

Reproduction of Rocky Mountain Bighorn Sheep (*Ovis c. canadensis*) in Washington: Birth Dates, Yearling Ram Reproduction and Neonatal Diseases

Abstract

Rocky Mountain bighorn sheep (*Ovis c. canadensis*) inhabited Washington state until the mid 1930's when all wild bighorn sheep became extinct. Re-introduction began in 1972, but basic comparative data are lacking on their reproductive success and diseases affecting survival. Birth dates of *O. c. canadensis* were determined from lambs of ewes bred in the wild in northeastern Washington and from lambs of ewes bred in captivity. Six lambs from ewes bred in the wild were born during 19 May-3 June, 1986. Ten lambs from ewes bred in captivity were born during 19 May-24 June, 1987. A yearling ram sired at least five of ten lambs in captivity. Birth weights of 15 newborn lambs averaged 4.9 kg (range, 3.1 kg - 5.9 kg).

During the second year, four of ten lambs, including the last three born, died within six days after birth. Septicemia due to *Escherichia coli* caused the deaths. Accumulation of bacteria in the sheep enclosure following the initial births may have contributed to the deaths. These data indicate potential disease problems in neonatal lambs, as well as newborn lamb weights and lambing dates in Washington.

Introduction

Rocky Mountain bighorn sheep (*Ovis c. canadensis*), were extirpated from Washington state by about 1935 (Buechner 1960, Johnson 1983). The loss is attributed largely to diseases and habitat loss due to domestic livestock grazing within bighorn range. It has been speculated that bacteria commonly carried by domestic sheep are transmitted to bighorns and cause acute mortality from bacterial invasion of the lungs when the two species have close contact (Foreyt and Jessup 1982). Rocky Mountain bighorn sheep were re-introduced to northeastern Washington in 1972 when 18 sheep from Alberta, Canada, were transplanted to Hall Mountain in Pend Oreille County. Subsequently, sheep have been transplanted to other areas of the state from the increasing population at Hall Mountain (Johnson 1983). Lambing dates and breeding synchrony for bighorn sheep in Washington have not been reported.

The purpose of this paper is to report lambing dates of *O. c. canadensis* in Washington, the potential for yearling ram breeding, and the neonatal mortality of lambs born in captivity.

Methods

Twelve bighorn sheep, 11 ewes and one ram-lamb were captured in a corral trap from the herd at Hall Mountain (48°50'N, 117°15'W, altitude

1867m) on 19 December, 1985. Ewes in this group were between 0.5 and 8.5 years of age (mean 3.6). Seven of the ewes were two years or older and were considered to be pregnant based on their age and the date of capture. All the sheep were tagged with large, numbered colored ear markers, and they were transported by truck to a 2-ha enclosure on the Washington State University campus, Pullman, Washington (46°44'N, 117°11'W, altitude 765m). The sheep were maintained as a breeding herd and were handled only for routine preventative medicine procedures.

The pen had 2.5-m high chain link fencing and contained a 5m x 3m covered shelter that was open on three sides. Mineralized salt, alfalfa hay, and a pelleted feed (alfalfa—69%, barley—31%) were available at all times.

Ewes were observed daily and their lambing dates were recorded in 1986 (Year 1) and 1987 (Year 2). On the day of birth, the lambs were ear-tagged, and sex and weights were determined. Ewes in year 1 of the study were bred in the wild at Hall Mountain prior to capture. Ewes in year 2 were bred in captivity by one of two rams: a yearling ram, which was the lone male in the enclosure from the initial transport until 21 December 1986; and a mature ram, which was captured at Hall Mountain on 22 December, 1986 and placed in the enclosure that day. To determine which ram sired each lamb, approximate breeding dates were established by subtracting

the gestation period of 170-180 days (Johnson 1983) from the date of birth. If the extrapolated breeding date was on or before 21 December, it was inferred that the yearling had sired the lamb.

In year 2, lambs were weighed and ear-tagged on their days of birth. Each newborn lamb was given 1 ml Bo-Se (vitamin E and selenium) intramuscularly and the navel was dipped in iodine. Lambs that died were submitted to the Washington Animal Disease Diagnostic Laboratory (WADDL), Pullman, Washington, for necropsy.

Results

Six lambs were born in year 1 between 19 May and 3 June, a 16-day period (Table 1). Lamb 1 died of pneumonia two days after birth; the others remained healthy. Ten lambs were born in year 2 between 31 May and 24 June, a 23-day period (Table 2). Four lambs died within six days after birth; the others remained healthy. Birth weights of 15 newborn lambs averaged 4.9 kg (range 3.1-5.9).

TABLE 1. Birth dates, sexes and weights (taken within 24 hours of birth) of lambs born in year 1 (1986) from ewes that were bred in the wild.

Lamb No.	Date lambled	Sex	Weight (kg)
1.	May 19	M	unknown
2.	May 21	M	5.0
3.	May 28	F	5.0
4.	May 28	F	5.0
5.	May 31	F	5.1
6.	June 3	F	5.0

TABLE 2. Birth dates, sexes and weights (taken within 24 hours of birth) of lambs born in year 2 (1987) from ewes that bred in captivity.

Lamb No.	Date lambled	No. of Days from Dec. 22 to birth	Sex	Weight (kg)	Date of Death
1.	May 31	161	F	5.1	----
2.	May 31	161	F	5.2	----
3.	May 31	161	M	5.9	----
4.	June 1	162	F	4.3	----
5.	June 8	169	M	5.2	June 14
6.	June 11	172	M	4.6	----
7.	June 11	172	M	5.7	----
8.	June 15	176	M	3.1	June 18
9.	June 18	179	M	4.9	June 23
10.	June 24	185	F	4.8	June 25

Mature ram was placed with ewes on 22 December, 1986. Normal gestation is 170-180 days.

