Managing Predator Problems:

Practices and Procedures for Preventing and Reducing Livestock Losses

COOPERATIVE EXTENSION SERVICE
Kansas State University, Manhattan

Contents

Introduction

For many years, Kansas Extension Specialists have worked closely with livestock producers to help them reduce predator losses. Over the years, we have had the opportunity to observe a wide variety of livestock management practices and their associated predation problems. Certain livestock management practices have been found to be consistently associated with high predator losses whereas other practices are commonly associated with low losses.

The purpose of this publication is to share with the producer those management practices that have been found to be effective in reducing predator losses and to help producers avoid practices that lead to increased losses. In addition, a variety of nonlethal predator damage control methods are discussed. The primary emphasis is on reducing sheep losses to coyotes and dogs. Less detailed discussions are devoted to other types of livestock and other predators.

This publication draws upon our own experiences; the experiences of other specialists, researchers, managers and producers; and on the results of a Master's study at Kansas State University entitled, "Relationships Between Sheep Management and Coyote Predation" by Robert L. Meduna. That study was conducted in 1975-76 in cooperation with 100 southcentral Kansas sheep producers.

Some of the information in this booklet is based on a statistical comparison of management practices employed by Kansas sheep producers and their levels of predation loss. However, statistical studies, conducted with a large number of different managers under a variety of uncontrolled conditions, must be interpreted with some caution. It is impossible to examine one livestock management factor individually, while holding all other factors constant. Also, differing levels of management can influence not only predation losses, but other predisposing factors or sources of loss such as starvation, disease, parasitism, and weather. Then too, certain locales may traditionally have high predation losses, for reasons other than management, which are difficult or impossible to quantify. At least in some instances, a "good" livestock manager may have higher predation losses than a "poor" manager. However, by taking proven and prudent preventive measures (where physically and economically feasible), livestock producers can help to assure that their predation losses will be minimized for their particular locality.

This publication should prove especially useful to new producers who are just getting set up, but it also contains information that should be of interest to established producers. Not all of the suggested management practices in this booklet will be applicable to every operation, situation or locale. However, this publication can serve as a source of ideas that can be incorporated into new or existing livestock production systems.

Causes of Loss

Livestock Factors

There are a number of factors relating directly to livestock that can have an important bearing on predation losses. The relative importance of these factors will vary depending upon the type of livestock being considered.

Sheep

Both season and location of lambing can have major impacts on the severity of coyote predation on sheep. The highest predation losses of sheep in Kansas typically occur from late spring through September. In 1975-76, the 100 southcentral Kansas sheep producers in Meduna's study, (representing about 20% of the sheep produced in the state) reported an annual loss to predators of 0.9 percent of both sheep and lambs. In 1974, the USDA Economic Research Service estimated coyote losses in Kansas to be 3.2 percent of lambs and 3.4 percent of stock sheep, based on a questionnaire survey of a sample of Kansas sheep producers. In that survey only 356 of approximately 2,700 sheep producers in Kansas (l3%) were sent questionnaires and responses were obtained from only 146 of those contacted (41% response rate). In Kansas, much lambing occurs between October and December, whereas in most of the western United States, lambing occurs between February and May. By going to a fall lambing program, some Kansas sheepmen have not only been able to take advantage of high spring market prices for lambs, but have also avoided having large numbers of lambs on hand during those periods of time that predation losses are typically highest. Lambing in sheds or lots helps to avoid potential problems from the seasonally high fall coyote populations.

In general, large flocks of sheep tend to have a higher total predator loss in terms of numbers than smaller flocks. However, on a percentage basis, the proportion of sheep lost to predators averages less in the larger flocks. This suggests that larger operators are able to spread their predation risk over a larger number of sheep and, ***proportionately,*** are able to reduce their losses, despite the fact that they may actually lose more total sheep than a smaller producer.

At the present time, there are no documented differences in the vulnerability of various breeds of sheep to coyote or dog predation, although there has been very little research in this area. In general, sheep have been bred for meat and wool production and ease of handling, not for defensive behavior or aggression. It appears that most sheep are relatively easy prey for coyotes, although coyotes will selectively kill lambs in mixed flocks and may single out and attack sheep that exhibit disabilities.

Cattle

Cattle losses to predation are much less common, proportionately, than sheep losses, although individual calves are usually worth more than individual lambs. Less than one-half of one percent of all calves in the Great Plains were believed killed by predators in 1978,

according to a U.S. Fish and Wildlife Service report. In general, it appears that most calf predation is done by a few coyotes who learn a killing technique and tend to "specialize."

There is little information available on the susceptibility of various breeds of cattle to predation. Longhorn cattle are reputed to be effective at protecting their calves and themselves from predation but there is no objective research data to support this claim. Breeds of cattle or crossbreeds that tend to have calving complications also tend to have more predation problems.

The age of cattle is often related to the severity of a predation problem. First-calf heifers seem to suffer a disproportionately large share of the calf loss to predators. Heifers are generally more prone to calving complications and tend to be poorer mothers than older cows, thus giving coyotes more opportunity to prey on the calves. The age of the calf is also very important. Most calves killed by coyotes are less than one week old. Calves over 3-4 weeks of age are seldom bothered unless they are sick or injured, although attacks on large, healthy calves by groups of 2 or more coyotes have been reported. Older cattle are attacked by coyotes only under very unusual and rare circumstances. Calving paralysis is the most common cause of predator-inflicted injury or death to an adult cow. This paralysis gives a coyote an opportunity to feed on the unborn caIf and, sometimes, part of the cow as well.

Seasonal variations in calf losses basically follow the peaks of the calving season. Most losses of calves are reported in the late winter and spring with a peak in March.

Poultry

Poultry losses to predators have been greatly reduced by the adoption of confinement production systems.

Unconfined poultry, of any age, are a prime target for coyotes and free-ranging dogs. In many areas, it is possible to let poultry range freely throughout the day, if they are shut up well before dusk. Where good approach cover exists, coyotes may lie in wait to snatch a careless chicken or duck, even at mid-day.

Swine

Swine losses are restricted primarily to young pigs weighing less than 50 pounds. Confinement farrowing and feeding systems have greatly reduced swine losses to predation.

Young pigs that are allowed to forage and run freely on pasture, particularly in wooded or brushy areas, often have a tendency to gradually disappear over time. Some of that disappearance *may* be attributable to coyotes. Other "mortality" factors (disease, poisonous plants, parasites, starvation, weather, accidents, and escape) can be relatively high in young pigs that are not intensively managed and this mortality may be difficult to detect or monitor in pastures with heavy cover.

Occasionally, predators may take young pigs shortly after they have been separated from the sows for weaning. Coyotes apparently are attracted by the incessant squealing of the newly-weaned pigs which, if in an accessible lot or pen, are vulnerable to predation.

Predator Factors

Coyotes

Coyotes are the number one predator of livestock in Kansas and in most of the western United States. In general, individual coyotes will range over areas about 3 to 5 miles on a side (10 to 25 square miles) and those ranges usually overlap to varying degrees.

Kansas coyotes are accustomed to human odor. They are active primarily at night but may venture close to farmsteads even in broad daylight if terrain or cover are adequate for concealment. In Kansas, coyotes normally go under or through fences whenever possible. However, they are capable of jumping or climbing over fences and will do so under some circumstances.

Not all coyotes kill livestock. Those coyotes which are killing livestock are usually referred to as "offending animals." It is desirable, when using lethal control methods, to direct those methods at offending animals. Of course, there is no way to look at any individual coyote through a rifle scope or in a trap and be able to tell whether or not it is an offending animal. However, in a damage situation, control methods can be concentrated in and around the damage area and along coyote travel routes to and from the area. When this is done, there is reasonable assurance that the offending coyote(s) will be among the first few coyotes captured. Time after time, we have worked with producers experiencing coyote problems who, after capturing one or a few coyotes, had no more predator problems for months or even years afterwards, despite the continued presence of coyotes in their vicinity.

Predation on livestock appears to bear some relationship to coyotes' seasonal energy needs. Coyotes breed in February and have one litter of 5-7 young in late April or early May. During and immediately following this spring whelping season, coyote energy demands increase rapidly as the parents provide food for the young. At this time, some coyotes turn to domestic livestock as a readily available source of food.

In late summer and early fall, another increase in coyote predation is usually noted. At this time of the year, the food demands of the large and fast-growing pups may tend to outstrip the ability of the adults to provide them with "natural" foods. Again, domestic livestock may offer an easily obtainable source of abundant food. This late-summer increase in predation may also be related to learning or development of sheep-killing behavior by the coyote pups.

Winter losses of sheep to coyotes are generally lower than at other times of the year, despite the high energy needs of individual coyotes. This is probably due to lower overall coyote numbers, increased availability of edible carrion, and reduced availability of sheep because of closer pasturing and confinement feeding.

Coyotes typically kill from one to three sheep per

Coyote Kill

predation incident and feed on one or more. Coyote kills can usually be recognized by the presence of bite wounds in the throat or neck or, in small lambs, by bites in the top or back of the skull. If the animal was alive at the time of attack, removal of the skin in the area of the wounds should reveal extensive bleeding and bruises. Lack of bleeding at the point of attack (externally or internally) indicates that the animal was already at or near death at the time it was fed upon. Coyotes generally prefer to begin feeding on the intestinal fat and on the hindquarters and rib area. Coyotes attack small calves by biting and eating around the rectal and pelvic areas. If the calf attempts to escape, the coyote may grab at its tail, occasionally resulting in bob-tailed calves.

