Mortality Associated with Sheep Operations in Idaho

ROGER D. NASS

Highlight: Nine sheep bands from Idaho were monitored for mortality causes and circumstances during 1973 and 1974; two bands were monitored during 1975. Total ewe and lamb losses for the respective years were 9.5%, 11.5%, and 11.1%. Premature births, starvation, and disease were major causes of lamb deaths during the 3-month home ranch lambing period. During the same period, disease, shearing stress, infection, and birth complications were the main causes of ewe mortality. The yearly mean total loss for lambs on the range was 5.2%, the minimum (confirmed) loss to predators was 1.4%, and other known causes of death represented 1.1% loss. The mean minimum predation was adjusted to 2.9% on the basis of unaccounted for loss. The minimum predation rate on ewes was 1.1% (adjusted 1.6%) even though they were on the range twice as long as lambs. Coyotes accounted for 93% of all predator-killed lambs and ewes. Predation was most severe on lambs during the first 6 weeks on the range, but more ewes were killed during the fall and winter.

The predator-sheep controversy became especially serious after the Executive Order of February 1972 prohibited federal use and interstate shipments of coyote toxicants. Many sheepmen claimed that coyote populations would attain unprecedented high levels and thus make sheep raising unprofitable throughout the western states. Protectionist groups countered that coyotes did not kill sheep or that sheepmen always exaggerated their losses to predators. With increased monies available for predator research, the U.S. Fish and Wildlife Service started damage assessment studies in selected areas of Idaho and Wyoming to monitor sheep bands throughout the year for total mortality and to partition these deaths by time and circumstance. This paper reports on damage assessment studies from a shed lambing area of southern Idaho.

Owen Ellis and Richard Griffith, Jr., U.S. Fish and Wildlife Service (USFWS), were involved with field data collection, as were numerous temporary workers. Owen Ellis also helped tabulate the information from the field data cards.

Author is project leader, Damage Assessment, Section of Predator Damage, U.S. Fish and Wildlife Service, Denver Wildlife Research Center.

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Methods

Study Area

Parts of six counties, Owyhee, Twin Falls, Cassia, Elmore, Gooding, and Camas, in south-central Idaho encompassed the winter and summer sheep ranges of the three study ranches. Prominent vegetation on private and Bureau of Land Management (BLM) grazing areas consisted of sagebrush (*Artemesia* sp.), juniper (*Juniperus occidentalis*), and crested wheatgrass (*Agropyron cristatum*). Foothill vegetation of the summer range in the Sawtooth and Boise National Forests was lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), mountainmahogany (*Cercocarpus ledifolius*), aspen (*Populus tremuloides*), sagebrush, and grasses.

Sheep were typically trailed from BLM allotments to the home ranch about mid-January for lambing and stayed at the ranches after lambing until late March or early April when spring grazing was permitted on BLM administered lands. After grazing on BLM and some private lands until about June 1, the ewes and lambs entered the U.S. Forest Service ranges (Fig. 1). The lambs were usually shipped to market directly from the Forest Service ranges in July and August, but the ewes stayed in the mountains until grazing permits expired or they were driven down by snow in late October or early November. The ewes then grazed on BLM and private lands until mid-January, when they arrived at their respective ranches to start the cycle once again. Shed lambing ranchers use partitioned sheds to protect newborn lambs against inclement weather and to allow close inspection of ewes and lambs during the 24–48 hours following parturition.

A herder, with at least 2 dogs, accompanied each sheep band on the range and was usually with the sheep from 6 to 12 hours each day. Camp wagons were parked anywhere from 50 m to 1 km from the bedgrounds.

Procedures

Selection of ranches for study was based on typical 2,000–4,000 sheep herds and shed lambing operators who grazed herded bands on public lands within 241 km of Twin Falls, Idaho. Nine bands of sheep from three ranches were monitored for losses throughout 1973 and 1974, but only two sheep bands from one ranch were monitored during 1975. Predator control in this area was carried out through the Animal Damage Control Program, USFWS.

