

THE LOSTINE ROCKY MOUNTAIN BIGHORN SHEEP DIE-OFF AND DOMESTIC SHEEP

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Abstract: Approximately two-thirds of 100 bighorn sheep (*Ovis canadensis canadensis*) in the Lostine herd (Wallowa Mountains) of northeast Oregon died in 1986-1987. No mature rams and very few lambs survived. *Pasteurella haemolytica* and *Pasteurella multocida* were the suspected causes of disease. Circumstantial evidence linked the die-off to contact with domestic sheep. The history of the herd, its present status, and the die-off are summarized.

During the late autumn and early winter of 1986-1987, the Lostine herd of bighorns (located in the Wallowa Mountains of northeastern Oregon) suffered a major all-age die-off. The objective of this paper is to review that die-off, along with the history of the herd prior to the die-off, and its present status.

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HISTORY OF THE LOSTINE HERD TO 1986

The Lostine Rocky Mountain bighorn herd in northeastern Oregon started in November 1971 with the introduction of 15 ewes and 5 rams from Jasper National Park, Alberta, Canada. Sheep were released at the base of a southwest facing slope in the Lostine River drainage on the north end of the Wallowa Mountains. They wintered on the open grassland slopes above the release site and the following spring moved south along the summit of the Hurricane Divide where they spent the summer. This pattern has continued, with ewes and lambs moving 8 to 16 km (5 to 10 mi) south to spend the summer in the high alpine basins above timberline. The rams used this same summer range until 1980 when many began crossing Hurricane Creek to the Hurwal Divide and moving further south along the Hurricane Divide. Limited ram hunting, which started in 1978, may have been responsible for this expansion of ram range, which continues to this day. Typical of many western big game ranges, the Lostine herd's winter range is very restricted, but the summer range is vast.

Trapping and Transplanting

The Lostine bighorns did well and 63 animals were counted in 1977 (Table 1). Trapping and transplanting was started that winter and continued annually through January 1986. A total of 152 bighorns were trapped and transplanted to 9 different sites (1 in Washington, 3 in Idaho and 5 in Wallowa County, Oregon). Of the Oregon transplants, 31 returned to the Lostine range from distances varying from 11 to 64 km (7 to 40 mi) by air. Four of 5 transplant attempts in Oregon failed and only 15 bighorns remain at the one site. Two of the 3 Idaho transplants appear to be doing well and the Washington transplant (supplemented with bighorns from several other sources) is established and doing well. Twelve bighorns from 2 nearby transplant sites (11 and 14 km, or 7 and 12 mi, by air) also moved to the Lostine range.

Table 1. Composition and numbers of the Lostine bighorn sheep herd, 1972-1988.

| Year | Ewes | Lambs | Rams | Total Classified ^b | Lambs/100 ewes | Rams/100 ewes | Highest winter count |
|-------------------|------|---------|------|-------------------------------|----------------|---------------|----------------------|
| 1972 ^a | 14 | 3 | 3 | 20 | 21 | 21 | 19 |
| 1973 | 13 | 3 | 3 | 19 | 23 | 23 | 19 |
| 1974 | 17 | 8 | 5 | 30 | 47 | 29 | 30 |
| 1975 ^a | 25 | 12 | 10 | 47 | 48 | 47 | 40 |
| 1976 ^a | 26 | 19 | 8 | 53 | 73 | 31 | 53 |
| 1977 ^a | 24 | 19 | 17 | 70 | 79 | 71 | 63 |
| 1978 | | no data | | | | | 78 |
| 1979 | 33 | 23 | 22 | 78 | 70 | 67 | 85 |
| 1980 | 37 | 19 | 30 | 86 | 51 | 81 | 86 |
| 1981 | 55 | 11 | 26 | 92 | 20 | 47 | 92 |
| 1982 | 42 | 16 | 25 | 83 | 38 | 59 | 83 |
| 1983 | 38 | 27 | 28 | 93 | 71 | 74 | 96 |
| 1984 | 46 | 25 | 24 | 95 | 54 | 52 | 95 |
| 1985 | 58 | 19 | 20 | 97 | 33 | 34 | 97 |
| 1986 | 46 | 15 | 26 | 87 | 33 | 57 | 87 |
| 1987 | 19 | 2 | 11 | 33 | 11 | 58 | 33 |
| 1988 | 21 | 2 | 13 | 36 | 10 | 62 | 36 |

^a June-August counts on summer range.

