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ABSTRACT: A case of severe golden eagle *(Aquila chrysaetos)* predation on domestic sheep was documented on seven South Dakota ranches during the spring of 1993. One hundred forty-two lambs and one ewe were verified as being killed by eagles during a six-week period. In an effort to resolve the depredation problem, padded leghold traps were used to capture 21 golden eagles in or near the lambing pastures. The captured eagles were translocated and released approximately 322 km northeast of the capture area. Predation on lambs ceased following the relocation effort.

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INTRODUCTION

The problem of golden eagle *(Aquila chrysaetos)* predation on livestock has been well documented (Matchett and O'Gara 1987, Phillips and Blom 1988). However, there are relatively few accounts which have documented the impact of eagle predation on individual sheep producers and approaches taken to resolve the problem. Arnold (1954) concluded that eagle predation on sheep is sporadic and may vary considerably with changing local conditions. A variety of factors, including natural prey densities, availability of carrion, weather, ranching practices, vegetative cover, and topography, contribute to the varying nature of eagle predation. The interaction of these factors with the density, distribution, and behavior patterns of local eagle populations makes managing and predicting eagle predation problems a difficult task.

Eagle predation on lambs in western South Dakota has been reported for many years but the magnitude of the problem was considered low. However, upon investigating an eagle complaint in the spring of 1993 we determined eagles to be a major source of lamb mortality on several South Dakota ranches. The purpose of this paper is to document the amount of eagle predation that was observed in 1993 and to describe the management approaches that were used in dealing with the problem.

STUDY AREA AND METHODS

The 399 km^2 study area included seven sheep ranches located in the southwestern portion of Fall River County, South Dakota (Figure 1). The area is characterized by rolling hills and benches covered by big sagebrush *(Artemisia tridentata)* and grasses. A few cottonwood *(Populus* spp.) trees are located along the drainages of the area. The area supports a diversity of potential prey species for eagles including white-tailed jackrabbit *(Lepus townsendii),* cottontail rabbit *(Sylvilagus* sps.), black-tailed prairie dog *(Cynomys ludovicianus),* and pronghorn *(Antilocapra americana).* Field observations indicated that jackrabbit and cottontail numbers were down during the period of study. Sheep and cattle grazing are major land uses on the area. Open range lambing without herders is the common sheep husbandry practice for this area, but some shed lambing is used. Lambing normally occurs between 1 April and 20 June.

Following a complaint from a rancher that eagles were involved in killing an adult ewe, we initiated daily carcass surveys to monitor lamb losses associated with eagles. Sheep carcasses were located by systematically searching the study area from the ground and air. Eagle-killed lambs were identified by the presence of subcutaneous hemorrhages at talon wounds.

Eagles were captured using No. 3 Soft-catch traps which were set on regular perch sites such as corner posts or near animal carcasses (Figure 2). Traps set on corner posts were attached to a slide wire which allowed the trapped eagle to descend to the ground. Traps were checked twice per day. Captured eagles were removed from traps and transported to a holding facility prior to translocation. All eagles were banded with U.S. Fish and Wildlife Service (USFWS) leg bands. Eagles were aged as adults or subadults based on the amount of white plumage on the retrices.

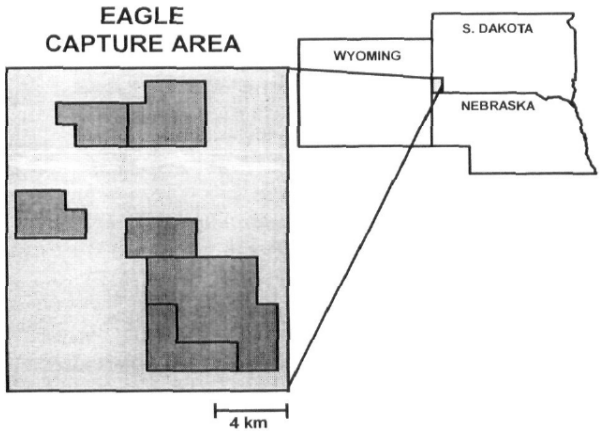
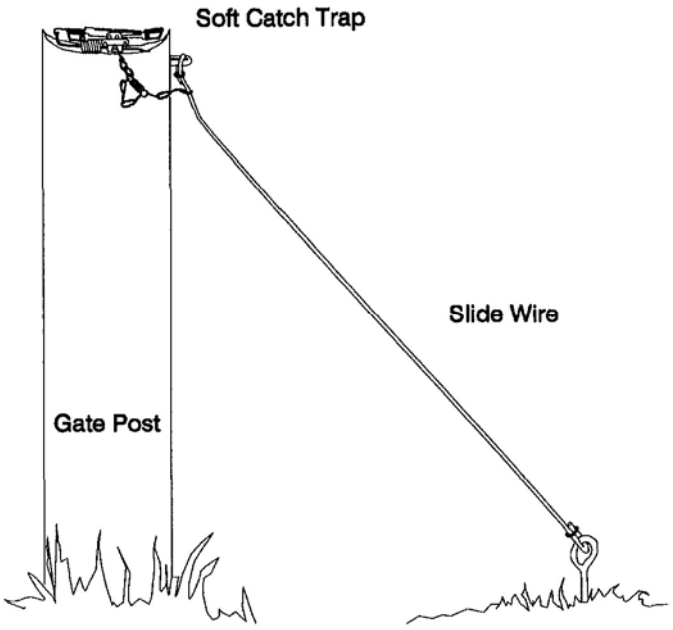