Lambing sheds and surrounding pens were inspected at 1, 2, or 3-day intervals, the exact frequency depending upon lambing intensity. Dead lambs were inspected, sexed, and categorized by cause of death. Carcasses not mutilated by necropsy were marked with a stain, or the ears were cut off, or they were removed to a discard area to avoid repeat counts. Criteria proposed by Rowley (1970) were used to separate parturient and post-parturient deaths. Ewe deaths during the lambing period were also monitored and recorded as to probable cause. Shed lamb necropsy data for one ranch during 1973 came from a student working on conjunction with a local veterinarian. The remainder of the data were compiled by USFWS personnel.

Range operations were monitored by assigning a man to one or two sheep bands. Sheep bedgrounds, loafing areas, and travel lanes were checked either daily or

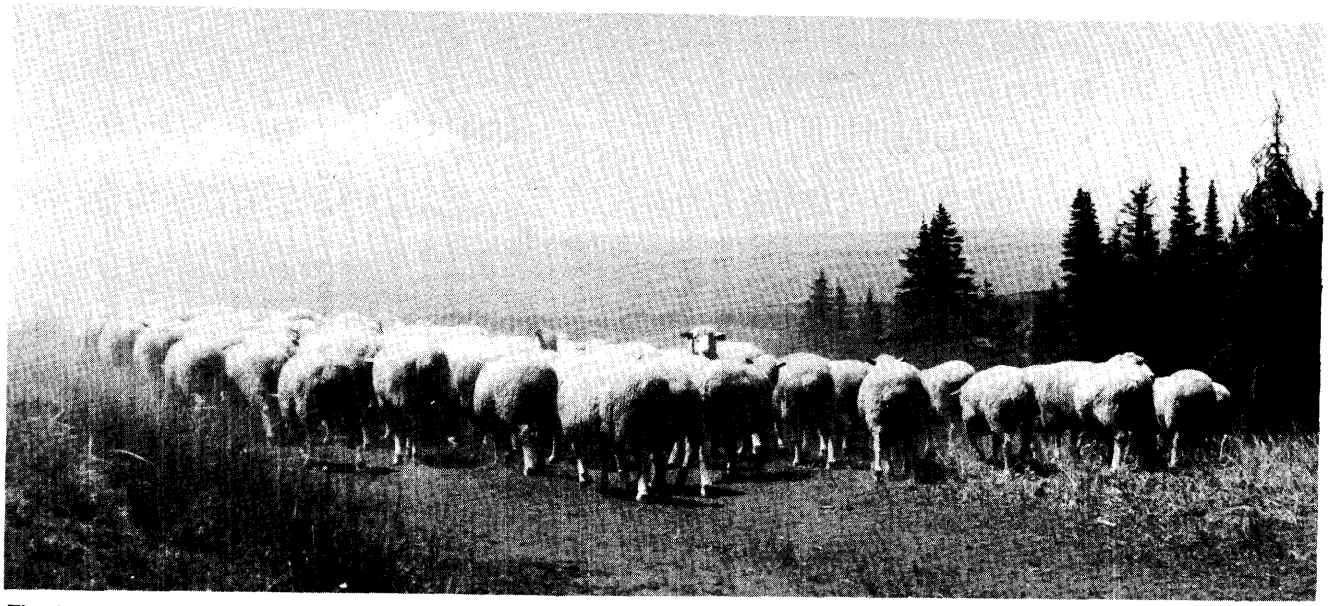

Fig. 1. *A band of ewes in high summer range.*

every other day by vehicles, horses, or walking, depending upon the terrain. Dead sheep were necropsied to establish cause of death and data cards were filled out to describe circumstances of each incident. Predator kills were identified by hemorrhaging and tooth puncture holes in the skin as reported by Davenport et al. (1973).