Although the method of kill is usually sufficient to identify the species of predator involved, it should not be considered absolute proof. In recent studies on a Montana ranch, coyotes attacked the neck or throat region in 66 to 92 percent of the cases and the head or neck region in 89 to 100 percent of the cases. Dogs were also observed to attack in the neck and throat region, an occurrence which we have occasionally observed in Kansas. In addition, studies in Utah have shown that coyotes will occasionally attack at the flank and hindquarters, similar to the manner of dog kills. Therefore, evidence other than the method of kill, such as tracks or hairs, is sometimes required to make a ***positive*** assessment as to whether or not a particular kill is definitely attributable to a coyote. Refer to "Understanding the Coyote" C-578 for more detailed information.

Dogs

Dogs are second only to coyotes as predators of livestock in Kansas. Dogs account for about one-fourth of all sheep predation losses in the state. Most damage is caused by free-ranging pets or unwanted dogs "dumped" in the country. Very few truly wild or "feral" dogs are found in Kansas. Dogs will occasionally hybridize with coyotes and these crosses (known as coydogs), although relatively rare, have been known to cause substantial damage.

Dog problems are more likely to occur near towns or cities, but can happen anywhere at anytime. Most dogs kill for "sport," not for food. Therefore, their attacks tend to be unpredictable and devastating. Dogs may attack singly or in groups, with the latter being perhaps more common. A marauding pack of dogs may form for just a single night and the producer's own dog may even be enticed to join in the killing spree.

Large numbers of sheep, poultry or pigs are often injured or killed in a dog attack. Kills are usually not clean; attacked animals are typically bitten and torn in several places, particularly on the hindquarters. Some animals may be injured but still alive. Sheep and cattle will sometimes be run through fences. Usually, there is little or no evidence of feeding on any of the carcasses. Some dogs, however, may kill in the same manner as coyotes, and vice versa. Therefore, tracks or other evidence are needed to make a positive identification of the predator species involved.

Dog Attack

There is some evidence to suggest that producers who own dogs are less likely to suffer attacks from coyotes, but evidence also indicates that they may be more prone to suffer dog losses. The use of guard dogs for the specific purpose of protecting sheep from predators will be discussed in a later section.

Other Predators

Red foxes, bobcats and feral house cats cause some relatively minor predation problems in Kansas. Poultry losses are the major problem, but any of these predators are also capable of killing small lambs or pigs. Bobcats may rarely kill newborn calves, but this is exceedingly uncommon in Kansas. Very few cases of livestock kills by eagles have been documented in Kansas, although it is not uncommon for eagles to scavenge agricultural carrion in winter.

Facility Factors

Certain characteristics of a livestock producer's facilities or locale can be related to the potential for predator problems. Some of these are discussed below.

Pastures

Most pasture fences in Kansas were built to confine livestock, not to exclude predators. Access into most pastures (under, through or over the fences) is easy for coyotes and dogs. Seemingly there is some relationship between size of pasture and predator losses, with higher loss rates reported in larger pastures. However, loss rates may not be related to pasture size *per se,* but pasture size may be reflective of other local conditions such as slope, terrain, and human populations. Hilly or rugged areas are typically sparsely populated and are characterized by large pastures; these conditions are ideal for coyotes.

Sheep losses to coyotes are typically highest in pastures that are grazed during the summer and fall (grass, grass-sudan, milo stubble) and lower in those grazed in winter (wheat and rye). This is consistent with the seasonal distribution of predator losses discussed earlier. An exception is sudan pasture which is grazed during the summer but typically has low losses. However, kills are difficult to find in tall sudan pastures so the loss rates reported for this pasture type may be somewhat low.

Sheep losses to dogs may be related to height of pasture cover. Loss rates to dogs tend to be highest in sudan and milo stubble and lowest in grass, wheat and rye pastures.

Sheep pastures which contain or are adjacent to streams, creeks and rivers tend to have more coyote problems than other pastures. These water courses, with their accompanying habitat, serve as natural hunting and travel lanes for coyotes.

Coyote and dog kills may **occur on any type of terrain, from perfectly flat to extremely hilly or eroded pastures. Most kills occur in the rougher portion of pastures, possibly because sheep are easier to head off and catch in those areas. Running sheep apparently slow** down when approaching the bottoms of draws. In flat regions where cover is abundant, coyote kills may be common in level pastures.

Corrals

Confining sheep at night is one of the most effective means for reducing losses to predation. However, some coyotes and many dogs are bold enough to enter corrals and kill sheep. Corral fences in Kansas are generally better than pasture fences, but most still offer little resistance to predators. Coyotes are more prone to attack sheep in unlighted corrals than in corrals with lights. There is some indication that the reverse maybe true for dogs.

Studies in Kansas indicate that losses to coyotes may be greater in corrals that are over 200 yards from a residence than in corrals that are located closer to human habitations.

Buildings

Producers who use lambing sheds have lower predation losses than those who lamb in pens or pastures. The higher the degree of confinement, the lower the predation losses that can be expected, and the more intensive the management needed. Sheep confined entirely to buildings or lots have lower predator losses than unconfined or semi-confined flocks, but the potential for non-predator losses (especially from diseases and parasites) is much greater.

Management Practices

General Husbandry Practices

Under this category we have grouped several general livestock management techniques that have been shown to be effective in reducing predator losses.

Corralling Sheep at Night

In farm-flock areas, the single most important step that a sheep producer can take to reduce coyote losses is penning sheep at night. Sheep that are regularly penned soon learn to come into the corrals or nearby vicinity in the evening where they can be shut in with a minimal amount of time and effort. Even if the corral fence is not "coyote-proof," the mere fact that the sheep are confined reduces the predation risk. Upgrading corral or pasture fences with predator resistant fences (discussed elsewhere in this publication) and adding lights can further reduce the risk of loss.

Carrion Removal

Removal and proper disposal of dead livestock is extremely important. Carrion tends to attract coyotes and may also habituate them to feed on livestock. Some producers reason that by feeding the coyotes they may keep them from killing any livestock. Perhaps this would be a valid preventative measure if an adequate supply of

It is important to remove carrion, particularly during winter. Some studies show that this practice will reduce the over-wintering coyote population and can shift coyote distribution out of livestock areas.

carrion could be maintained continuously. In reality, however, carrion is usually available for only brief periods and at erratic intervals. If a coyote becomes habituated to a diet of sheep carcasses, for example, it may turn to killing sheep if the carrion source becomes unavailable. In addition, a recent study in Canada has shown that the removal of agricultural carrion can significantly reduce over-winter coyote populations and can shift coyote distributions out of livestock areas. Although the applicability of these findings to Kansas conditions is not known, we know from food habits studies that Kansas coyotes feed extensively on carrion in winter.

Pasture Selection

If sheep are not lambed in sheds or lots, choice of lambing pastures should be made with consideration of the potential for predator problems. Lambs in remote or rugged pastures are usually more vulnerable to coyote predation than those in closer or more open pastures. In general, a relatively small, open, tightly fenced pasture that can be kept under close surveillance is ideal for lambing. Past experience with predators, weather and disease must also serve as a guide in the selection of lambing pastures.

Choice of calving pastures involves weighing predation risks against weather and disease considerations and arriving at an acceptable compromise. Rugged pastures provide good weather protection for cows and calves but are also ideal areas for coyotes. Small pastures tend to have increased disease problems whereas larger pastures may lead to an increased predation risk. Cow-calf operators need to make the necessary decisions based on past experience and judgments as to the relative severity of predation, disease and weather. Consideration should be given to calving heifers in smaller pastures near the house or ranch headquarters, where they can be kept under closer surveillance.

Shed Lambing

Lambing in sheds or lots can reduce both predation and non-predation losses, but it requires more of a commitment in terms of time and facilities than does pasture lambing. Many producers do the actual lambing in small lots, then place the ewes with their lambs in a barn or shed for several days before turning them back out into lots or small pastures. This procedure reduces predation both on healthy newborn lambs and on lambs weakened by lack of food (orphans) or by a difficult birth.

Basically, the decision on shed lambing depends upon whether a sheep producer has the facilities, desire, and time to manage intensively for a higher percentage lamb crop, or whether he prefers to manage less intensively and settle for a lower percentage lamb crop.

Record-Keeping

The value of a good system of record-keeping cannot be overstressed in a livestock management operation. From a predation standpoint, records help producers to identify loss patterns or trends, in addition to providing baseline data which can be used for making decisions on what type, and how much, predator damage control is economically feasible. Records also aid in identifying critical problem areas which may require corrective action.

Counting sheep regularly is important in large pastures or areas with heavy cover where dead sheep could remain unobserved. It is not unusual for producers who do not regularly count their sheep to suffer fairly substantial losses before they finally discover that they are missing some sheep. Sometimes so much time elapses before the losses are discovered that it becomes impossible to determine with certainty whether the losses were due to predators or to other natural causes.

Variable Grazing

Where available facilities permit, a livestock producer may be able to distribute his livestock in such a way as to reduce the amount of predation loss. For example, some pastures may traditionally be the site of predator problems at certain seasons of the year. If it is possible to change grazing schedules so that the problem pasture is used at another time of the year or by less vulnerable livestock, predator losses may be reduced. While changing pastures cannot guarantee that predation pressure will not also shift, this technique can be effective, especially when the new pasture is more open, closer to buildings, or easier to keep under observation.

