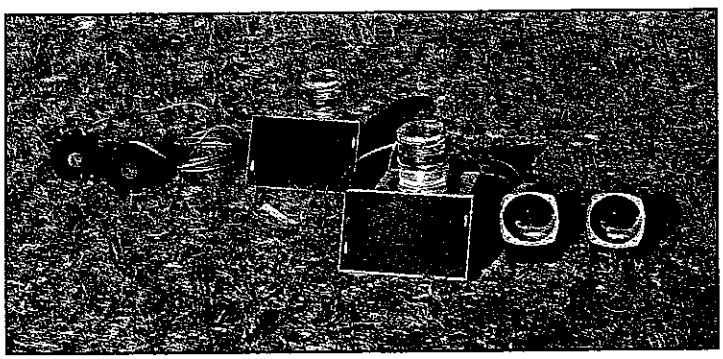

photo: Danny Martin

Example of a RAG box used to scare wolves.

for example, that many wildlife advocates are not aware of the intensive research being conducted in order to improve relations between humans and wildlife, not only with wolves but many different mammals, birds and reptiles.

To manage adverse interactions between wolves and people, many different techniques are necessary because every animal and predation situation is unique. There is no one magic answer; usually there is no singly effective non-lethal solution to a particular conflict. Therefore, the best management is adaptive, nimbly adjusting methods to situations, and adjusting again when the situation changes. But adaptive management requires that numerous methods be explored and developed. It also requires the understanding of complex information for the effective deployment of solutions. One way to make sense of the numerous techniques is to classify them into several categories: Disruptive Stimuli, Aversive Stimuli, Husbandry, Barriers, and Relocation.

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Disruptive Stimuli

Disruptive stimuli are novel or otherwise undesirable stimuli that prevent or alter behaviors of animals, in this case predation behaviors. The stimuli evoke a "fright" or "startle" response, which causes a disruption of the predatory sequence and ideally, a retreat from protected livestock. One of the first applications of electronic disruptive stimuli are the Electronic Guards, developed by the Denver Wildlife Research Center in the 1970's. Currently, Wildlife Services manufactures and sells them to livestock owners for livestock protection. Disruptive stimuli can be high-tech, like those from Electronic Guards and RAG boxes, or low-tech and relatively simple, like fladry. In Eastern Europe, strips of cloth hung in rows of waving flags were used to funnel driven wolves into a pen; called fladry, there is no physical barrier, only a psychological one, as waving red flags confuse the wolves and confound their attempts to escape. Researchers, especially Marco Musiani with the University of Calgary, have investigated the effectiveness and limitations of fladry barriers for protecting livestock and have found some indication of effectiveness, but some limitations, and so his studies are continuing.

photo: John Shivik

Danny Martin, a technician at NWRC, puts an electronic training collar on a wolf.

While these techniques can be useful in certain situations such as for livestock in small area for a short term, disruptive stimuli such as electronic effects and fladry have a serious limitation: habituation. Some friends of mine recently learned about habituation when they bought an owl effigy to keep small birds and mammals out of their yard. It worked well for a day or two, but by the third day, the prey species were used to the fake raptor. By the fourth day, the squirrels and birds had habituated to the point that they began using the plastic predator as a convenient perch. Similarly, wolves will eventually habituate to most stimuli that are initially repellent.

New and different things repel animals, and disruptive stimuli must remain novel to delay habituation. Studies indicate that randomizing multiple stimuli helps to prevent habituation. For example, a series of different noises and lights is better than one droning sound, and moving the source around is also beneficial. The idea is to always keep the animals guessing, so they never know what is coming next. Even better, as I found in some of my recent experimentation, behavior contingent activation (i.e., disruptive stimuli only activate when an animal is performing an unwanted behavior) drastically reduces habituation. And that is why the RAG box monitors the airwaves for radio-collared wolves, only activating when wolves approach a protected area, which should extend the time period when the device is effective for repelling wolves.