^b January-April counts unless otherwise noted. Highest count by ground or supercub aircraft. Includes bighorns transplanted for herd reduction.

Ram Hunting

Hunting of rams was started in 1978 and continued through 1986. A total of 56 tags were issued and 47 rams were harvested. Five of these rams scored over the minimum for Boone and Crockett Club entry into the record book.

Winter Range Purchased

In 1975, efforts began to purchase the Lostine winter range from private landowners (90% of the range was owned by 2 individuals). Horses were grazed on the range prior to this time (the range was leased by Oregon Department of Fish and Wildlife in 1975). In 1981, 720 acres of the primary bighorn range were purchased and two additional tracts were bought by the ODFW in 1982 and 1984. A total of 388 ha (970 ac) were acquired at a cost of \$397,000 U.S.

Lungworm Treatment

Periodic examinations of bighorn feces indicated low counts of lungworm larvae (Protostrongylus spp.) through 1979. Samples examined by Dr. W.J. Foreyt, Washington State University, in 1981 (personal communication, February 13, 1986) indicated high levels with 5 of 10 bighorns tested having greater than 1,000 larvae/gram of feces. Lamb survival also began to decline in 1980 when 35 lambs per 100 ewes were observed compared to 74 lambs per 100 ewes from 1977-79. Field treatment of the Lostine herd with the drug albendazole (Smith Kline) incorporated in alfalfa-barley pellets began in 1982. Lungworm levels were reduced (Foreyt, et al. 1983) and lamb survival improved dramatically (71 lambs per 100 ewes in 1983). Since then, treatment with albendazole fortified pellets or fenbendazole Safe-Guard protein blocks (Hoechst-Roussel Agri-vet) has been continued annually or at 2-year intervals. In addition, all animals captured and handled were given injectable Ivomec 10 mg/50 Kg [110 lbs] (Ivermectin, MSD-Agvet, Merck & Co., Inc., New Jersey).

Population Levels

The herd has been kept at a relatively stable population level by trapping, transplanting, and limited hunting. Winter counts ranged from 63 in 1977 to a high of 97 in 1985 prior to the 1986-87 die-off (Table 1). These counts reflect a total population of 80 to 100 bighorns on the winter range before trapping and transplanting and after the annual ram harvest. A winter population objective of 80 animals was established and kept at or below that level by trapping and transplanting all except in 1982 when 83 sheep were counted.

The total winter range encompasses 530 ha (1,300 ac), supporting 1 bighorn per 5 ha (12 ac) at peak population density of 100 animals. There is presently no domestic livestock use on the range, but 100 to 150 mule deer (Odocoileus hemionus hemionus) and 25 to 50 Rocky Mountain elk (Cervus elaphus nelsoni) use the range periodically. Wintering bighorn population densities of 1 per 5 ha (12 ac) were reported by Blood (1963) for a herd of California bighorn in British Columbia. Woodgerd (1964) reported that on Wildhorse Island in Montana, a sheep density of 1 per 5 ha (12 ac) of grassland existed. This was on a range used all year on a 10.4 km² (4 mi²) island with an estimated 200 mule deer present. Considering these studies and range condition that appears to be improving, the Lostine winter range does not appear to have been overstocked prior to the die-off.

THE DIE-OFF

Methods

The disease problem began in November 1986 when sick and dead bighorns were reported. Nine sick animals were captured in early December. Blood, nasal swabs, and fecal samples were collected and all animals captured were given Ivermectin at previously mentioned dosage rate (for parasite control) and a long acting antibiotic Liguamycin LA-200 [Pfizer, Agricultural Division, New York, NY) at a dosage rate of 4.5 ml/45 kg (100 lbs)]. The range was closed to all public entry. Daily trips to the winter range were initiated (as the weather permitted) to observe sick bighorns and prebait them with alfalfa pellets. In mid-December, the treatment of bighorns was started with antibiotics and ivomec. The animals were trapped in a corral trap to administer the drugs or given antibiotics via Palmer Cap-chur dart. All animals trapped were eartagged with Alflex numbered tags and individual records of symptoms and treatments received were started. This procedure was continued through March 1987 when weekly visits were initiated and treatment discontinued. Several searches were made during the winter and spring with the assistance of volunteers from sportsmen's groups. Weekly monitoring trips to the winter range were discontinued in early June as most animals had dispersed over the summer range.

