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ABSTRACT: Preventive relocation of black bears *(Ursus americanus)* was tried as an alternative to lethal removal of bears that attacked sheep in northeastern Oregon. Bears in likely problem areas or in close proximity to sheep bands were captured with culvert traps and moved to other ranges without sheep. Sixteen bears were relocated in 1990 and five in 1991 from areas where five damaging bears had been destroyed in 1989. The five bears relocated in 1991 were radio collared and monitored by the Oregon Department of Fish and Wildlife. None of them were involved in livestock depredations subsequent to relocation. Sheep losses to bears were lower in 1990 and 1991 than in prior years when bears were not relocated. Relocation appears to be a feasible alternative to lethal control of black bears that attack livestock. The costs of preventative relocation and killing depredation bears were approximately equal, but relocation was deemed more acceptable to the general public.

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INTRODUCTION

Black bear predation on domestic sheep is a chronic problem for many western livestock producers. A recent survey of livestock predator problems revealed that bears killed approximately $450,000 worth of sheep and lambs in the U.S. in 1990. In Oregon, black bears destroyed an estimated 400 head of sheep and lambs valued at $17,800 in 1990 (NASS 1991).

Most complaints of bear damage to livestock in Oregon involve depredations on sheep in areas of greatest bear density, including portions of northeastern Oregon where this study was conducted. Most of our bear damage situations involve range bands of sheep that are bedded down at night and watched by a herder. These sheep are most vulnerable to predation when scattered and grazing during times when bear are most likely to be active. Any increase in the diurnal activities of bear, such as increased foraging time, could increase the chances of a conflict (Poelker and Hartwell 1973).

Bear damage management in Oregon is a responsibility of the Oregon Department of Fish and Wildlife (ODFW). APHIS/ADC personnel act as agents of ODFW when conducting bear damage control work. ODFW policy specifies that "any animal which is destroying livestock or causing concern for human safety will not be relocated" (ODFW 1993). Corrective control is defined as control actions applied when damage is occurring or after it has occurred. Preventive control is defined as any action taken, designed to prevent or discourage wildlife damage to property, livestock or other conflicts with people. Therefore, according to ODFW policy, once damage has been confirmed, relocation is not a corrective control option. In recent years, ADC personnel have had limited preventive control options for bear damage, other than to advise livestock operator in the use of predator-frightening devices such as livestock guarding dogs or siren strobe devices. Ranchers also were asked to keep a close eye on their sheep when in bear country and to call ADC when they had damage.

Because of historical limitations on funding and methodology, the most common approaches to management of bear depredation problems has been to scare away or kill the bears responsible for damage. Livestock operators on sheep ranges of Eastern Oregon traditionally have used two lines of defense:

1. Herders were furnished with a weapon and ammunition, herd dogs and occasionally a livestock guarding dog in an attempt to scare off any bear that came around the band.
2. If the herder was unsuccessful and a bear killed or injured sheep, the livestock operator contacted ADC or a private agent to assist him by attempting to remove the damaging bear.

This paper describes an alternative, nonlethal relocation approach that has been used for two grazing seasons on selected grazing allotments on the Umatilla National Forest and adjoining private lands in Northeast Oregon. We compared the management costs of relocation and lethal removal and evaluated the relative advantages and disadvantages of these alternatives.

STUDY AREA

The area identified for this project included both public and private traditional sheep grazing allotments in Northeastern Oregon (Figure 1). The public land is managed by the Umatilla National Forest, and the private lands are owned by various ranch and timber companies. This area has been grazed by sheep since the last century, and bear damage to livestock is a relatively common occurrence. During the project, three sheep operators used parts of the range for some or all of the grazing season. The traditional grazing season in Northeastern Oregon is April 15 to October 31, depending on annual weather conditions. Between four and six bands of sheep graze the study area at any time during the grazing season. The average elevation ranges from 3000 to 5000 feet above sea level, and the average annual precipitation is about 12 inches per year. The basic vegetative type of

the study area is mixed conifer forest and high mountain meadows.