Aversive Stimuli

Disruptive stimuli interfere with behaviors by capitalizing on animals' innate dislike of novel, disagreeable stimuli, and the more noxious the stimuli, the more aversive the stimuli are likely to be. There is a fine but important difference between the application of disruptive and aversive stimulus techniques, however. Conceptually, the application of aversive stimuli is the opposite of disruptive stimuli: that is, with disruptive stimuli, learning decreases effectiveness, but with aversive techniques, effectiveness is dependent upon learning. Aversive stimuli are noxious stimuli that are paired with a specific behavior in order to condition an animal not to perform that behavior. Like learning not to touch a hot stove after the action is paired with a painful, but relatively innocuous burn of the hand, it is a type of learning that falls within the paradigm of classical conditioning. Marco Musiani, for instance, postulates that linking electric ropes to fladry fences will promote aversive learning and thus overcome the effects of habituation. Currently, wolf managers are using rubber bullets and other less-than-lethal ammunition to harass wolves away from livestock with the hope that some conditioning against humans, pastures, and livestock will occur. The U.S. Fish and Wildlife Service has begun a program of training livestock owners to use the special non-lethal weapons, but the guns do not shoot too far, and aren't very accurate, so I only know of one wolf that has been hit and chased away from livestock. Hopefully, wolves are conditioned, but if nothing else, livestock owners have some control in their situation and the psychological benefit of being able to actively protect livestock helps to promote the acceptance of wolves by those who

are impacted by them.

The concept of aversive conditioning appears easy, but conditioning can be specific and tricky to apply because animals often do not associate the negative experience with the specific behavior trainers are trying to prevent. For example, I knew of a pet dog that preferred to sleep on an expensive sofa, even though this behavior was forbidden by her owners. When the dog jumped onto the couch, the owners disciplined her with an aversive, "bad dog!" They were proud of their ability to train the dog, because they never again saw her jump up and sleep on the couch. The owners could not, however, determine why there was dog hair still accumulating on the furniture. Unfortunately, what the dog learned and what the owners thought they were training were two different things. When the owners were home, she was disciplined for being on the couch. When the owners were not home, however, there were no repercussions for the sofa-slumbering pet other than a sound, comfortable sleep. Therefore, the dog learned not to sleep on the furniture *when the owners were home* and did not generalize the negative experience to the couch itself. Wildlife managers face the same problem of acquiring accuracy of conditioning using aversive stimuli to manage predation. But for them, it is even more difficult. Pets are under complete supervision by their owners; wolves roam free and thus pose additional difficulties. This means that rubber bullets may be useful for wolves, but that we should not expect them to automatically teach wolves to avoid livestock.

photo: USDA

A Great Pyrenees guard dog sits with its sheep.

Luckily, learning occurs naturally in wolf social structure and if we approach wolf management scientifically, we can use their natural behaviors to keep them from eating livestock. Alphas teach betas about pack hierarchy, and pups presumably learn about what to eat from their parents and pack mates. Learning may also occur after an unpleasant incident with a potential but not preferable prey item, such as a porcupine, and biologists can take advantage of natural wolf behavior to promote unpleasant associations with livestock. Using electronic training collars commonly used in dog training, some scientists (myself, in collaboration with the Turner Endangered Species Fund, Wildlife Services, U.S. Fish and Wildlife Service, and the University of Montana) have attempted to determine if we can aversively condition wolves not to attack livestock. Essentially, we are giving cattle "electronic quills" in the hope that the wolves learn that cows are not worth the trouble to attack and kill. The project is still in its nascent stages, but the goal of the many organizations working together on this project is that a new, albeit specialized and limited, non-lethal tool can be developed for wolf management. The use of electronic collars may be limited but the potential is sufficient to justify experimentation: what if two alphas are conditioned not to attack livestock? Would they then keep their pack from attacking livestock? Would they also keep other wolves away from the livestock within their territory essentially become guard wolves? And could this technology spin off to protect bee-hives from bears and haystacks from elk? Every non-lethal tool should be examined and developed; the more tools we have, the better chance we have of having the right tool for the particular job, for finding a way for humans and wolves to live in peaceful coexistence.