Several trips to the summer range were conducted to determine ewe:lamb ratios and to visually monitor general bighorn body condition. Regular trips to the winter range were initiated in December 1987 to determine survival of the Lostine bighorns, post disease lamb survival, and to document additional survivors. Twenty of 36 (56%) of the surviving bighorns were caught and blood, nasal swabs, and fecal samples collected for analysis. Captured animals were dewormed and the few without eartags tagged.

Time of the Outbreak

The disease outbreak may have started in October 1986 on the east side of the Lostine herd's summer range. In early October, a local outfitter (E. Deardorff, personal communication, October 22, 1986) reported seeing 2 bighorn rams and a ewe with a domestic sheep (a ewe) 13 km (8 mi) southeast of this location. The domestic ewe was shot, dressed out, and found to have foot rot and lung adhesions. One of the bighorn rams was identified by its eartag to be from the Lostine herd. In mid-October, a large old ram was found dead by hikers near Ice Lake 16 km (10 mi) northwest of where the domestic-bighorn encounter occurred.

In late November, sick and dead bighorns were reported on the Lostine winter range. A search of the area several days later revealed 5 dead and 1 sick lamb and 13 other live sick bighorns. Four of the 5 lambs were necropsied and lung samples taken to the Washington State University diagnostic laboratory. Three of the 4 were good quality lambs in excellent physical condition. The lungs of all 4 animals were very red and inflamed but other organs looked normal.

The disease appeared to be just starting in late November when the range was surveyed. Bighorns were returning to the winter range, and the rut was in progress. Both of these factors were likely responsible

for the rapid spread of the disease. Deaths of sheep of all ages occurred through December and into early January. No deaths were known to occur after mid-January.

Signs of Disease

Signs of sick bighorn took 2 forms. The most common was an extremely deep cough with a heavy clear nasal discharge. In the worst cases, bighorns quit eating, laid around away from the herd and some died. Most animals with these signs continued to stay near the herd and the coughs gradually improved (little coughing was apparent after January 1987). The nasal discharge continued through the winter with some animals still showing mucous when they left the winter range in May. Many of these animals were treated with antibiotics that appeared to help recovery.

A few bighorns showed only lethargy and moved away from the group. Most of these did not appear to be feeding and also had droopy ears. In nearly all cases, they died fairly quick. Treatment was not administered to most of these animals as we did not realize they had the disease. The few that were treated with antibiotics given with a Cap-chur dart died. All surviving bighorns appeared fully recovered by July 1987.

Domestic Sheep/Bighorn Relationship

Circumstantial evidence indicates the Lostine bighorns contracted Pasteurella pneumonia from domestic sheep. The contact mentioned earlier could have been the source of the disease. The location of carcasses indicate the die-off started in the east and went west to the winter range. Other possible sources of the disease include strays from domestic sheep bands found on ranges in the Eagle Cap Wilderness 3.2 and 9.6 km (2 and 6 mi) west of the Lostine range.

Bailey (1936) reported concern that the few remaining Oregon bighorns might contract diseases from domestic sheep in the Wallowa Mountains. Bighorns were gone from this area by the early 1940's. Max Walker (personal communication, 1987), longtime county resident, reported bighorns once numerous in the Imnaha area (Wallowa County). Early settlers reported that bighorns died out from a "distemper" caught from domestic sheep. In recent times, Foreyt and Jessup (1982), reported on fatal pneumonia in bighorns following association with domestic sheep. Other bighorn deaths in northeast Oregon circumstantially linked with domestic sheep contact have also been reported (Oregon Department of Fish and Wildlife files, V. Coggins typewritten report, July 1984).