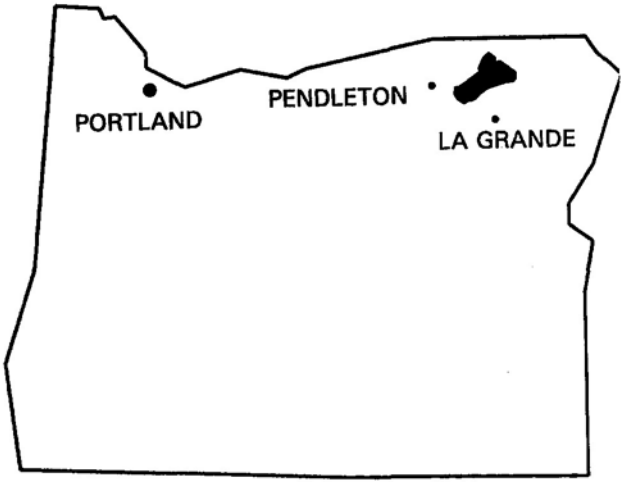

Figure 1. Oregon bear relocation study area.

METHODS

Our evaluation of recurring bear damage incidents revealed certain patterns that were important in devising an effective relocation strategy. We dealt with migratory sheep bands that generally travelled the same routes year after year. Bear damage was reported annually or frequently at certain points along these routes. Most of these "target areas" are in the vicinity of prime bear habitat or travelways. Travelways may be identified as saddles or main ridges that separate major drainage systems. Attempts to reroute livestock away from these target areas usually prove to be ineffective in reducing bear conflicts, as moving the sheep simply places them in proximity to other bears that are likely to prey on them.

Incidental to our review of bear damage patterns, we noted that most damaging individuals were adult boars (Table 1). In 1989, 4 of the 27 bears taken in Oregon in response to livestock damage complaints were under the age of three while 18 were four years old or older (Trainer and Golly 1991). Approximately 85 percent of the "damage" bears were males (Table 1), even though the adult bear population probably contains more females than males.

We speculate that these old male bears are dominant animals within their ranges and that many of the livestock damage situations could be the result of predator territorial defense behaviors.

We define this type of territorial behavior as reaction to a disturbance within an individual bear's home range. The bear may flee or hide from the disturbance, or may react either with mild curiosity or with an aggressive show of dominance aimed at the cause of the disturbance. This concept could explain why juvenile bears and females with cubs are so seldom involved with livestock damage. They may be simply responding to the disturbance of livestock grazing through their territory in a more recessive and shy manner, whereas some adult males become very aggressive.

Table 1. Age and sex composition for black bears taken in response to livestock damage incidents in Oregon, 1989 to 1991.

Year	No.	Median Age (Years)	% Male	% Female
1989	27	5.0	78%	22%
1990	24	4.3	92%	08%
1991	25	3.7	84%	16%
Total	76	4.3	85%	15%

Such differing responses to disturbance could help explain the high percentage of adult males involved in livestock damage complaints. We used this rationale to formulate the preventive damage control method described in this paper. Adult bears, particularly males, were targeted in geographic areas where prior experience indicated that problems were most likely to occur.

An interagency meeting was held to coordinate project specifics such as designated release sites, land status agreements, necessary control equipment, and data to be gathered. We agreed to proceed with preventive livetrapping efforts and coordinate with the ODFW as the program developed. Project agreements were signed and a release site designated. Livestock grazing routing maps were provided by the U.S. Forest Service. Livestock operators agreed to provide ADC with their routing schedule and to notify us of any necessary changes or of any bear incidents.

After identifying likely problem areas as described above, we used culvert traps and Aldrich foot snares (Boddicker 1983) to capture and move dominant, resident bears from these areas before the sheep arrived.

Bear depredation often will be preceded by one or more instances of harassment or frequent sightings of a bear in the immediate vicinity of the sheep. Therefore, bears found frequenting the proximity of sheep bands, especially with any regularity, were removed before predation occurred. Captured bears were weighed, marked, and released in a previously designated area where sheep were not present.