Predisposing Factors

In this area of general husbandry practices, it is important to understand the possible relationships between ***predisposing factors*** and actual or perceived predator losses. Coyotes do not always kill sick or weak sheep and, in some cases, they may actually kill some of the healthiest sheep in the flock. However, in a recent Montana study, it was observed that visibly "handicapped" sheep were killed by coyotes, usually before healthy sheep were taken. Nutrition, diseases, parasites, poisonous plants, weather, or injury may therefore predispose livestock to predation by making a particular lamb or calf more vulnerable to predation because of weakness, loss of mobility, or reduced alertness. In addition, when any of these factors leads to the death of the animal (and subsequent scavenging by predators), the predation issue is confounded and, at first glance, improper conclusions may be reached.

For example, if a producer is losing sheep to poisonous plants or disease and wrongly diagnoses the situation as a predator problem, he may waste valuable time and effort on improper corrective actions. 'Therefore, when a predator problem is suspected, it doesn't hurt to check more closely to make sure that there is not some other factor involved. This should include proper identification of predator kills (as discussed in previous sections) as well as a check of the herd for signs of disease, birthing problems or other conditions that could lead to weakness or death.

Fencing

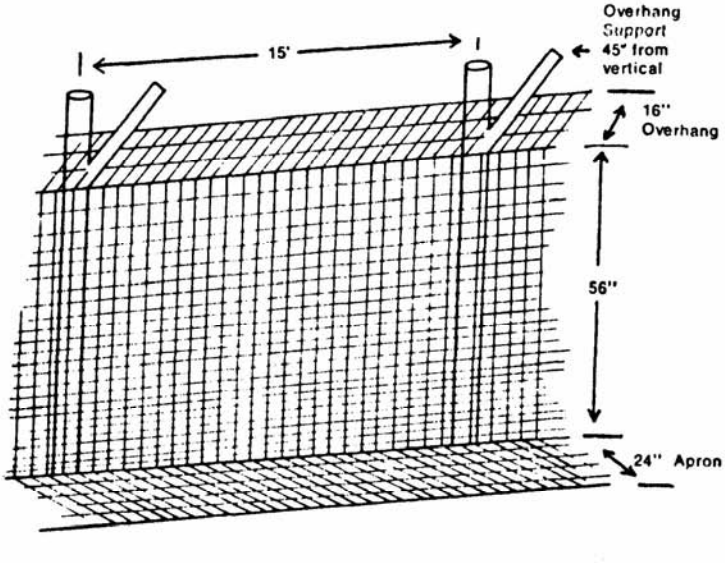
Various types of fences have been used for centuries to control or limit the movements of domestic livestock. Now, there is convincing evidence that practical fences can be designed, built and maintained to limit the movements of livestock predators as well. Probably the first predator-resistant fences were the encircling thorny barricades or sharpened palisades erected by primitive peoples around villages or campsites to protect themselves and their livestock from large nocturnal predators. More conventional types of fencing have been used in attempts to deter coyotes since at least the 1890s. In the early 1900s, D. E. Lantz described the use of fencing around corrals and small pastures in Kansas to protect livestock from coyotes. Early in this century, J.T. Jardine described several other experiments with coyote-proof fences conducted in Oregon rangeland areas.

Fences which coyotes cannot easily go under or through can, to varying degrees, create "barriers" which coyotes must either avoid or cross with come difficulty. Barrier fencing against coyotes can be classed as one of two fairly distinct types. ***Exclusion fences*** are designed to prevent the entry of coyotes entirely. ***Drift fences*** exclude some (but not all) coyotes and restrict or direct the movements of the remainder, usually making it easier to detect and remove animals which do gain access to a pen or pasture. Exclusion and drift fences may be constructed as conventional fences, electrified fences, or a combination of the two. In the past, barrier fences were felt to be economically feasible only for corrals and small pastures. However, various types of predator-resistant fence designs are now proving to be not only effective, but economically feasible for more routine types of use around pastures.

Electric Fences

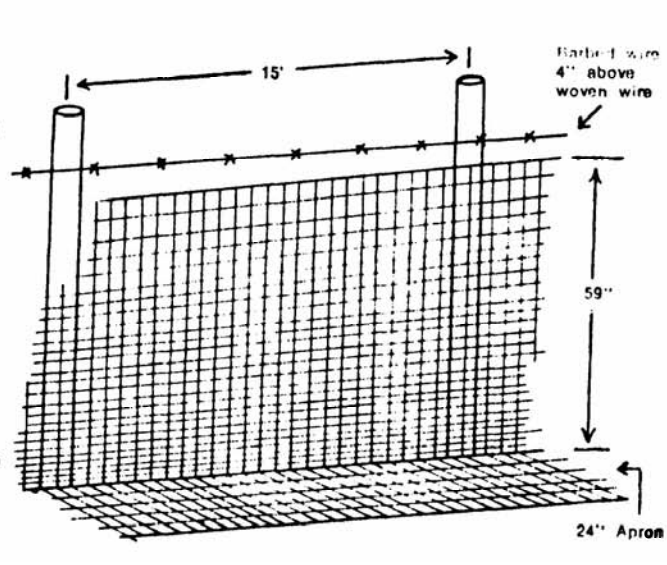
The use of electric fencing to deter coyotes was discussed by W.L. McAtee as early as 1939. In past years, a few Kansas sheep producers have used standard single or double-wire electric fences in attempts to exclude coyotes, with some apparent success. It was not until recent revolutionary developments in electric fence technology and design, however, that this technique became an effective and economically practical method for excluding predators from livestock.

The development of new, low-impedance "energizers" (chargers) in New Zealand and Australia has prompted renewed interest in the utilization of electrified fences for protecting livestock from predators. According to government research, these energizers have lower internal resistance than American chargers, are capable of maintaining higher line voltages under simulated load conditions, and have a better capacity to drive through vegetation. Because of the low impedance of these energizers, grass, weeds or snow have little effect on the line voltage under dry conditions. Under wet vegetation conditions or when woody or brushy vegetation is in contact with the fence, line voltage may be decreased. There is less of an arc, and consequently less fire hazard, with these energizers than with conventional



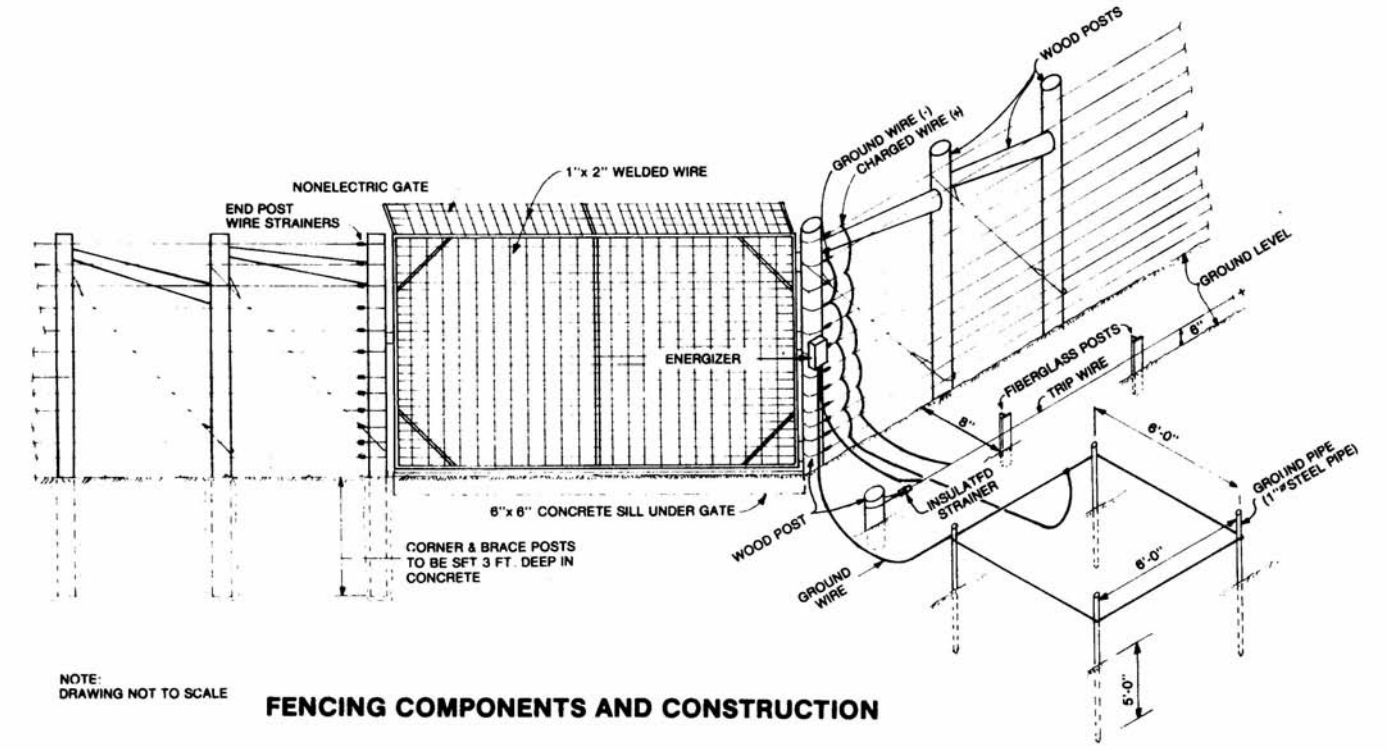
Exclusion Fence

This fence tested by deCalesta in Oregon was found to successfully exclude coyotes. Cost is reduced by using old wire for the apron.



