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HORN ABERRATIONS IN DALL'S SHEEP *(OVIS DALLI)* FROM YUKON TERRITORY, CANADA[1]

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Abstract: Horn aberrations in Dall's sheep from the Kluane Lake area of Yukon Territory were of two basic types. In the more prevalent type, the horn was severed at an annual growth check and the terminal segment of the remaining portion formed a short conical protuberance. The second type had characteristics of the first, but in addition, underwent extreme twisting or torquing during subsequent growth. Sheep with aberrant horns represented 2% of the Kluane Lake population or 14% of harvestable rams (≥6 yr old). Deformed horns, occurring in ewes and rams, were generally observed in animals 6 yr or older. Aberrations followed necrosis of the terminal segment of the horn core: cavitation of the sheath between successive periods of growth or the sequestering of portions of necrotic core within the sheath resulted. All sheep examined (eight) had a normal complement of 54 chromosomes.

INTRODUCTION

Sporadic sightings in the Kluane Lake area of southwestern Yukon Territory of Dall's sheep rams with malformed and broken horns were first brought to the attention of the Yukon Wildlife Branch in the early 1960's (Hoefs, 1980). As hunting pressure in that area increased, more rams with horn aberrations were reported. This led to an investigation into the cause and prevalence of the horn aberration by the Yukon Wildlife Branch in 1977 (Hoefs, 1980). Two rams with aberrant horns were collected during that year. An additional four rams with malformed horns were collected during an extensive survey of over 1,000 sheep in 1979 (Hoefs, 1980). Six more rams with deformed horns were harvested by hunters and were examined by biologists of the Yukon Wildlife Branch (Hoefs, 1980). Anatomical measurements and other descriptive data were determined for these 12 specimens. A preliminary report on the findings, and the frequency and distribution of affected sheep were presented at the Northern Wild Sheep and Goat Conference (Hoefs, 1980). After these initial investigations, three hypotheses were proposed: (1) sheep in the Kluane Lake area were especially prone to accidents that resulted in broken horns and/or aberrant growth; (2) horn deformities were caused by a disease, and (3) a genetic defect contributed to the deformed horns.

One ewe and seven rams with aberrant horns were collected from the same population during July of 1980 to facilitate further investigation of the deformed horns and to test the validity of the proposed hypotheses.

MATERIALS AND METHODS

One ewe and seven rams with horn aberrations were collected in the Ruby Range of the Kluane Lake area in south-

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western Yukon following a helicopter survey of approximately 1,300 sheep. Three additional sheep were observed with deformed horns, but were not available for examination. Each sheep was shot from a helicopter and blood samples were taken before the animal was transported to the base camp. The horns were described, sagitally sectioned and photographed. Chromosome preparations were established from 72-hr leucocyte cultures following the technique of Moorhead et al. (1960). Table 1 was constructed from a compilation of data from this study and on additional Dall's sheep from southwestern Yukon sampled by the Yukon Wildlife Branch.

RESULTS

Two patterns characterized the horn aberrations (Fig. 1). More commonly, a portion of the horn broke at an annual growth check, leaving the remaining segment as a short conical protuberance. In the second type, a portion of the horn was also missing at a growth check; the remaining horn segment had undergone aberrant growth, resulting in extreme torquing of the horn. Horns of this type