Results and Discussion

Overall Losses

During 1973, 1974, and 1975, the numbers of ewes and lambs under surveillance were 21,586, 22,881, and 5,630, respectively. Total sheep losses were 9.5% in 1973, 11.5% in 1974, and 11.1% in 1975. The increase from 1973 to 1974 was due to more lamb mortality at and shortly after birth; during 1975 ewe mortality was exceptionally severe (Table 1).

Lambing Period Losses

Ewe and lamb mortality percentages showed little variation among the three flocks during the 1973 lambing period. Ewe losses were 1.4, 0.9, and 0.8%; lamb losses were 7.4, 7.2, and 5.1%. Mean lambing period losses for the three flocks were 1.0% for ewes and 6.5% for lambs. During 1974 individual ranch losses increased to 2.1, 1.6, and 1.5% for ewes and 11.1, 9.1, and 7.6% for lambs. Mean losses from the three flocks were 1.7% for ewes and 9.6% for lambs. Ewe and lamb mortality dropped to 1.6 and 8.5%, respectively, during 1975.

Unknown causes of lamb mortality during the lambing and wintering periods led all other categories (Table 2) because many specific causes of death were difficult to diagnose, especially without laboratory tests. Premature births and starvation were the leading specific known factors of mortality; together they accounted for at least 31% of the lamb mortality. Disease and miscellaneous deaths were second highest known factors and included enterotoxemia, coccidieosis, pneumonia, infections, and other miscellaneous mortalities.

The 9% listed in Table 2 as "give away" are actually not deaths, but are included because they are lost to the rancher as a source of profit. Many of the lambs given to friends and others are in poor physical condition and die regardless of special care and veterinary bills (personal experience). Most ranchers do not have the equipment or manpower for raising orphan or "bum" lambs. An excess of twins and triplets coupled with poor milk production in some ewes may result in numerous bum lambs that must be grafted to good milking ewes, if any are available, or given to people that will bottle feed them.

Of 1,606 lamb carcasses sexed, 55% (848) were male; male lamb percentages by ranch were 53, 56, and 57.

General management practices are important in preventing deaths among newborn lambs. Sanitation, amount of space in the lambing sheds, interest of shepherds, supplemental feeding of ewes, and other practices have an important bearing on the number of lambs that survive. After pregnant ewes arrive at the home ranch, they are confined to a large feedlot near the lambing sheds. As they give birth or are about to, they are brought into the sheds and kept there with their lambs in small pens for 24 to 72 hours, depending upon the intensity of lambing and the space available. When many ewes are dropping lambs, those in the sheds must move outside to make way for the newborn. If weather conditions are severe, an extra 24 hours of protection in the shed can help lambs through the crucial first few days of life. Sanitation is essential to prevent diseases, and good nutrition is necessary for adequate milk production by the ewes. Shepherds can save numerous lambs by switching them between good and poor milking ewes and by adding a second lamb to a good milking ewe that only had a single lamb.

Table 1. Total lamb-ewe mortality figures, 1973–75.

	Lambs			Ewes		
	Original	Dead or lost		Original	Dead or lost	
Year	no.	No.	%	no.	No.	%
1973	12,836	1,455	11.3	8,750	595	6.8
1974	13,808	2,104	15.2	9,073	528	5.8
1975	3,427	399	11.6	2,203	225	10.1
Totals	30,071	3,958	13.2	20,026	1,348	6.7

Table 2. Lamb mortality during lambing and wintering at home ranches (mid-January through March) 1973–75.

Year	Premature	Past term	Starve	Smother	Disease and misc.	Accident	Unknown	Give away	Totals
1973	131	56	98	69	237	29	118	94	832
1974	246	77	194	59	263	42	322	112	1,315
1975	54	27	28	29	12	11	111	18	290
Totals	431	160	320	157	512	82	551	224	2,437
Percent	18	7	13	6	21	3	23	9	100

Disease, including enterotoxemia, pneumonia, and mastitis, was the leading cause of death among ewes at the home ranches (Table 3). Shearing stress, infection, and birth complications, in that order, were other major death causes. Combinations of disease, stress, and old age sometimes prevented identification of specific causative agents. If older ewes are not culled, more difficulties arise during pregnancy and severe weather, thus, more deaths occur. Inclement weather immediately after shearing can cause severe losses; rough handling during shearing and infections caused by shearing cuts may also cause mortality.