Drift Fence

This fence will exclude most coyotes and greatly hinder the movement of all. Shorter fences without the apron can also serve as drift fences if they are tightly constructed and conform closely to the ground.



FENCING COMPONENTS AND CONSTRUCTION

All ground wires are connected to four l-inch steel pipes driven about 5 feet into the ground (fig. 3). The steel ground pipes should be spaced at least 6 feet apart. All charged wires are connected to the energizer (see section on "Power"). A nonelectric gate maybe constructed from 1- by 2-inch welded wire fencing and aluminum tubing. The gate should be at least 5 feet high. A concrete sill is buried under the gate. End-post wire strainers should be used.

Galvanized high tensile steel wire (12.5 gauge) is recommended. Smooth wire stretchers should be used to stretch the wire to approximately 250-pound tension.

Wood comer and brace posts are recommended. Because of the powerful strain on comer posts, corner and brace posts should be set 5½ feet above the ground and at least 3 feet deep in concrete. Line posts may be either fiberglass (no insulators needed) or wood or steel with plastic or porcelain insulators. All wires must be free running from comer to comer to allow for proper tension and maintenance.

A high-voltage energizer must be used to overcome voltage drainage caused by vegetation and the resistance of the animal's body. The only energizer presently known to be capable of providing the necessary voltage is manufactured in New Zealand, but is distributed throughout the United States. ***(from Gates,*** *1978)*

"weed burner" types of charges currently in use. Because the charge pulse lasts for such a brief period of time, the fence poses little danger to livestock or humans. However, any type of electric fence is potentially hazardous and should be adequately marked and treated with respect.

The design or "configuration" of the fence is probably just as important as the type of charger that is used. These fences employ radically different designs from the conventional, single or double-wire electric fences that most Americans are familiar with. These fences consist of multiple wires; the number and spacing of wires varies with the purpose of the fence, local conditions, and economic factors. In dry areas, grounded wires may be alternated with hot wires.

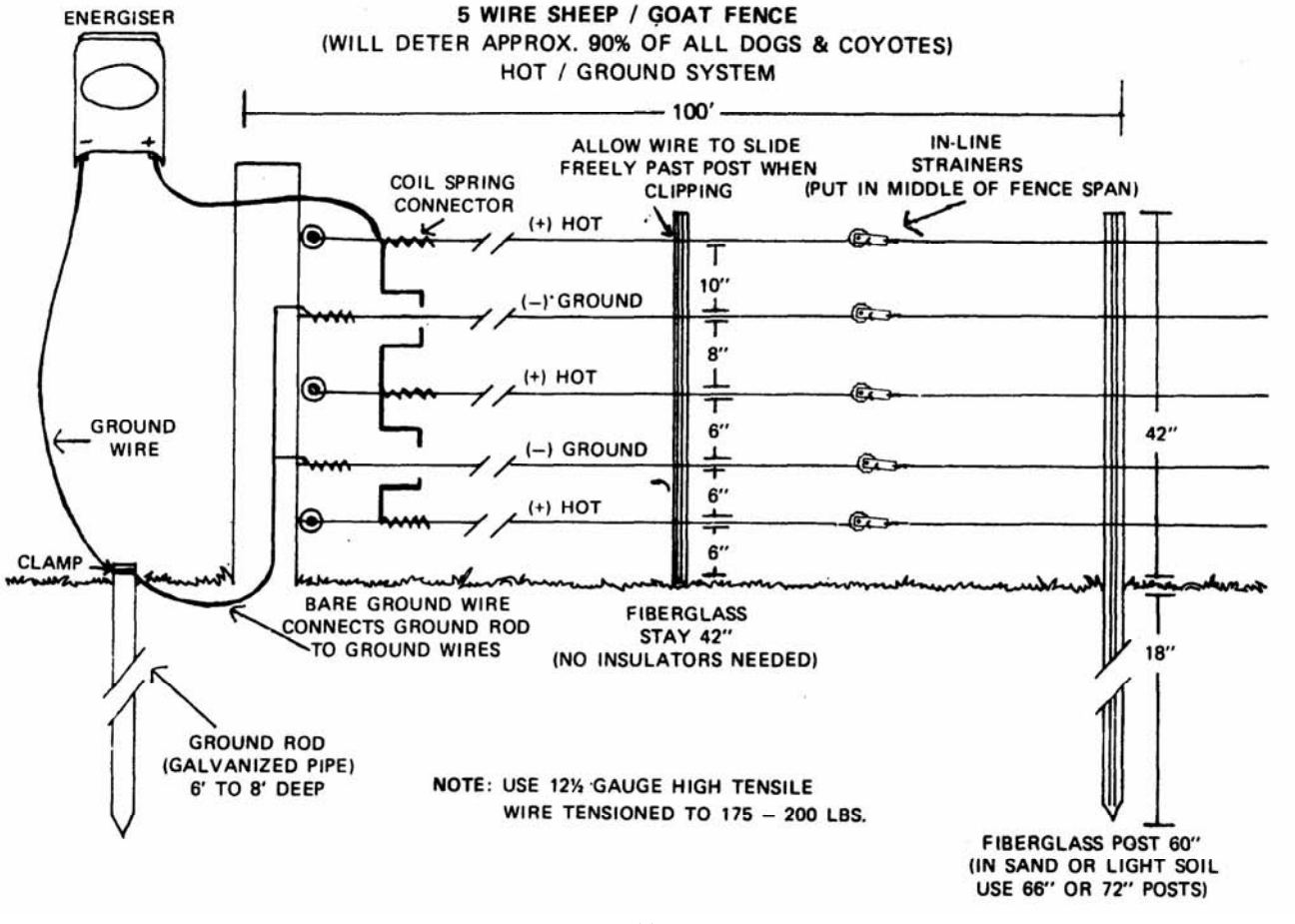
These fences utilize high tensile strength, smooth wire stretched to a tension of 150 to 250 pounds. This tension helps to maintain the proper wire spacings and assures that any animal attempting to force its way between wires will make strong contact. If adjacent wires are charged and uncharged, any animal contacting both simultaneously "completes the circuit" and receives a strong shock. Because of the multiple wires and the high tension that must be maintained, it is imperative that corners and long spans be adequately braced. Under dry soil conditions, it is important that the fence be adequately grounded. A grounding arrangement commonly used is to drive 4 steel rods or pipes at least 5 feet into the ground at the corners of a 6 foot square and to wire them all together (see illustration). Also, it is important that these fences be regularly inspected and maintained. Line voltage should be checked regularly with a voltmeter. The fences are usually constructed so that the proper wire tension can be maintained by using in-line wire tighteners, thus avoiding having to unfasten the wires from the posts.

Tests conducted in 1977 by the Denver Wildlife Research Center in North Dakota and by the USDA's Sheep Research Station in Dubois, Idaho, have shown that a 5½ foot electric fence, with 12 alternating hot and ground wires, completely stopped coyotes from entering test enclosures and killing sheep. Such a fence, while effective, would most likely be used only by producers whose losses are very high or who are putting up new (or completely replacing old) permanent fencing. This type of fence is effective and practical for use as a coyote-proof, nighttime corral. Details of the fence are shown in the accompanying illustrations on preceding page.