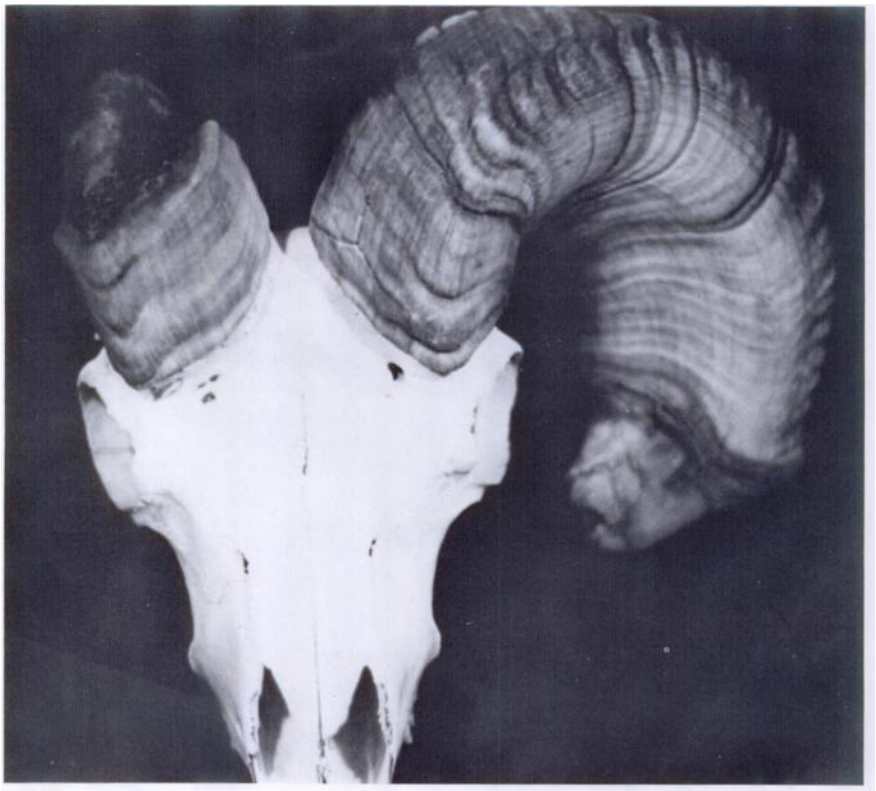

FIGURE 1. Skull of ram with both types of horn aberrations showing severance of the right horn which has resulted in a short segment with a smooth conical protuberance. The left horn has the terminal end severed and has undergone extreme torquing.

often grew into the animal's eye, maxilla, nasal bone or mandible.

The observed horn aberrations were in sheep ranging from 6-14 yr of age, with the exception of a 2-yr-old ram. The ewe collected in this study was estimated to be 10-11 yr old.

Horns of affected rams grew at a significantly slower rate than those of normal rams, even when the affected ram had what appeared to be one normal horn. Normal horns in 9-yr-old rams were 92.10 cm (Standard Error ±0.08) long whereas in affected rams the normal appearing horn was 75.80 cm (S.E. ±3.5). Growth differentials occurred during each of the nine annual growth increments, with the greater differences occurring within the first 2 to 5 yr of growth (Table 1). Horn differential growth was also noted between the normal appearing and the aberrant horn of an affected ram (Table 1). Annual growth increment rates during years 3 to 8 were slightly less in the aberrant horn. Cross sections of affected horns in the eight sheep sampled in this study revealed that the distinct and typical keel of a normal horn was altered to either an oval or elongated ellipse. Additional deformities of the skull adjacent to the base of the horn were associated with these aberrant patterns. A sagittal section of one normal-appearing horn of an affected ram revealed that approximately 1/3 of the upper portion of the horn core had become necrotic and was separated from the living core by 4 mm of connective tissue (Fig. 2). All other normal-appearing horns of affected sheep evidenced cavities between adjacent annual growth segments (Fig. 3). In four of the aberrant horns, remnants of horn core were observed sequestered within