Table 3. Causes of ewe mortality during lambing and wintering at home ranches.

Cause of death	Dead No.	Dead %
Disease	36	33
Shearing stress	17	16
Infection	15	14
Birth complications	13	12
Undetermined	12	11
Accident	10	9
Bloat	5	5
Totals	108	100

Range Losses

Sheep herders and scavenging birds were valuable aids for locating dead lambs and ewes on the range. Conscientious herders knew the location of many predator-killed sheep. Some herders were at the bedgrounds about sunrise so they could start the sheep moving in the correct direction for optimum grazing, thus, they could locate many of the predator kills in the bedground vicinity. In addition, their normal sheep tending duties placed them in likely locations for discovering dead sheep. Turkey vultures (*Cathartes aura*), ravens (*Corvus corax*), and black-billed magpies (*Pica pica*) feeding on and circling carcasses enabled the searchers to locate sheep that otherwise might have been missed.

Confirmed lamb losses on the range increased by 0.5% from 1973 to 1974 and then decreased by over 2.0% during 1975 (Table 4). The minimum predation (verified predation) and other death categories accounted for the increase, possibly because of a larger and more experienced crew of searchers during 1974. Diligence and experience are important factors in finding predator-killed sheep on rangelands.

McAdoo (1975) reported 6.0% post-docking predator-caused lamb loss in a Nevada range flock; Davenport et al. (1973) found a 0.9% lamb loss to predation in some Utah herded flocks; and Nesse (1973), working in California, found a 1.88% lamb predation rate in 1972 and 0.85% loss in 1973. Confirmed lamb predation losses in the present study ranged between 1 and 2% during each of the 3 years and represented from 26 to 84 lambs lost to individual ranchers per year.

The verified minimum predation figures plus the unaccounted for losses equal the possible maximum predation rate. This figure is the top predation limit because all other lambs are accounted for. These figures for 1973, 1974, and 1975 were 4.4, 4.6, and 1.5%, respectively.

The "true" predation rate is somewhere between the minimum and maximum figures and depends upon the number of unaccounted for losses which were killed by predators. The best approximation of the true rate may be calculated by determining the percentage of predator kills among lambs that were found and apply this percentage of predation to the unaccounted for losses. Accordingly, of 690 lambs found, 386 (56.0%) were verified predator kills, thus 56.0% (423) of 755 unaccounted for losses added to the minimum figure would provide a revised number of 809 predator-killed lambs. The average yearly lamb predation would then be an adjusted 2.9% instead of the minimum 1.4 or maximum 4.4%. On an adjusted basis, lamb predation percentages would increase from 1.2 to 3.1 in 1973, from 1.7 to 3.3 in 1974, and from 1.2 to 1.3 in 1975.

Davenport et al. (1973), working in Utah, thought that verified predator loss figures were a good representation of actual or total predator losses. They stated, "Thorough searches of the 'predation' pastures usually resulted in the discovery of all of the lambs killed prior to the search. There is, therefore, good reason to conclude that the verified predator loss (minimum estimate of the actual loss) may in fact encompass a large portion of the actual loss." They felt that the tendency for predator-killed sheep to be found on or near bedgrounds and in open areas resulted in the discovery of most sheep carcasses. This situation was not true in our Idaho study where many predator kills were found in remote areas and areas of dense vegetation. Because of the random location of "other death" and predator-killed sheep carcasses, it seemed likely that causes of unaccounted for losses would be similar to those of discovered losses. Nesse (1973) estimated the number of true predator kills to be about 1.5 times greater than those actually found.