Figure 1. Location of study area in southwestern South Dakota.

Figure 2. Trapping method used for capturing golden eagles in sheep depredation areas.



RESULTS AND DISCUSSION

Between 12 May and 10 June 1993, we confirmed the loss of 142 lambs and 1 ewe to golden eagles. Lambs killed by eagles ranged from 2 to 60 lbs. and averaged approximately 15 lbs. Losses were distributed on seven sheep ranches with the Barkley Ranch sustaining the highest loss (Table 1). Many of the lambs necropsied were found after eagles were observed feeding on lamb carcasses. Table 1 represents minimum lamb losses because eagles, other predators, and scavengers rapidly cleaned up carcasses. Many eagle-killed lambs probably went unnoticed because we were unable to thoroughly search all pastures on a daily basis. For example, owners of the Plumb Ranch reported over 70 lambs they suspected were lost to eagles; we only documented 14.

Table 1. Distribution of lamb losses to golden eagles on seven South Dakota ranches in May and June, 1993.

Ranch Name	Verified Lamb Kills
Barkley	78
Henry	1
Lebar	31
Pfister	7
Plumb	14
D. Porter	9
T. Porter	2

The exact factors which contributed to the severe eagle predation in this area are unknown. A decline in jackrabbit numbers appeared to be an important factor leading to the extensive sheep depredation which occurred in southwestern Montana in 1974 and 1975 (O'Gara 1978). Jackrabbits were low on our study area in the spring of 1993 and this may have contributed to the depredation problem. Also, the availability of mule deer *(Odocoileus hemionus)* and pronghorn carcasses from animals that died during the previous winter was probably responsible for sustaining and possibly drawing migrating eagles to the area. As this food source disappeared in the early summer, lambs were the most readily available source of food.

Four of the seven ranches had reported losses of lambs to eagles in past years. In most instances losses were minor and no control efforts were initiated. However, the Porter Ranch reported substantial losses in 1987. This case was resc<ved by removing an active nest that was close to a lambing flock.

Following consultation with USFWS law enforcement officials, an eagle depredation permit was issued which allowed for the live-trapping and translocation of eagles from the sheep depredation areas. Nineteen subadult and two adult eagles were captured on the study area between 6 June and 24 June 1993 during 153 trap nights of effort. Eighteen eagles were trapped on gate or corner posts while the remaining three were taken at carcass sets.

The two adult eagles captured during the trapping effort were released on the study area because of concern for young still occupying nests immediately adjacent to the study area. All subadult eagles were held at the Reptile Gardens near Rapid City for two to four days and examined by a licensed raptor rehabilitator. These eagles were later transported and released on the Cheyenne River Indian Reservation, approximately 322 km northeast of the capture area.

This area was selected because of its availability and relatively long distance from the depredation area. Eagle relocation efforts by Phillips et al. (1991) suggested that the greater the distance breeding eagles were moved, the longer it took them to return to their territories. We suspect this same principal holds for non-territorial eagles captured in this study and hence decided to relocate them at least 322 km.

Five other raptor species were captured incidental to trapping for golden eagles (Table 2). All of these individuals were released unharmed on the study area.

Table 2. Species and numbers of raptors captured during golden eagle trapping efforts in southwestern South Dakota, June 1193.

Species	Number Captured
Golden eagles (*Aquila chrysaetos*)	21
Prairie falcon (*Falco mexicanus*)	3
Swainson's hawk (*Buteo swainsoni*)	1
Ferruginous hawk (*Buteo regalis*)	1
Turkey vulture (*Cathartes anra*)	2
Great horned owl (*Bubo virginianus*)	2

Reports from ranchers and our field observations indicated that predation on lambs decreased following the capture effort. Eagle numbers on the study area declined and lambs were growing larger by the end of the trapping period. Both of these factors probably contributed to reduced predation by eagles.

The conflict between eagles and livestock producers continues to be a problem in many areas of the western U.S. Solutions to this type of wildlife damage problem are difficult and can only be achieved through cooperative efforts between ranchers and natural resource management agencies. Management plans need to be developed that will protect the livestock of individual ranchers and provide adequate protection for the eagle resource.

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