Another type of aversive conditioning with a name that has been bandied about recently is a very powerful and useful phenomenon called Conditioned Taste Aversion (CTA). In this paradigm, a less than lethal poison is introduced into the gastrointestinal tract after an animal has consumed a type of food; the poison causes illness and the illness causes an intense and neurologically deep aversion to the flavor of the food. Like people who have eaten a piece of tainted sushi, or perhaps consumed too much tequila one night and gotten violently ill the next morning, just the smell of the food or beverage makes them queasy and nauseous for months and sometimes years after the event. This type of conditioning is excellent for preventing animals from eating certain foods. Scientists at the National Wildlife Research Center have played a crucial role assisting with development, testing, and Environmental Protection Agency registration of CTA chemicals, especially as bird repellents. Yet the usefulness of CTA in wolf management is limited. One significant obstacle is the lack of a proper odorless and tasteless environmentally safe poison that will cause violent illness, but not injure the wolf or non-target species. The most severe limitation of CTA in predation situations, however, is the fact that predatory behavior is genetically wired in two distinct and independent components: kill and eat. A strong aversion to a tainted meat bait does not necessarily translate to a strong aversion to killing live prey. Attack and kill behaviors may continue after an animal is successfully conditioned using CTA.

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The technique was first applied to wildlife management situations in the early 1970's, and was studied intensively, especially by Carl Gustavson (with several years of funding from the Denver Wildlife Research Center) through the late 1980's, but results varied widely, and effectiveness for wolves or coyotes in field situations was never unequivocally demonstrated. Even where emetics such as lithium chloride are legal to distribute in the environment (i.e., Canada) they are not regularly used due to reported ineffectiveness. The conditioning can be incredibly strong, especially in laboratory situations, but not that easy to effectively apply in wolf management situations. Thus, in the U.S., no one has spent the money and effort to acquire chemical registrations from the Environmental Protection Agency for applying the conditioned taste aversion concept in wolf ranges.

Husbandry

Another category of non-lethal management method is intensive husbandry: things animal owners can do, such as bringing livestock in at night and closely monitoring and protecting animals, especially during vulnerable times such as birthing. This can be a very effective way to protect animals from predators, but also has drawbacks and limitations. Most people reading this article probably don't have livestock, but they probably live with cats or dogs. Think of good husbandry as good pet guardianship; it is rewarding but not necessarily easy. For example, a cat owner recently called me for advice on protecting her pets from marauding coyotes. I explained that intensive husbandry, such as bringing her cats indoors, would be very effective. However, she felt it dreadful to not allow her cats to roam free, to be and act like cats, not tamed and complacent indoor *objets d'art*, like goldfish. Her cats' lives, she argued, were better for it, and she rejected the compromise of keeping them indoors where they would be safe from predators, but not live as freely as she felt they deserved to live. This cat-lover's situation exemplifies the limitations of husbandry methods for protection: they impact the animals that are being protected and the people that are protecting them. When I last talked to her, her cats were being picked off like Scooby-snacks, but she chose perceived quality of life over longevity. Similarly, livestock grow, mature, and reproduce the best when they are allowed to roam without being harassed. A calf won't gambol and gain weight if it is stressfully shuttled from area to area or back and forth to pens, but it also cannot grow if it is harassed or killed by wolves. The solution is one of optimization: finding the line between maximum human protection and optimum animal existence.

photo: John Shivik

One of the wolves involved in the training collar experiment.

One way to have a protective presence without too much of a human presence is to use guard animals. John De Grazio, then with the Denver Wildlife Research Center was sent to Turkey in the early 1970's to bring back information on the use of livestock guarding dogs, and his information enabled the application of the concept in the U.S. Other scientists at the Center continued investigations, but also worked with and funded Ray Coppinger, who has been very influential in the study and use of livestock guarding dogs. We now know that guarding dogs can be very effective for protecting sheep from coyotes, and this method is actively promoted by Wildlife Services. Currently (at least until wolf populations grow a little more!) coyotes are the most significant predator impacting domestic sheep, but formidable Pyrenees, Akbash, and Anatolian dogs repel them, at least in open areas where good dogs can detect coyotes intruding. Similarly, llamas have shown some effectiveness because or their natural desire to stay with a herd coupled with their intense dislike and violent intolerance of canids.