Fifty-two percent of all predator-killed lambs and 53% of all other death lambs were males. During 1973, 45% of other death lambs were males and during 1974, 49% of predator-killed lambs were males.

Although the number of ranches we sampled was small, differences in lamb losses were evident among the three ranchers during 1973 and 1974 (Table 5). Rancher A had the least unaccounted for losses and his adjusted predation percentages were the lowest of the three ranchers, even though the year to year fluctuations were large. Ranchers B and C had higher but

Table 4. Lamb status during the April to August summer range period.

Year	Lambs to summer range	Lambs short at shipping No.	Lambs short at shipping %	Confirmed lamb predation No.	Confirmed lamb predation %	Other deaths No.	Other deaths %	Unaccounted for loss No.	Unaccounted for loss %
1973	11,969	623	5.2	141	1.2	93	0.8	389	3.3
1974	12,417	713	5.7	208	1.7	150	1.2	355	2.9
1975	3,137	109	3.5	37	1.2	61	1.9	11	0.3
Totals	27,523	1,445	5.2	386	1.4	304	1.1	755	2.7

Table 5. Minimum, maximum, and adjusted predation rates on lambs, 1973–75.

Rancher	Year	Predation (%) Minimum	Maximum	Adjusted
A	1973	1.5	2.3	1.9
A	1974	2.7	2.9	2.8
A	1975	1.2	1.5	1.3
B	1973	0.6	6.0	3.8
B	1974	1.2	6.2	3.3
C	1973	1.5	4.3	3.5
C	1974	2.2	4.0	3.2

similar adjusted predation rates during 1973 and 1974 and both had numerous unaccounted for losses.

Ewes were less susceptible to predation than lambs when both were present on the range. However, during 1973 an equal number of predator-killed ewes and lambs were found, so the minimum confirmed predation was 1.6% for ewes and 1.2% for lambs. The adjusted predation percentages were 2.5 and 3.1 for ewes and lambs, respectively; the adjusted rate for lambs was higher because of more unaccounted for lambs than ewes. Even though ewes are on the range and thus available to predators about twice as long as lambs, they still incur a lower predation rate. The confirmed ewe predation corresponded closely with the rates reported by Nesse (1974) at 1.1% and McAdoo (1975) at 1.0%. Ewe losses to predators in 1974 and 1975 decreased to less than one-half of those in 1973 (Table 6). Unaccounted for losses also decreased considerably from 1973 through 1975, but losses to other known causes remained constant for the first 2 years and then increased sharply during 1975. The rigors of the rugged range take their toll on old or sick ewes, especially if forage is inadequate or the weather severe, or both.

Table 7 shows minimum, adjusted, and maximum ewe predation percentages for the study duration. The mean adjusted predation percentage for 3 years was 1.6 for ewes and 2.9 for lambs. Adjusted predation percentages for ewes and lambs, respectively, were 2.5 and 3.1 during 1973, 1.0 and 3.3 during 1974, and 0.8 and 1.3 during 1975. Early et al. (1974) reported that 16% of the 1972–73 Idaho lamb crop died before it could be marketed and that 4% of the total loss was attributed to predation. Early and Roetheli (1974) found the "average" Idaho sheep operation lost 16 dollars per day to predators.

Range Losses by Season

Predation of lambs was greatest during their first 6 weeks on the range. At that time grazing was concentrated on BLM lands, which are flat, rolling, or foothill areas where grass and sagebrush predominate. More coyotes occupy these habitat types than the higher timbered mountain areas that sheep graze after June 1. Few predator-killed lambs were found in March because only two sheep bands in the study group had grazing allotments which opened up that early. These sheep usually were on their allotments only 7–10 days during March. The cumulative, 3-year, confirmed predator lamb kill rose from 12 in March to 78 in April and then doubled again to 159 in May (Fig. 2). Predation declined rapidly through June, July, and August. Some lambs were shipped to market during early July so fewer were exposed to predation in July and August.