Culvert traps and occasionally Aldrich foot-snares were set and maintained in target areas one to two weeks prior to the arrival of the sheep. Availability of culvert traps was a constant problem due to the limited number of traps, the size of the area, and number of trap sites. Aldrich foot snares were used when culvert traps were unavailable or in areas where a bear was reluctant to enter a culvert trap. One culvert trap was kept free for use in transporting captured bears to release sites.

After capture, the animals were tranquilized and ear-tagged for identification; a tooth was removed for age determination by means of tooth cementum layer analysis (Stoneberg and Jonkel 1966). The drug used for immobilization was telazol® (Tiletamine HCl/Zolazepam HC1), and injection was by dart gun or jab stick. Each animal was checked for physical condition and weighed before release. Using this technique, it was not necessary to relocate the bears a great distance (over 20 miles) since it is likely or even preferable that they eventually return to their original range. All bears were released within 24 hours from the time of capture and were fully recovered from the effects of immobilization prior to release.

In the second year, five relocated bears were instrumented with radio collars to facilitate tracking (by the ODFW) of their movements and to determine whether they returned to the original range.

RESULTS

During the 1989 grazing season, prior to this study, 44 sheep were confirmed as having been killed by bears within the study area (Armistead 1989), and five damaging bears were lethally removed. Beginning in 1990, relocation was used for preventive bear control where applicable. Sixteen bears were relocated; 47 sheep were confirmed as killed by bears (Armistead 1990), and only one bear was lethally removed. Many of these losses occurred within the North Fork Umatilla Wilderness Area which is outside the study area but within the grazing route of two bands of sheep. It should also be noted that, in Northeastern Oregon, more bear/livestock complaints were recorded in 1990 than in any other year between 1986 and 1992 (ODFW 1993).

During the 1991 grazing season, only 16 sheep were confirmed killed by bear; five bears were relocated, and none were killed. We speculate that the apparent reductions of bears captured on grazing allotments and in confirmed losses during the 1991 season resulted from an unusually cool, wet spring, and the effects of the relocation program the previous year.

Of the five bears that were radio-collared and monitored subsequent to relocation in 1991, none were involved in livestock depredations. One collar remained active for about a year. Two bears, including the one whose collar remained active the longest, were harvested by sport hunters. A third bear was found dead about a half mile from the release site when his collar began to give a mortality signal. One collar either quit working or the bear moved north into the state of Washington; it was never located again. The fifth bear was shot in the vicinity of another band of sheep.

DISCUSSION

Modern wildlife damage management is becoming increasingly dependent upon having a variety of alternatives available from which to choose to alleviate particular damage situations. Often it is not acceptable to remove a damaging animal by trap or gun. More and more often animal control specialists are expected to apply preventive control techniques that will not only solve ongoing wildlife damage problems, but also reduce the likelihood of future problems. Bear relocation is one such preventive, nonlethal technique.

An accurate cost evaluation of preventive relocation is difficult because there are many variables to consider. Some elements of our project (balances and radio telemetry equipment) would not have been necessary to use the technique and are excluded from our cost analysis. ADC damage management objectives could have been met without tranquilizing, weighing, and equipping the bears with radio transmitters, but we thought it desirable to cooperate with other agencies that wanted to study the movements of relocated animals.

The cost factors common to both control methods (lethal removal and relocation) include labor, transportation, and capture equipment (Table 2). It is interesting to note that, in our study, the costs per bear were similar for the two control methods.

Much of the expense of lethal removal resulted from the fact that, in Oregon, bears are classified as edible game animals, and by law the meat must be salvaged unless condemned as inedible. The labor costs involved in salvaging carcasses of damaging bears greatly increase the expense of lethal control, compared to other states where carcass salvage may not be required.

In this project, we used three culvert live traps and several Aldrich foot-snares. A culvert-type live trap costs about $3250 and is a major start-up cost of this technique. With proper maintenance, however, culvert traps will last at least 20 years. If the initial costs of traps are amortized over their expected useful life span, the annual cost per culvert trap is only about $160.