Ray Coppinger examined the use of guard dogs for wolf predation management, with some success. Reports from Europe are also optimistic. However, wildlife managers in the western United States have not been so successful, so far, using guard animals with wolves. As it turns out, a large dog is pretty much just a domestic wolf, and to a wolf, a domestic dog is a conspecific disrespectfully intruding on its territory. In situations where one dog was clearly ineffective against wolves, scientists, ranchers, and managers have tried using a pack of dogs to protect livestock, but often without success. Recently I spoke with a rancher who found his guard dogs in the act of protecting his livestock from a nearby wolf pack. He felt lucky to observe intruding wolves being challenged by his guard dogs. However, his fortune was not in seeing such a rare and amazing sight; it was that he was able to save his dogs from being killed. The two wolves, he recounted, were thoroughly trouncing his four guard dogs, and he felt lucky to have saved a dog or two's life. In other situations, people's pets, guard dogs, and recently llamas, were not so lucky. Wolves kill for a living, they are very good at what they do, and like every other Westerner in love with the land where they were born and raised, they don't take kindly to territorial intrusions. More study is needed to determine why guard dogs sometimes appear to be effective but other times their use ends tragically.

There are other ways to improve ranching practices that may reduce the number of wolf intrusions and kills in livestock range. For example, keeping fields clean of carcasses may help to keep wolves and other predators out of areas where they may meet and eat livestock. However, Mech's recent study in Minnesota could find no clear relationship between the application of carcass removal and a reduction in wolf predation on livestock. The size of the livestock operation and proximity to people seemed to be more important, so removing carcasses alone is not enough, as wolves living on rangeland will discover livestock eventually, whether they are living or dead.

Barriers and Relocation

Another management technique involves constructing barriers that keep predators and livestock apart, such as fencing. For example, some producers have successfully used fencing to protect sheep bedding grounds. A predator-proof fence is possible to construct, but the initial cost of constructing such a fence usually keeps them from being built. Then these constructions require maintenance. Wire rusts, frost heaves, and vegetation grows up, over, onto, and falls on fencing. Electrical fencing is possible and solves many of the problems of chain link fencing, but its maintenance requirements are a little higher since even a small amount of vegetation can short out the system. The last limitation of fencing, apart from its aesthetic shortcomings, is that if it is strong and high enough to keep predators out, it will also restrict the movements of other species, such as deer and elk. Therefore, if physical barriers are economically feasible at all, they are probably most appropriate in small areas, such as calving grounds and bedding grounds.

The last type non-lethal method often thought of is directly managing a predator, especially by relocating it. If wolves and livestock do not occupy the same place, they cannot interact,

and thus relocation appears very attractive. Moving a wolf can be effective and make people feel good about it not being killed. However, the truth is that most predators that are relocated either return (even when displaced hundreds of miles), get into the same, or worse trouble than they were already in, or die. A wolf expelled from its territory is in a more difficult situation and may be forced to seek out easy-to-kill livestock or other human-provided prey in order to survive. So although some people feel better about moving a wolf rather than killing it, after being taken out of their element, relocated wolves usually die, either slowly by starvation, brutally by the teeth of another pack, or instantly against the grille of a westbound RV headed for Yellowstone.

Managers usually must choose the most efficient and least expensive means of resolving a conflict between wolves and humans.