Table 7. Minimum, maximum, and adjusted predation rates on ewes, 1973–75.

Year	Predation (%) Minimum	Maximum	Adjusted
1973	1.6	3.7	2.5
1974	0.7	2.0	1.0
1975	0.8	1.1	0.8
Mean	1.1	2.7	1.6

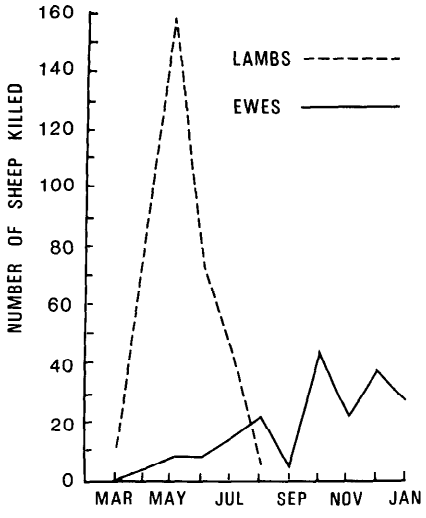

Fig. 2. *Cumulative monthly confirmed predator losses for 1973, 1974, and 1975.*

Lamb deaths on the range from causes other than predation followed the same general trend as predator kills, but the high point was in April (Fig. 3). "Other Cause" mortality declined sharply after the April high. The first month on the range is a hardship for weak, sick, or orphaned lambs. Rosko (1948) also reported high losses to causes other than predation during the first month or two on summer ranges. In this study, disease (27%) and poison plants (25%) accounted for many of the lamb deaths. Other significant categories included accidents (11%), bums (10%), and undetermined (8%). Pneu-

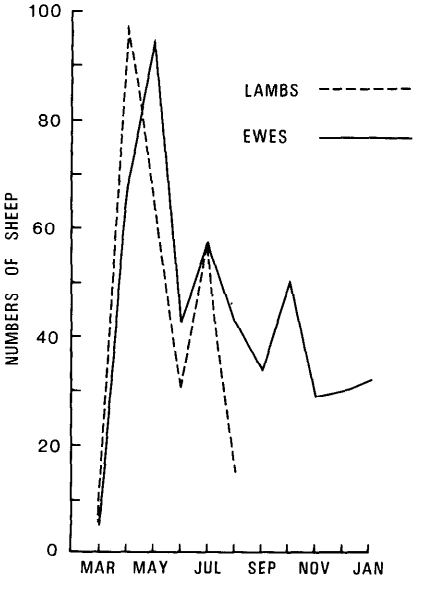

Fig. 3. *Cumulative monthly losés on the range to causes other than predation for 1973, 1974, and 1975.*

Table 6. Ewe status during the 9-month rage grazing period, 1973–75.

Year	No. ewes to summer range	Ewes short on the range No.	%	Ewe predation No.	%	Other deaths No.	%	Unaccounted for loss No.	%
1973	8,664	509	5.9	141	1.6	202	2.3	180	2.1
1974	8,848	375	4.2	64	0.7	197	2.2	114	1.3
1975	2,105	172	8.2	17	0.8	149	7.1	6	0.3
Totals	19,617	1,056	5.4	222	1.1	548	2.8	300	1.5

Fig. 4. *Coyotes did not feed on 25% of the sheep they killed.*

monia and enterotoxemia were the more prevalent diseases.

Predation on ewes did not follow the same pattern as for lambs. Modest predation occurred during the spring and summer when lambs were present; however, late fall and winter losses were severe, especially during 1973 (Fig. 2). Some ewe predation outbreaks coincided with cold weather and snow cover in the mountains when rodents and other small mammals were not readily available to predators. Nesse (1974) also reported that ewes became important prey after the lambs were gone.