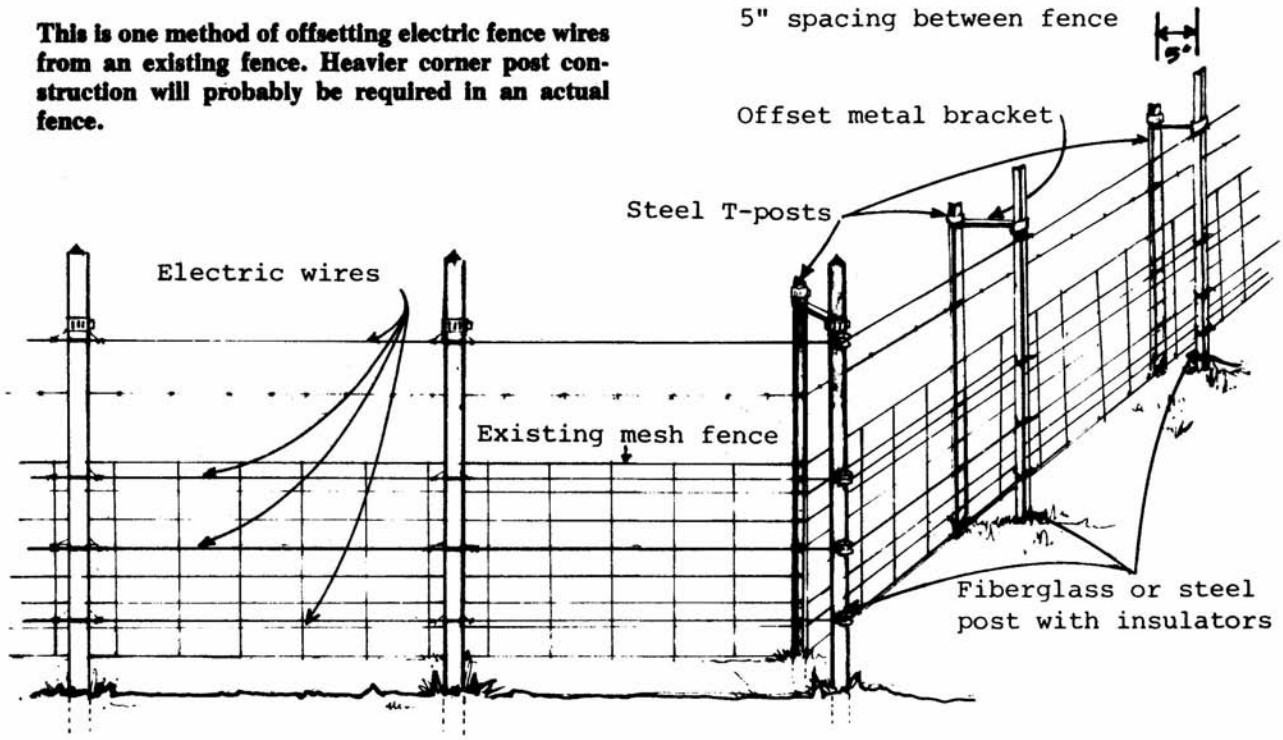
Where all-electric fencing has been used in Kansas, producers have apparently had good success excluding coyotes from pastures and lots with a 5-wire, alternating hot-and-ground fence, shown below. The cost of materials per mile (not including charger or volt meter) for these fences is approximately (in 1979): 12 wire-$1460; 7 wire-$1040; 5 wire-$860; 3 wire-$620.

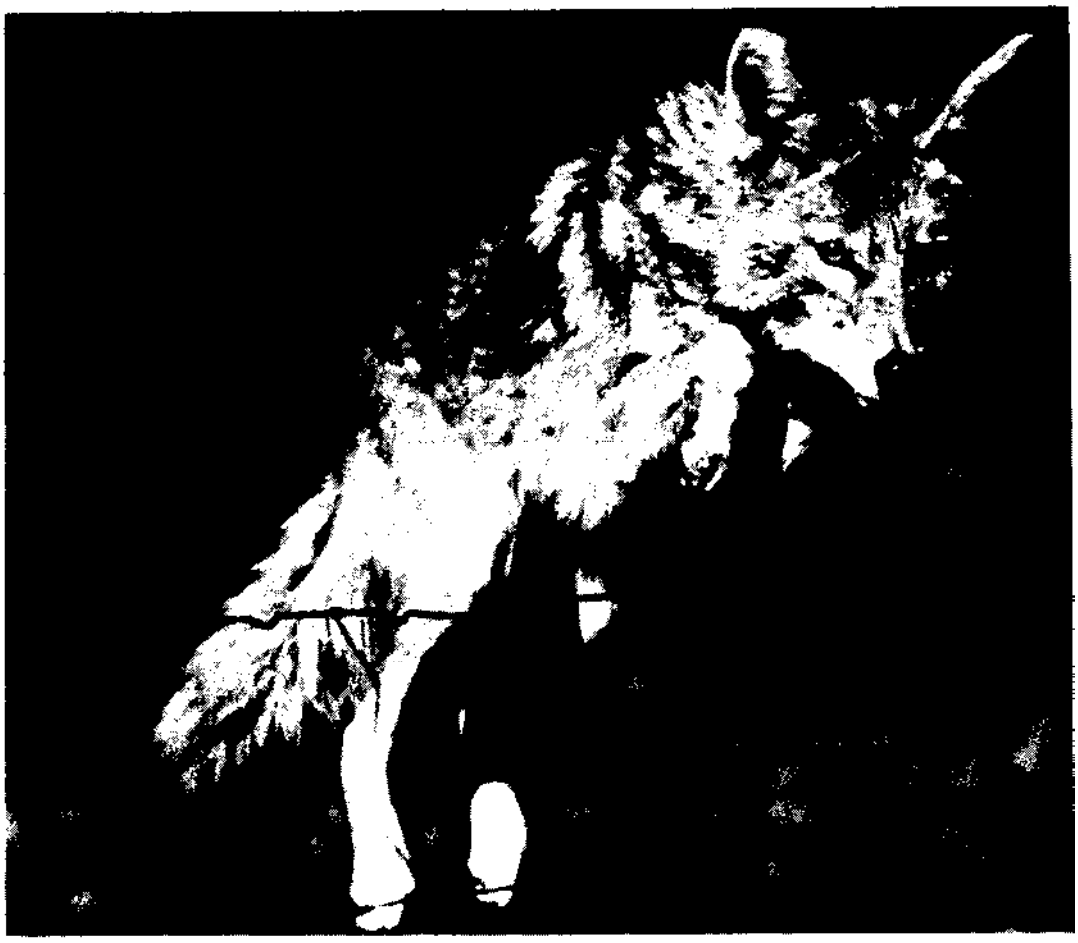
Many times it may be more practical and economical to add electric wires to an existing fence, rather than building a completely new fence to exclude predators. Tests in Kansas by the Denver Wildlife Research Center, USFWS, in cooperation with the KSU Extension Service, showed that, where existing woven wire fences are in reasonably good condition, sheep can be protected from coyotes by adding 4 or 5 off-set electric wires. In that case, all of the electric wires were charged and the existing fence was used as a ground. More or less wires might be required for a particular fence, depending on the net wire spacings and the habits of individual depredating coyotes. This type of fence construction is shown on page 12.

In 1979, predator research biologists from the Denver Wildlife Research Center, USFWS, interviewed sheep producers in the West who were using electric fences or wires to protect sheep from coyotes. Twenty-three producers were interviewed in Kansas, Oklahoma and Texas and 14 in California, Oregon and Washington. Fourteen producers provided adequate information to permit a comparison of predator losses before and after they erected their electric fences or wires. Before fencing, losses to coyotes by all 14 producers over an aggregate total of 271 months and 27 lambing seasons totaled 1,064 sheep. Losses after fences or electric wires were installed, over a period of 228 months and 22 lambing seasons, totaled 51 sheep. This represents a reduction of about 94 percent in reported predator losses after the installation of electric fences or wires (corrected for the number of months and lambing seasons). Of 34 respondents, 23 (68%) rated their fences as very effective and 11 (32%) as fairly effective for controlling predation. All but one or two of 34 producers said that their fences were a good investment, that they would install more electric fence or additional wires if losses in the future were high, and that they would recommend electric fencing as a predator damage control technique to other producers.



This is one method of offsetting electric fence wires from an existing fence. Heavier corner post construction will probably be required in an actual fence.





Coyotes may sometimes jump over low fences around pastures and corrals. Photo by Guy E. Connolly

Conventional Fences

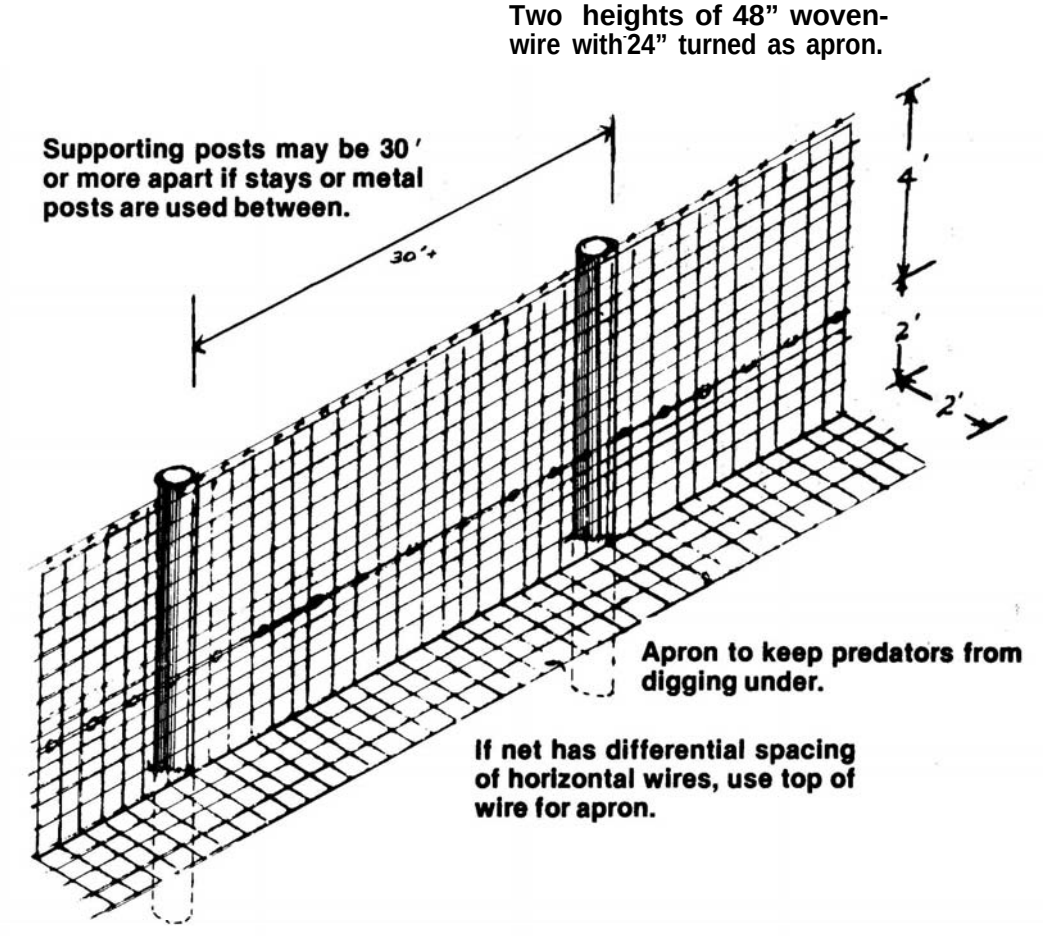
Conventional (non-electric) fences can be constructed in such a way as to exclude coyotes or hinder their movements. Although the initial cost of a conventional fence is higher than that of an electric fence with similar predator resistance, maintenance costs and time are generally less.