Using relocation is like using disruptive stimuli, aversive stimuli, husbandry, habitat manipulation, and barriers in that it is available, expensive, and of limited effectiveness except in very specific situations. Wolf managers, whether they are from the Fish and Wildlife Service, Wildlife Services, or tribal, state, or local agencies, have been put into a difficult situation: they must solve complex problems with very limited resources. Managers usually must choose the most efficient and least expensive means of resolving a conflict between wolves and humans. The RAG box, for instance, has saved wolves and livestock by keeping the two apart. However, that particular device can only be used with radio-collared wolves. It is also limited to small pasture situations, is new, electronic, and not easy to install. At over $2000, it is much more expensive and less long-lasting than a box of bullets. That is why there is a concerted, serious effort, especially by Wildlife Services' National Wildlife Research Center, to understand the non-lethal techniques available, to develop new ones, and to make them less expensive to apply.

What Really Works?

Developing effective non-lethal techniques is slow and often frustrating because humans tend to want a magic panacea, an effortless, perfect and easy to swallow nostrum. As I look back at the article I have written, I feel a little despondent that as every new method was introduced, its limitations were focused upon. However, even though no one non-lethal method will always work, I believe that *en masse*, we really do have answers and ability. The key is to acknowledge the effectiveness, but also the limitations of all management methods and to trust the biologists and managers who are doing the best they can with the resources they have. It is also important, however, to use knowledge to work toward solutions rather than ignorance, which drives division and stalls progress. Western land use is an exceedingly complex and excruciatingly emotional issue, but all are necessary key players. Realize that everyone, including advocates, ranchers, livestock, and the wolves themselves must concede a little in order to achieve coexistence. There are no painless solutions, but there are many options and allies, like the rancher that thought up the concept for the RAG box.

John Shivik with Gretchen.

Therefore, Wildlife Services and the National Wildlife Research Center continue to develop and promote non-lethal techniques for predation management. Interestingly, non-lethal techniques are used by livestock producers far more often than is usually acknowledged. Indeed, based on 1999 figures reported by the National Agricultural Statistics Service, 39% of cattle operations, 88% of sheep operations, and 63% of goat operations use non-lethal control methods. This translates to $3 million spent on non-lethal methods for cattle, $4 million for sheep and lambs and over $700 thousand for goats, for a total of $7,990,722 that is spent by livestock owners. This number was calculated from a sample of cooperators throughout the U.S., so it is an underestimate of the total amount spent. In addition, the National Wildlife Research Center spends over 75% of its $10 million budget on non-lethal management techniques (although this includes many species and situations such as minimizing the threat of exotic brown treesnakes, preventing bird-aircraft collisions, and protecting endangered species, and so my predator work is only a small part of the entire human-wildlife conflict picture). Including research and funding from all sources, about twice as much money is spent on non-lethal techniques as lethal ones.

So much effort is spent on wolves specifically because they are remarkable animals and an important component of ecosystems, but the essence that makes them so valuable also makes them challenging animals to coexist with. Wolves have highly tuned senses and a great capacity to hunt and kill, and they are not easy to simply dupe into not attacking livestock and pets and even people in some circumstances. Conflicts will continue to occur, and they will not always be solvable with non-lethal methods. However, non-lethal techniques are important for wildlife managers, and there is an intense need to not only continue, but to expand upon their research and development. Ideally, a well-balanced management program wisely uses all appropriate techniques towards a goal of conflict resolution, while maintaining healthy animal populations, including populations of wolves, humans, and livestock. Sometimes it will require the compromise of creating cacophony in calving grounds with strobe lights and sound effects, but the effort is a small price to pay to ensure that the best wolf range, away from livestock and people, will continue to resound with the solemn and melodious howl of wolves.

John Shivik is a Research Wildlife Biologist and Project Leader at the National Wildlife Research Center. He created the Project, 'Alternative capture systems and aversive stimulus applications for managing predation,' in 1999, but has specialized in resolving conflicts between humans and wildlife, especially predators, since 1992. He earned an M.S. from the University of California, Berkeley, and a Ph.D. from Colorado State University. He has worked on everything from spotted owls in New Mexico and Arizona to brown treesnakes on Guam, and coyotes and wolves in various areas of the U.S. He believes that he has learned more about sensory biology and animal behavior from his German Shepherd Gretchen and the other search and rescue dogs he works with, than from all his formal training in wildlife biology. Ω