The four dead lambs from year 2 (lambs 5, 8, 9, and 10) were submitted to WADDL for necropsy. Their average weight, 4.5 kg, did not differ significantly (t test, $P > 0.05$) from the average for surviving lambs, 5.1 kg (Table 2). All were healthy and vigorous at birth but, within 24-48 hours, the four became lethargic, weak, began losing weight, developed diarrhea and became dehydrated. At necropsy the bacterium *Escherichia coli* was isolated from the intestine of all four lambs, and from the lungs of lambs 5 and 8. In addition, lamb 5 had severe lymphocytic depletion, low selenium levels, and *Klebsiella* spp. was recovered from the lungs. Infectious bovine rhinotracheitis virus (IBR) was isolated from feces of lamb 8. Approximately two hours prior to death, lamb 8 was treated with an oral electrolyte and glucose solution. There was no response to the treatment. Lamb 9 had marginal selenium blood levels when compared to domestic sheep and was positive for *E. coli* F41 pilus antigen from the intestine. This lamb was treated with gentocin, banamine, penicillin and oral electrolytes one day before death, but there was no positive change in condition. *Pasteurella haemolytica* was isolated from the lungs of lamb 10, but gross or microscopic lung lesions did not indicate active infection.

The yearling ram sired at least five lambs, the mature ram at least one (Table 2). Lambs 1 through 5 were sired by the yearling ram, while lamb 10 was sired by the mature ram. Four lambs, lambs 6, 7, 8, and 9, could have been sired by either ram since the gestation period overlaps the time both rams were with the ewes.

Discussion

Lambs born in year 1 from ewes bred in the wild provided valid birth dates for bighorns in north-eastern Washington in 1986. Lambing dates recorded for both years appear to be late for this region, particularly the year 2 lambs. In year 2, this may have been due to the inexperience or lack of aggression of the yearling ram. In Washington, most lambs are born in early May, with the peak of lambing about May 5 (Johnson 1983). In southern British Columbia, California bighorns lamb between late April and mid-June (Geist 1971). Thorne *et al.* (1979) found that peak lambing periods of Rocky Mountain bighorn sheep in Wyoming may vary from year-to-year

within herds and between herds in one year. The lambing period of Rocky Mountain bighorns generally spans about seven weeks (Johnson 1983, Geist 1971), and is generally later and shorter in higher latitudes and elevations (Thompson and Turner 1982). The lambing period for year 1 in this study was slightly more than two weeks ($n=6$) and for year 2 was just over three weeks ($n=10$).

Birth weights of 15 newborn lambs ranged from 3.1 kg to 5.9 kg, ($x=4.9$ kg) ($n=15$). This is compatible with other reported captive bighorn lamb birth weights which ranged from 2.8 to 5.5 kg (Bunnell 1982, $n=17$). Geist (1971) surmised that 5.0 - 5.5 kg would be the maximum birth weight for bighorn sheep. Eight lambs from this study fell within this range and two exceeded the upper limit.

Potential problems with survival of captive bighorn lambs is illustrated in year 2. Four of ten lambs born that year died soon after birth. All ten lambs appeared equally healthy and active at birth. Bacterial accumulation in the enclosure may have contributed to the deaths by overwhelming the passive immunity of the lambs. The bacterium *E. coli* was isolated from all dead lambs, and bacterial septicemia was the major factor in the deaths. Colibacillosis, caused by *E. coli*, is a major cause of death in calves and domestic lambs under ten days of age (Blood *et al.* 1983). This disease is especially common on farms where crowded calving or lambing occurs. One of the lambs also was positive for IBR virus. (IBR is a herpes virus generally found in cattle and known to cause abortions.) Apparently this is a first report of IBR in bighorn sheep. The significance of IBR in bighorns is unknown, but did not appear to be responsible for illness or death in the lamb.

To prevent neonatal mortality associated with bacterial infection in captive bighorn lambs, I recommend larger pens for captive ewes during the lambing period which would allow for some

degree of isolation of lambs from feces, or placing fewer ewes in each pen to reduce fecal contamination. Possibly treating newborn lambs with plasma, known to contain high levels of immunoglobulins, immediately following birth would deter bacterial invasion. Free-ranging bighorn ewes usually select remote areas away from the rest of the herd prior to lambing and appear with their lamb a few days to several weeks later (Geist 1971). Lamb mortality due to septicemia in free-ranging bighorns has not been reported.

A mean gestation period of captive bighorns was 174.2 ± 1.7 (SD) days (Shackleton *et al.* 1984). Geist (1971) concluded that North American mountain sheep have gestation periods of about 175 days. Based upon the data from year 2 lambing dates, the yearling ram sired five lambs born in 1987, and possibly as many as seven. This indicates that yearling rams are capable of successful breeding. Bighorn rams attain sexual maturity at about 18 months (Geist 1971, Blunt *et al.* 1977), yet normally do not successfully breed until much later (Geist 1971). In free-ranging bighorns or captive herds in which a mature ram is present, yearling rams seldom have an opportunity to breed because mature rams aggressively ward off breeding attempts of subordinate rams. In this study the yearling ram should have had ample time and opportunity to breed all 10 ewes by the removal date. It is possible that the ewes rejected the advances of this young ram, or it may be that he lacked the sexual aggressiveness that older rams demonstrate. However, transplants of yearling rams into new areas or into herds with an over-abundance of ewes can result in successful breeding. This may be important in transport situations where older rams are difficult to obtain, are considered too dangerous or physically too large to transport, or may wander far from ewes after transplantation but before breeding.

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