The height and design of the fence are dependent upon economic considerations and the desired purpose for the fence. An exclusion fence will cost considerably more than a drift fence.

Before constructing a predator-resistant fence, some pertinent physical and behavioral traits of coyotes should be considered. Most coyotes in Kansas prefer to go under or through a fence, if possible, rather than jumping over. Research has shown that some coyotes can pass through a netwire opening no larger than six inches on a side. Also, coyotes are excellent jumpers if they have the inclination or need to do so. There is some reason to believe that the degree of fence-jumping behavior exhibited by coyotes may differ in various regions of the country, possibly because of differences in soil and weather conditions. Coyotes are also capable of climbing many types of fences.

There is a great deal of behavioral variation between individual coyotes. One coyote may be deterred by a fence only 3% feet in height, whereas another may jump or climb over a 6 foot or higher fence. As a general rule, a 51/2 foot fence will be high enough to exclude most coyotes. The addition of an overhang and a wire apron on the outside of the fence, to prevent climbing over and digging under, reduces the possibility of the fence being breached by a coyote to almost zero.

Although several "coyote-proof" fence designs have been proposed over the years, they have been slow to gain acceptance because of their high initial costs. Maurice Shelton, from Texas A&M University, proposed the fence design shown in the accompanying illustration in about 1974. At that time, he estimated that the fence could be built for approximately $4100 per mile. The cost in 1980 would be significantly higher. Shelton pointed out that, although this cost per mile may seem



unrealistically high, it is still only a 30 to 40 percent increase over the cost of constructing a new conventional net fence. Therefore, if new fencing is to be constructed, it seems important to consider coyotes as one of the animals whose movements are to be controlled. Shelton also pointed out that the cost per head of fencing declines rapidly as larger areas are fenced and higher stocking rates are used. Many producers may fail to consider amortization of fencing costs over the life of the fence. The initial cost of the fence plus maintenance costs, divided by "the estimated "life" (in years) of the fence, will provide an estimate of the annual expense for the fence. A comparison of that estimated annual cost with the average annual predator loss (dollars) will aid in determining the economic feasibility of the fence. Building a predator-resistant fence is often particularly practical and feasible when the construction of new fencing is already needed.

Recently, David deCalesta, from Oregon State University, reported on the use of a 6 foot high fence with an overhang and apron for excluding coyotes from sheep (see illustration). He estimated cost of this fence in 1978 at $2500 per mile for materials and $1680 per mile for labor, giving a total cost per mile of approximately $4180. This type of fence was constructed around 2 pastures on ranches with histories of sheep losses in western Oregon. One rancher used the pasture enclosed by the fence as a "security pasture." Lambs **and ewes** were grazed in this pasture until the lambs were one month old, then they were moved to surrounding pastures. Later, the security pasture was used to contain sheep when coyotes began to kill sheep in surrounding pastures, until those offending coyotes could be eliminated. During the one-year test of the fence, no sheep were killed by coyotes in the security pasture and 4 sheep were killed in surrounding pastures. On the other ranch, sheep were kept in the pasture enclosed by the coyote-proof fence throughout the test period. No sheep were killed in the test pasture, although 38 sheep were killed in surrounding pastures.

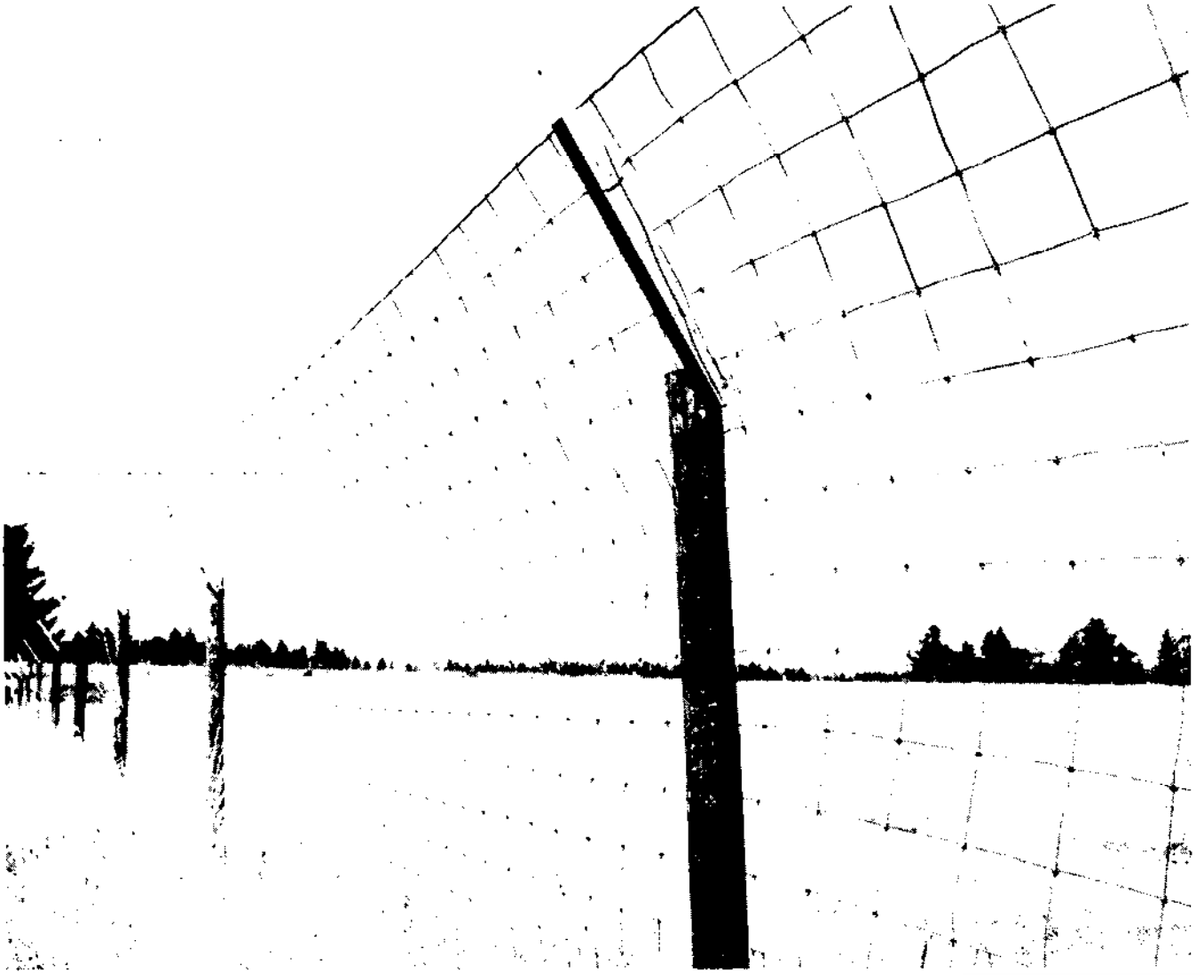


Photo by David deCalesta

Gate construction used with fence on page 13.
Photo by David deCalesta

Predator Frightening Devices

When using predator frightening devices, it should be kept in mind that their effectiveness may decrease over time as coyotes become used to them. Varying the position, appearance, duration or frequency of the frightening stimuli, or using them in various combinations, may increase both the degree of effectiveness and the length of time over which the devices will be effective.

Lights

In Meduna's study involving 100 southcentral Kansas sheep producers, he concluded that "the use of lights above corrals at night had perhaps the most obvious effect on losses to predators of any factor examined in the study." Of 79 sheep killed by coyotes in corrals, only 3 were lost in corrals with lights. Nearly 40 percent of the producers in that study used lights over corrals. There was some indication that sheep losses to dogs were higher in lighted corrals, but the sample size for dog losses was small and the results inconclusive. Most of the producers (80%) use mercury vapor lights with electric-eye sensors which automatically turned the lights on at dusk and off at dawn. The remainder used standard incandescent lights with either timers or manual switches.

Another advantage of lighted corrals, which is often overlooked, is that lights can help in removing a problem coyote if losses do begin to occur. Coyotes will often set up a fairly predictable killing pattern. When this happens in a lighted corral, it is possible for a producer to conceal himself at some point above or downwind of the corral, and to shoot the coyote as it comes in to make a kill.