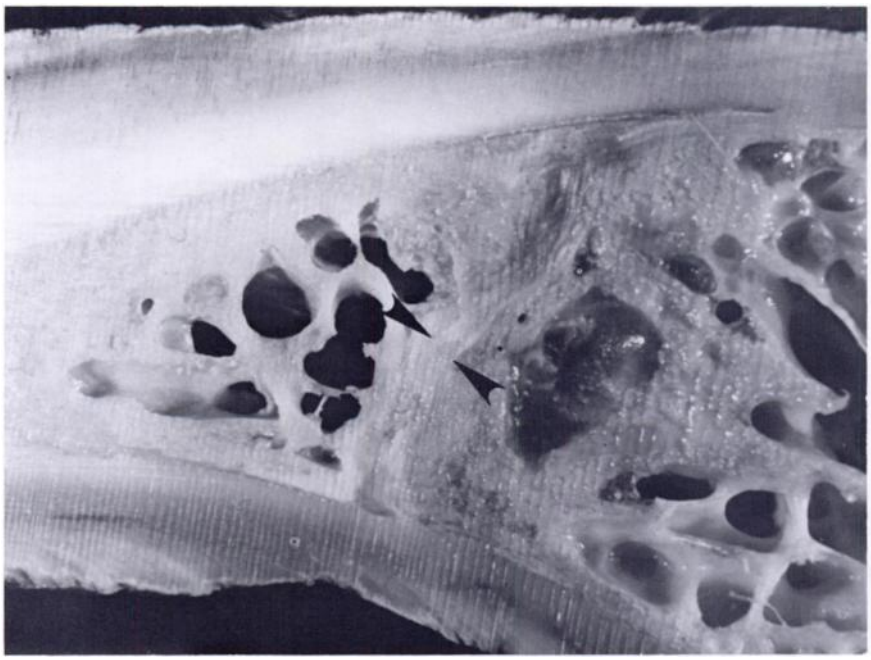

FIGURE 2. Upper 1/3 of core was necrotic and separated from the living tissue by a 4 mm layer of connective tissue (arrows).

TABLE 1. Annual horn growth increments (mm) of Dall's sheep rams with normal and abnormal horns.

No. of rams	Expressing anomaly	Abnormal horn[a]	Annual Increments (mean ± S.E.)								
			1	2	3	4	5	6	7	8	9
10	+	+	—[b]	—[c]	81.00 ±1.00	103.00 ±18.56	90.11 ±8.66	76.36 ±7.40	53.60 ±5.80	39.56 ±5.44	30.89 ±2.98
7	+	-	—	159.50 ±28.50	158.40 ±12.59	117.43 ±7.77	100.00 ±9.22	82.00 ±5.16	70.67 ±6.05	45.83 ±3.15	29.67 ±2.99
10	-	-	—	176.60 ±13.62	170.10 ±7.94	144.10 ±6.11	116.50 ±6.59	97.40 ±9.95	71.80 ±4.44	51.40 ±4.59	42.29 ±4.94

[a] Abnormal horn is horn that is severed at a growth ring.

[b] First year annual increment was not included because of variation in wear of the horn tip.

[c] Not all 10 sheep are represented in each annual increment because abnormal horns had segments missing at different years. For each increment the number of horns measured were increment 3, 2 horns; 4, 6; 5, 9; 6, 11; 7, 12; 8, 9, and 9, 9. Three affected rams had two abnormal horns and they were included within this group.

FIGURE 3. Necrosis of the extreme tip of the horn core often resulted in cavitation between the interface of adjacent segments of the sheath (arrows).

the sheath. Aberrant growth patterns of the sheath followed the irregularities of the affected horn core (Figs. 4 & 5). A thickening of the lateral surface of sheath occurred when the adjacent region of the core was affected (Fig. 6).

Necrosis of the mandible and disruption of the tooth arcade was observed in five of the eight rams and in the ewe. Aberrations of the tooth arcade consisted of loosened, displaced and missing teeth with excessive protrusion and uneven abrasion. Some of the mandibles evidenced various degrees of focal necrosis.

The affected Dall's sheep had a normal diploid chromosome number of 54 and a karyotype with three pairs of biarmed and 23 pairs of acrocentric autosomes, and one pair of sex chromosomes.

DISCUSSION

The Dall's sheep population in the Kluane Lake area is estimated to be 1,300. The prevalence of the horn defor-

FIGURE 4. The core of the aberrant horn (right) of this 2-yr-old ram was enlarged and no longer displayed the conical pattern of a normal horn core tip (left).

mation is 2% of this population, or 14% when only the mature (≥6 yr) ram segment is considered (Hoefs et al., 1980). The prevalence in ewes cannot be assessed since their horn status is difficult to identify during aerial surveys. Of two ewes with aberrant horns identified during the 1980 study, one was examined. Both ewes were in small groups and neither had a lamb with her. During July, 1979 a nursery band of 60 ewes was observed and three were identified as having horn aberrations (Hoefs, 1980). The prevalence in ewes therefore may be similar to that of rams.

Although the highest prevalence of horn aberrations was observed northeast of Kluane Lake, sheep in other areas of southwestern Yukon Territory have been sighted with deformed horns. Reports of sheep with broken or malformed horns from outfitters and hunters have been documented by the Yukon Wildlife Branch (Hoefs, 1980). Sightings have been reported from Tin Cup Lake, Coast Mountains, Kluane National Park, Duke River and the Klukshu River drainages. No documentation has been obtained that these horn aberrations are the same as reported in this study. Similar observations of animals with deformed horns have been reported in populations of Stone's sheep *(O. dalli stonei)* from northern British Columbia by outfitters.