Aldrich bear snares, rather than culvert traps, may be used to capture bears. However, it is necessary to use a tranquilizer gun to tranquilize the animal in a snare; the jab-stick is only appropriate when the animal is in a culvert trap. We also recommend that a culvert trap and trailer be used to transport tranquilized bears since they exhibit a high degree of variability in their reactions to immobilizing drugs.

Negative Considerations

The most obvious negative impact of this technique is cost. The equipment cost alone of three or four culvert live traps can exceed $10,000. In addition, the costs of tranquilizing equipment, drugs, and the training and certification of personnel in the use of the equipment can be high.

When considering the justification for spending public funds, corrective control expenses are more easily justified, as they occur only in response to confirmed damage. Preventive control expenses, on the other hand, may be harder to justify since they must occur in the absence of damage. When preventive control is wholly effective, the result is a complete lack of livestock losses or damage reports. The longer it has been since a confirmed predator damage problem, the more difficult it is to justify the increasing expenses of an aggressive preventive control program. In addition, predator damage can vary greatly from one year to the next, making it difficult to evaluate the effectiveness of both preventive and corrective techniques.

Table 2. Average costs of applying lethal and nonlethal bear damage control methods.

	Preventive Bear Relocation	Corrective Bear Killing
Equipment		
3 Culvert live traps ($3,250 each)	$9,750.00	---
6 Aldrich leg snares ($30 each)	$180.00	$180.00
1 Tranquilizer gun and accessories	$450.00	---
Equipment Total	$10,380.00	$180.00
Labor		
Average cost/bear ($14.75/hr)	$225.31	$326.34
Average cost/season ($14.75/hr)	$2,253.06	$652.69
Vehicle		
Average cost/season ($0.225/mile)	$565.87	$105.52
Total Labor + Vehicle/season	$2,818.93	$758.21
Total Labor + Vehicle/bear	$140.95	$189.55

Accessibility by motor vehicles is a major prerequisite for preventive removal of bears. This was a minor problem in our area, which had sufficient road systems to allow vehicle access to most damage areas. But many bear depredation incidents in the western United States occur in remote back country that is not accessible by motor vehicle.

Preventive bear removal also could be hampered by a lack of cooperation among wildlife and land management agencies. Successful use of this technique requires the active participation and support of ranchers, land managers, and wildlife management agencies as well as wildlife damage management expertise.

Positive Considerations

The main benefit of this technique is that it provides an effective and practical alternative method for resolving bear/livestock conflicts without killing bears. Also, it increases the likelihood that problem bears, which are valuable game animals, can be harvested by sportsmen rather than by damage control agents.

Another benefit of nonlethal, preventive bear relocation is the increased scrutiny of damage situations during the planning process. This results in improved recognition of bear damage patterns, enhancing managers' ability to predict when and where livestock are most vulnerable to predation.

The most obvious benefit of preventive bear relocation, however, is that it constitutes another effective, non-lethal alternative that can be applied in some highly sensitive situations where lethal removal may be undesirable or even unacceptable.

Finally, we consider it beneficial that nearly all interested parties supported the use of this technique. The sheep operators were very supportive because relocation offered a solution if other non-lethal techniques failed. Ranchers preferred preventive relocation to the traditional alternative of waiting for bears to attack livestock and then removing them by lethal action. All representatives of cooperating agencies were pleased with the development of a new non-lethal management strategy.

Among the general public, most of the people we talked to were pleased and supportive of our efforts to avoid killing bears. However, a few persons were not pleased with the technique. They stated that the bears should not be disturbed at all and that sheep operators should tolerate bear damage in view of the benefits they derived from public land grazing permits.

CONCLUSIONS

Preventive relocation appears to be a feasible alternative to lethal control of bears that attack livestock in our northeastern Oregon study area. Although bear relocation costs about as much as killing depredating bears, it is more acceptable to the general public. In addition, it may be more effective in minimizing damage. Sheep losses to bears were lower during the relocation program than in prior years.

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