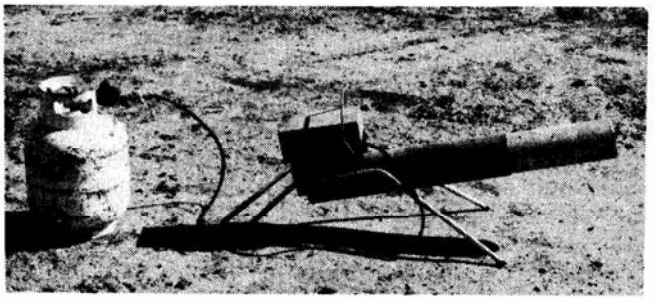
It has been stated that the use of revolving or flashing lights may enhance the effectiveness of lights. We have no information to either support or dispute this statement.

Propane Exploders

These devices produce loud explosions at automatically timed intervals when a spark ignites a measured amount of propane gas. On most models, the time interval between explosions can be varied from about one per minute to about one per hour.

Use of these devices is usually considered to be of only temporary effectiveness at keeping coyotes away from sheep. The period of effectiveness can be increased by moving the exploders to different locations and by varying the time interval between explosions. In general, the timer on the exploder should be set to fire every 8-10 minutes and the location should be changed every 3 or 4 days. Normally, the exploder should be turned on just before dark and off at daybreak. However, if coyotes are killing sheep during daylight hours, the exploder should be operating at that time.

Because of their temporary effectiveness, use of these devices is best confined to reducing losses until more permanent control or preventive measures can be



taken. In about 24 coyote depredation complaints over a 2-year period in North Dakota, propane exploders were judged to be successful in stopping or reducing predation losses until offending coyotes could be removed. "Success time" of the exploders appears to depend a great deal on how well they are tended by the livestock producer.

Bells

Some sheep producers place bells on some or all of their sheep in an effort to discourage predators. In Kansas, Meduna's statistical study of producers indicated that bells might be of some usefulness in discouraging predation in nighttime corrals. There were no detectable differences in losses between flocks on pasture in which some or all sheep wore bells and flocks in which no sheep wore bells. However, no attacks were reported on sheep or lambs wearing bells.

Vehicles

Use of a vehicle such as a car or a pickup, parked in the area where losses are occurring, is often of temporary effectiveness in reducing predation losses. Effectiveness can be improved or extended by frequently moving the vehicle to new locations. An old-fashioned scarecrow may also be of limited effectiveness.

Aggressive Livestock

Billy goats, ponies or other domestic livestock that are more aggressive than sheep may also help to deter coyotes under some conditions. However, their use is no guarantee against loss.

Radios

Use of a tractor radio or other loud radio turned to an all night station has been found to be at least temporarily effective at deterring coyotes.

Shepherds

Direct herding of sheep (by a sheepman, a member of his family, or an individual hired for that purpose) is generally a last resort type of situation in Kansas where pastures are relatively small and sheep can be easily corraled at night. However, in range sheep operations, this practice is more common and can be effective in reducing predation losses.

Guard Dogs

Guard dogs have reportedly been used successfully for many centuries in Europe and Asia to protect livestock from bears and wolves. Although interest in the use of dogs for livestock protection is increasing, research on the effectiveness of this technique is still incomplete. The Denver Wildlife Research Center, USFWS, recently completed preliminary tests of the Hungarian Komondor for protecting sheep flocks in fenced pastures. A significant reduction in sheep losses to coyotes was demonstrated, although one pair of dogs harassed sheep. Further studies are now being conducted by government and university researchers to more thoroughly assess the dogs potential for protecting livestock. A number of livestock producers are currently using these dogs for livestock protection, although their effectiveness for this use is still unknown at the present time. However, of the producers using Komondors or Great Pyrenees who responded to a recent questionnaire sent out by predator researchers from the U.S. Sheep Experiment Station at Dubois, Idaho, a majority rated the dogs as good to excellent at protecting their livestock from predation.

Komondor Guard Dog. Photo by Guy E. Connolly, USFWS.

Great Pyrenees

Other breeds of dogs which could prove suitable for guarding livestock include the Great Pyrenees, the Hungarian Kuvasz, the Italian Maremma, the Yugoslavian Shar Planinetz, and the Turkish Karabash. One possible problem with dogs such as the Great Pyrenees is that most of them today have been bred for pets and show dogs, not livestock guard dogs. Although it appears that the use of guard dogs may have a place, they will need to be carefully selected and trained. A guard dog must have a different behavior and temperament than a livestock herding dog. A main component of guarding is "following behavior. " A properly bred and trained guard dog will be content to stay with or near the flock or herd, but never attack them. A second component of guarding is "aggressive behavior, " the tendency of the dog to protect the herd or flock against what it perceives as threats.

Jeff Green, a predator damage control researcher at the U.S. Sheep Experiment Station, is currently conducting research on the Komondor and the Great Pyrenees for protecting sheep and he lists the following points for consideration by producers contemplating purchasing livestock guarding dogs: 1) There is no one breed of dog that is currently thought to be the "best" for predator control; 2) Dogs should be purchased from a reputable breeder—one who knows about the dogs he sells; 3) Given a choice, buy dogs from a working parentage; 4) Start the dogs with livestock at an early age (8-12 weeks) and be sure that the livestock won't injure the young puppy or frighten it badly; 5) Put the pups immediately where you want them to work (don't raise a pup for several months in your home or yard and then later expect it to stay near the barn with your sheep); 6) Be patient, large working dogs may not mature until or 3 years of age, so expect puppy problems (such as

playing with sheep) for sometime. However, be swift to correct any bad behavior of the dog, especially as it relates to playing with or harassing livestock. The dog must know that harassing the stock is unacceptable; 7) Give the dog some basic obedience training (come, sit, stay, no, etc.) and be able to reasonably control it; 8) Even though a pup is of a guarding breed, it may not necessarily perform the livestock guarding task well; 9) Don't expect miracles, presumably the guarding is instinctive, but be prepared to teach the dog what you expect it to do (where it is to guard and what it is to guard); 10) There is a variety of opinions as to the degree of affection that should be given a guarding dog. The best approach is probably to give the dog affection when it is where it is supposed to be and when it is doing what it is supposed to be doing. This positive enforcement will produce better results than physical abuse.

Experimental Predator Deterrents

The deterrent methods listed below are all in the experimental stages at the present time. They will probably either never come into practical field use, or will require many more years of research and development. They are listed here only because they have been the subject of a great deal of publicity and have generated a lot of questions.

Repellents

Literally hundreds of candidate chemicals have been screened for use as predator repellents. To date, laboratory and field studies of these chemicals have failed to produce even one effective compound which could safely be applied to a food animal destined for human consumption. There are no coyote repellents currently registered in the United States.

Aversive Agents

Aversive conditioning of coyotes is an area which has received much publicity, but which has yielded very few concrete results. Theoretically, if a coyote is fed a prey-like bait containing an illness-producing drug, it will in the future associate that illness with the live prey and will be inhibited from attacking. However, laboratory research on this technique has yielded inconsistent and contradictory results and field tests have been inconclusive, at best.

Electromagnetic Devices

Use of various ultrasonic or electromagnetic devices to repel coyotes has sometimes been touted as a solution to predator problems. However, to date, there is no objective scientific evidence which shows effectiveness of these devices. Also, it should be kept in mind that levels of ultrasonic sound sufficient to repel coyotes could also be potentially harmful to livestock, pets, or humans exposed to the sound.

Predator Removal

Use of preventive measures and nonlethal control techniques alone may not always be sufficient to satisfactorily resolve a predator problem. Although nonlethal methods do reduce both the likelihood and the severity of predation losses and can help to buy some time if losses do begin, many producers will still find it necessary, at some point, to remove offending predators.

In recent years, there has been more interest in trapping and hunting predators for the increased value of their fur, rather than just for damage control purposes. However, for a producer who is strictly interested in reducing predation losses, there is little to be gained from removing predators when no losses are occurring in the hope that it will help to prevent future losses. An exception to this would be predator removal initiated in an area just prior to a time period when predation problems have historically and consistently occurred. Most coyotes are territorial, but certain components of the population are quite mobile, particularly during the fall and winter months. Territories that are vacated when a coyote is killed are usually rapidly reoccupied. Not all coyotes kill sheep and even fewer kill calves. Therefore, if coyotes living in association with a livestock production unit are causing no particular problems, it makes little sense to kill them, just to have them be replaced by other coyotes which may or may not cause problems.

In Kansas, the most effective and reliable technique for removing depredating coyotes is the steel trap. Direct, individualized assistance is available to any livestock producer in the state who is experiencing a predator problem just by calling the local County Extension Office. A predator damage control specialist will come to your farm as quickly as possible, supply you with the necessary equipment, and show you exactly where and how to make sets to capture the offending coyotes. Follow-up assistance is also available, if needed. In some areas, local trappers or hunters (dog hunters, callers) may be available to help a producer with a predator problem.

For more information on lethal damage control techniques, 'see the KSU Extension Bulletins *How to Trap a Coyote, C-522* and *How to Call Coyotes, C-400.* Aerial hunting and the use of poisons for predators are illegal in the state of Kansas.

Management Systems-Summary

This discussion of management systems is intended to illustrate and summarize how the methods discussed in this publication can be brought together, or integrated, into a comprehensive system of livestock management for reducing predator losses.