Mortality

The Lostine bighorn herd was estimated at 100 animals prior to the die-off. Thirty-four surviving animals including 20 ewes, 2 lambs, and 12 rams, were located after the disease had run its course. Twenty-six dead bighorn including 6 ewes, 9 lambs, 10 rams and one of unknown sex and age, were found. This accounts for 60 bighorns with about 40 missing and presumed dead. Nearly all the dead animals (24 of the 26) were located on the winter range or in a low elevation drainage below their migration

route. All rams over 4 years of age died during the outbreak as did all but 2 lambs. Most surviving ewes were younger (3-6 years old) animals (Table 2).

Table 2. Sex and age of Lostine bighorns surviving the die-off of 1986-87.

| Age | E w e s | | | Lambs | R a m s | | | | Total |
|--------|---------|------|-------|-------|---------|------|------|------|-------|
| | 1 Yr | 2 Yr | 3+ Yr | | 1 Yr | 2 Yr | 3 Yr | 4 yr | |
| Number | 1 | 3 | 17 | 2 | 1 | 5 | 6 | 1 | 36 |

Disease Agents

Bacterial pneumonias, principally Pasteurella haemolytica or P. multocida appeared to be the cause of most bighorn deaths. Both were found in lungs examined at the diagnostic laboratory of Washington State University and were cultured from nasal swabs taken during the outbreak and during the post-disease studies (most of these were P. multocida). Antibodies to parainfluenza-3 (PI₃) and bovine respiratory syncytial virus (BRSV) were also detected in some of the sera. The significance of these two viruses is unknown at this time.

Predisposing Factors

Predisposing factors such as adverse weather, overcrowding, malnutrition and excessive harassment by humans (Feuerstein et al. 1980, Spraker et al. 1984, Thorne 1987) do not appear linked to this die-off. Bighorns were in excellent physical condition, having just returned from the summer range. A fall green-up produced good winter range forage conditions. Overcrowding did not appear to be a factor since population levels had been held relatively stable by hunting and trapping and transplanting since 1978. Also, Lostine bighorns have a very large summer range and are widely scattered at low densities. No change in human use patterns was observed, and fecal lungworm larvae levels were low.

Lamb Survival after the Die-off

Post-disease production of lambs appeared to be good, with 8 lambs located in July 1987 with 13 ewes (1 yearling and 4 two-year olds) or 62 lambs per 100 ewes. In October, some of the same ewes were seen with only 1 lamb and by December when all survivors were located, only 2 lambs (10 per 100 ewes) were with the herd. Both surviving lambs were much smaller than normal, but no coughing or nasal discharge were noted. Pasteurella spp. was not detected in nasal swabs and there were no titers to PI₃ and BRSV. Nasal swabs taken from adults indicate 72% of the bighorns sampled (13 of 18) were Pasteurella multocida carriers. This Pasteurella organism may have been responsible for the high lamb mortality in summer. Pasteurella haemolytica was detected in only one sample.

MANAGEMENT IMPLICATIONS

The most important lesson learned from this study is to keep bighorns away from domestic sheep. Although hard cause-effect data relating disease in bighorns to presence of domestic sheep are lacking, it is believed Pasteurella spp. transmitted from domestic sheep was responsible for this die-off. Where separation of the two is not possible, serious disease problems can be expected as has been reported by other observers. Bighorns should not be reintroduced to ranges where contact with domestic sheep is likely.

Field treatment results were not included in this paper, but antibiotics administered to sick animals appeared to have saved many Lostine bighorns. While antibiotics were given by injection, specially formulated antibiotics in alfalfa pellets, protein blocks, or in other food sources would probably have worked better. This would have resulted in earlier treatment with less stress to the sheep and capture of most of the herd would not have been necessary. Sick animals not able to come to the trap would have had access to antibiotics.

It is also recommended that an emergency treatment procedure be established to deal with bighorn disease outbreaks in accessible herds. It is believed that had treatment with antibiotics started when the disease was first detected, many additional animals could have been saved.

Lamb survival studies and disease surveillance are planned to continue for the next two years or until lamb survival returns to normal.

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