Ewe losses to causes other than predation were greater in spring than in fall (Fig. 3). The high point of 94 deaths was in May after relatively high losses in April; June through January losses tended to be downward, fluctuating between 29 and 57 dead sheep per month. Snow, cold weather, reduced grass supplies, and traveling many miles on the trail appeared to be the main causes for hastening the deaths of less robust ewes, thereby holding late fall and winter losses at modestly high levels. Disease (49%) and poison plants (19%) were the leading causes of deaths followed by bloat (11%), ewes dropped from the band (9%), and accidents (6%).

Coyotes, bears, and dogs accounted for 93, 4, and 3%, respectively, of the predator-killed sheep. A cougar and a bobcat each killed one sheep. Lethal wounds were usually found on the neck (82%) and the head (5%). Anterior body wounds were noted on 10% of the sheep and posterior wounds on 3%. Wound descriptions were similar to those reported by Davenport et al. (1973).

The number of sheep killed during one attack ranged from 1 to 16; single kills occurred more frequently than multiple kills. Twenty-five percent of the confirmed predator-killed sheep were not fed upon (Fig. 4). Percentages of carcass consumption by predators and scavengers fit into these categories; one-fourth (19%), one-half (14%), three-fourths (24%), all (13%), and unknown (5%). Greater portions of the sheep carcasses were eaten during the late fall and winter than during other seasons.

Kill sites occurred in the open or sparsely vegetated bedground vicinity (34%), grass-sage (31%), open grass (21%), big sagebrush (8%), and timber (6%). Most kills took place on hillsides and in draw bottoms. Small dead lambs were difficult to locate if they were not on an open bedground area. Many bedgrounds were within 50 m of timber, steep slopes, or tall sagebrush; therefore even bedground-associated kills were sometimes difficult to find. Dead ewes were also difficult to locate in many parts of the rugged summer range.

Certain bands of sheep sustained persistent predation in the same areas from year to year. These areas could be classified as excellent coyote habitat, for they consistently held numerous coyotes as evidenced by sign and sightings by searchers, sheepherders, and Animal Damage Control personnel, and by the numbers of coyotes taken during control efforts. Sheep and coyote interactions were frequent in these areas. The yearly frequency of predation among a single rancher's sheep bands varied from 5 to 45 lambs and appeared to be a function of the habitat type through which the different bands moved. Nesse (1974) also believed that habitat was an important factor in determining the extent of predation on sheep.

Animal damage control was carried out in a normal manner throughout this study. Trapping, calling, and aerial gunning were used on a complaint basis and also for population reduction in areas of severe predation. Cooperative predator control funds (federal, state, county, and private) varied from 60 to 90 cents per adult sheep per year. The ranchers incurred additional predator control expenses for guns, ammunition, scaring devices, corralling of sheep at night, and other items related to protection from predation.

In the absence of control, losses would surely have been greater, but to what degree is not known. Two USFWS-contracted studies provided some data on lamb losses in the absence of predator control. Henne (1975) reported a 29% loss from a Montana ranch and DeLorenzo and Howard (personal communication) found losses to be about 14% per year in a 2-year study on a New Mexico ranch. Various predator control efforts may be evaluated in a more realistic manner when baseline data are available on livestock losses with no predator control.

Conclusions

Predation appeared to be influenced by the type of habitat utilized by individual sheep bands. More predation and unaccounted for losses consistently occurred in areas where topography and vegetation inhibited predator control efforts.

Predation on lambs was most severe in spring during their first 6 weeks on

the range; however, ewes were more susceptible to predation during fall and winter. More lambs than ewes were killed by predators when both age classes were present on the range.

The predation data reported in this study, either confirmed or adjusted, may seem low when considering the percentage of lambs marketed or the lamb loss from causes other than predation; however, if these predator losses are viewed as dollars lost they become significant to the sheep rancher. Ranchers are concerned if predators kill 20 or 120 of their lambs each year even though the loss percentages may be low. When lambs are worth 40 to 60 dollars each, the impact of losses is real and does affect the economics of a sheep operation.

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