In Kansas, producers who do not pen sheep at night can normally expect to have predator problems. Poor pasture and/or corral fences are often associated with higher than normal predation losses and can also increase the difficulty of removing problem predators if

losses do begin to occur. Good, tight net-wire fences, even though they are not "coyote-proof," will act as deterrents to some coyotes and will restrict the movements of most others. When coyote access to a pasture is limited, it becomes much simpler to properly place snares or traps for the removal of offending animals, if necessary. The addition of a coyote-proof corral for nighttime confinement (an exclusion fence constructed with either conventional or electric fencing) adds additional security from predation to a sheep production operation. If the corral is not coyote-proof, it should be lighted to reduce the predation risk and to aid in removing offending coyotes should losses occur.

Lambing in sheds or lots reduces not only losses from lambing complications and starvation, but also reduces predation losses. If shed lambing is not possible, lambing in small, tightly fenced pastures which can be closely watched is advisable from a predation standpoint. If the possibility of predation is feared during critical lambing or calving periods, a producer should consider the preventive use of propane exploders or other predator-scaring devices before losses begin. Producers living near towns or cities should be especially alert to potential problems from free-running dogs.

Of course, sanitation is important in reducing predator problems. Good managers generally have less dead livestock in the first place, and they dispose of carrion properly by burying or having it hauled off. This not only helps to keep predators from becoming habituated to feeding on livestock, but it may also reduce predator numbers in the immediate livestock production area.

Sheep producers with flocks of 300 or more are most efficient in terms of predator losses, on a percentage basis, even though their total predation losses may be higher than those of producers with fewer sheep. A new producer just building a flock, however, is cautioned to proceed slowly. Numerous problems other than predation can crop up in a hurry when a manager exceeds his knowledge, experience, or facilities.

By keeping accurate, up-to-date records, a producer may, over time, identify patterns or trends in predation losses. Certain seasons, certain locations, or a combination of both, may be associated with high or low losses. Once these problem times or areas have been identified, the producer can then modify his management practices, if feasible, in an attempt to correct the problems. Even though it may not be possible to solve predation problems by management methods alone, accurate records can be of value in helping the producer to anticipate when and where problems may occur. Records of financial loss can also be useful in determining the economic feasibility of proposed predator damage management practices. Counting sheep or pigs at regular intervals while they are on pasture can also aid in the early detection of a predation problem. If there is no practical way of eliminating predator access to the livestock, predator removal will usually be necessary once losses have begun. However, use of predator frightening methods can be of definite benefit in preventing or reducing losses until the offending animal(s) can be captured.

Predator damage management means much more than attempting to remove problem coyotes once damage has begun. Damage management means utilizing the "ounce of prevention" principle to reduce predation risks through modifications in livestock management, including the employment of one or more of a variety of nonlethal damage reduction techniques where applicable. Remember, "It's too late to lock the barn door once the horse has been stolen." By practicing proven preventive measures, livestock producers can minimize predation losses and simplify problem animal control when and if it becomes necessary.

Predator Damage Management Checklist

General Husbandry Practices

- ☐ Corraling sheep at night
- ☐ Pasture selection
- ☐ Proper disposal of carrion
- ☐ Recorord-Keeping
- ☐ Variable grazing
- ☐ Selection and surveillance of pastures
- ☐ Recognition of predisposing conditions

Predator-resistant Fencing

- ☐ Electric Fencing
  - ☐ Exclusion Fences
  - ☐ Directing Fences
- ☐ Conventional Fencing
  - ☐ Exclusion Fences
  - ☐ Directing Fences

Predator Frightening Devices

- ☐ Lights
- ☐ Propane Exploders
- ☐ Bells
- ☐ Vehicles
- ☐ Aggressive Livestock
- ☐ Radios
- ☐ Shepherds

Experimental Predator Deterrents

- ☐ Guard Dogs
- ☐ Strobe-siren Device

Predator Removal

- ☐ Traps, snares
- ☐ Shooting
- ☐ Dogs

Selected References

The following list contains many of the references used in preparing this publication and provides possible sources for readers desiring more detailed information.

Boggess, E. K., R.D. Andrews and R.A. Bishop. 1978. Domestic animal losses to coyotes and dogs in Iowa. J. Wildl. Manage. 42(2):362-372.

Bowns, J.E. 1976. Field criteria for predator damage assessment. Utah Sci. 37:26-30.

Brawley, K.C. 1977. Domestic sheep mortality during and after tests of several predator control methods. M.S. Thesis, Univ. Montana. 69pp.

Connolly, G. E., R.M. Timm, W.E. Howard, and W.M. Longhurst. 1976. Sheep killing behavior of captive coyotes. J. Wildl. Manage. 40(3):400-407.

Coppinger, R. and L. Coppinger. 1978. Livestock guarding dogs for U.S. agriculture. Livestock Dog Project. 25pp.

deCalesta, D.S. and M.G. Cropsey. 1978. Field test of a coyote-proof fence. Wildl. Sot. Bull. 6(4):256-259.

Gee, C. K., R.S. Magleby, W.R. Bailey, R.L. Gum and L.M. Arthur. 1977. Sheep and lamb losses to predators and other causes in the western United States. U.S. Dep. Agric., Agric. Econ. Rep. 369. 41pp.

Gates, N. 1978. Constructing an effective anticoyote electric fence. U.S. Dep. Agric. Leafl. 565. 6pp.

Henderson, F. R. 1975. How to trap a coyote. Kansas State Univ. Coop. Ext. Serv. Publ. C-522. 8pp.

Henderson, F. R. 1975. How to call coyotes. Kansas State Univ. Coop. Ext. Serv. Publ. C-400. 12pp.

Henderson, F. R., E.K. Boggess and B.A. Brown. 1977. Understanding the coyote. Kansas State Univ. Coop. Ext. Serv. Publ. C-578. 24pp.

Henne, D. R. 1975. Domestic sheep mortality on a western Montana ranch. M. S. Thesis, Univ. Montana. 53pp.

Jardine, J.T. 1908. Preliminary report on grazing experiments in a coyote-proof pasture. U.S. Dept. Agric. Forest Serv. Circ. 156. 32pp.

Jardine, J.T. 1909. Coyote-proof pasture experiment, 1908. U.S. Dep. Agric. Forest Serv. Circ. 160. 40pp.

Jardine, J.T. 1911. Coyote-proof enclosures in connection with range lambing grounds. U.S. Dep. Agric. Forest Serv. Bull. 97. 32pp.

Lantz, D.E. 1905. The relation of coyotes to stock raising in the West. U.S. Dep. Agric. Farmer's Bull. 226. 24pp.

Linhart, S., J. Roberts, G. Larson and T. Rose. 1978. Field evaluation of electric fencing to alleviate coyote predation on sheep. 1978. U.S. Fish Wildl. Serv., Denver Wildl. Res. Center Rep. 16pp. (unpublished)

Linhart, S. and J. Roberts. 1977. Field evaluation of electric fencing to alleviate coyote predation on sheep. 1977. U.S. Fish Wildl. Serv., Denver Wildl. Res. Center Rep. 18pp. (unpublished)

McAtee, W.L. 1939. The electric fence in wildlife management. J. Wildl. Manage. 3(l): 1-13.

Meduna, R.L. 1977. Relationships between sheep management and coyote predation. M. S. Thesis, Kansas State Univ. 140pp.

Munoz, J.R. 1976. Causes of sheep mortality at the Cook Ranch, Florence, Montana. 1975-76. M. S. Thesis, Univ. Montana. 55pp.

Shelton, M. n.d. Fencing as a means of protecting livestock from predation. Texas A&M Univ. Agric. Expt. Stn. 8pp.

Thompson, B.C. 1976. Evaluation of wire fences for control of coyote depredations. M. S. Thesis, Oregon State Univ. 59pp.

Todd, A.W. and L.B. Keith. 1976. Responses of coyotes to winter reductions in agricultural carrion. Alberta Wildl. Tech. Bull. 5. 32pp.

U.S. Fish and Wildlife Service. 1978. Predator damage in the West: A study of coyote management alternatives. U.S. Fish Wildl. Serv., Dep. Int. 168pp.

Young, S.P. and H.H.T. Jackson. 1951. The clever coyote. Stackpole Co. and Wildl. Manage. Inst. 411pp.

Acknowledgements

We especially want to thank Robert J. Robel and Robert L. Meduna for their efforts in securing funds and conducting the research upon which a major part of this publication is based.

We wish to express our appreciation to Bennett A. Brown, Guy E. Connolly, David S. deCalesta, Jeffrey S. Green, Samuel B. Linhart, Robert L. Meduna, Darrell Montei, Roger D. Nass, Robert J. Rebel and Robert M. Timm for reading and making constructive comments and criticisms on earlier drafts of this publication.

Photo by Guy E. Connolly

F. Robert Henderson
Extension State Leader,
Wildlife Damage Control Program

Clifford W. Spaeth
Extension Specialist, Animal Sciences and Industry

KSU
KANSAS STATE UNIVERSITY

COOPERATIVE EXTENSION SERVICE, MANHATTAN, KANSAS

C-620 October 1980

Issued in furtherance of Cooperative Extension Work, acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, and United States Department of Agriculture Cooperating, Walter R. Woods, Director. All educational programs and materials available without discrimination on the basis of race, color, national origin, sex, or handicap. 10-80—10M; 8-85—5M; 1-89—5M

File Code: Wildlife—2