The horn aberration is predisposed by a portion of the horn core becoming necrotic. The necrosis is followed by cavitation of the interface between annual growth segments of the sheath or sequestering of necrotic segments of the boney core within the sheath. As the affected horn continues to grow, the weakened sheath becomes vulnerable to

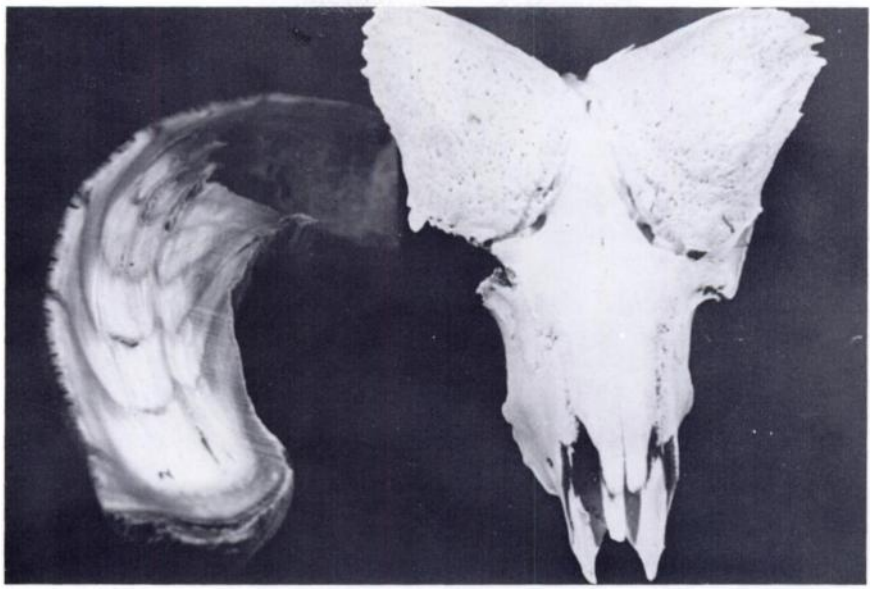

FIGURE 5. Sagittal section of an aberrant horn demarks 5 yr of growth following initial necrosis of the terminal portion of the core. The abnormal pattern was permanently characterized within the sheath.

FIGURE 6. Necrosis of the horn core was often followed by an abnormal enlargement of the wall of the sheath. Enlargement only on one side may contribute to the torquing of the horn.

breakage. When rams become serious contenders (≥6 yr of age) in the rut and engage in frequent head clashes, the horn breaks away. Consequently, rams with noticeable horn aberrations are usually 6 yr of age or older. The encapsulation of part of the core causes radical changes in the direction of normal horn curvature and torquing at 90° angles. Excessive growth of the sheath along the lateral side of the core also causes abnormal torquing of the horn. In the more extreme cases of horn aberrations, the horn tip grows back into the head causing localized infections or, in some cases, blindness as the horn comes in contact with the eye.

Factors contributing to horn aberrations affect the rate of growth of horn. This growth differential was evident when comparing what appeared to be a normal horn of an affected ram to horns of nonaffected rams. The growth rate was retarded in affected rams. Structural defects that result in the severance or extreme twisting of one horn of an affected ram generally occur in the intact horn, but to a lesser degree.

The primary cause contributing to the horn aberration could not be determined. Aberrations of the tooth arcade and focal osteolysis of the mandible do not appear to be related to the horn aberration. These tooth anomalies have a high prevalence in many populations of Dall's sheep (Murie, 1944; Neiland, 1972; Hoefs and Cowan, 1979), whereas the horn aberration has been reported in a relatively few populations (Hoefs, 1980). The Dall's sheep in the Kluane Lake area do not appear to be any more accident prone than populations of Dall's sheep in other areas of the Yukon and Alaska. The necrosis of the horn core may be of genetic origin, although this conclusion could not be substantiated by chromosome analysis.

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