Bienn. Symp. North. Wild Sheep
and Goat Counc. 3: 188-197

DISEASE SURVEYS IN DALL SHEEP IN ALASKA
(preparing for domestic grazing)

Wayne E. Heimer, Alaska Department of Fish and Game, Fairbanks, AK

Randall L. Zarnke, Alaska Department of Fish and Game, Fairbanks, AK

Diane J. Preston, Alaska Department of Fish and Game, Fairbanks, AK

ABSTRACT

Agricultural development in Alaska will likely involve an expanded red meat industry. History has shown that mountain sheep in the western United States do not interact favorably with domestic grazers. One major problem for native sheep may be transmission of diseases from domestic livestock. In anticipation of expanded domestic grazing, and in an effort to minimize the potential for disease transmission to native Dall sheep (Ovis dalli), a serologic survey for diseases of Dall sheep has been conducted for several years. Dall sheep sera were tested for evidence of previous exposure to Anaplasma spp., Brucella spp., Toxoplasma spp., Leptospira spp., Campylobacter fetus, bovine viral diarrhea, bluetongue, contagious ecthyma, ovine progressive pneumonia, parainfluenza, and infectious bovine rhinotracheitis. Tests revealed serum antibody to Campylobacter fetus in 22 (30%) of 73, Brucella spp. in 3 (3%) of 90, contagious ecthyma virus in 24 (25%) of 96, and parainfluenza III virus in 1 (1%) of 73 Dall sheep sampled. Lumpy-jaw data were also gathered.

INTRODUCTION

Small-scale agriculture has been present in Alaska since the days of Russian settlement. The United States purchased Alaska in 1867, and government surveys in the late 1890's implied that food production would be possible in Alaska (USDA 1898). Agricultural stations were first establisned in the early 1900's, and during the next 50 years, various efforts were made at commercial agriculture with limited success and with little environmental consequence. A brief surge of agricultural production occurred in the 1950's and 1960's but proved to be generally unprofitable due to comparatively inexpensive transportation costs of imported food and intensive marketing efforts by out-of-state producers. Still, agriculturists, particularly those employed by govenment agencies, never abandoned the idea of Alaska as an agricultural state. These agencies encouraged gardening and carried out research on plant varieties adapted to

Alaska. They showed that vegetable crops were viable and suggested that some seed crops could be profitable in Alaska if given sufficient agricultural infrastracture and large-scale development.

During the mid-1970's, the political and economic climate changed (though little change was noted in the physical climate), and, suddenly, agriculture took on a new importance. Alaska began receiving substantial oil revenues, and projects formerly unthinkable (such as major agricultural development) became candidates for investment of the State's new-found wealth. Agricultural economists, agronomists, and marketing consultants vigorously promoted agriculture (Alaska Rural Development Council 1974). During the renewed advocacy phase, Alaskans were made painfully aware that they were not self-sufficient for food and that the food supply line was long and potentially fragile. The spectre of world hunger was raised and it suddenly seemed important for Alaska to produce food for itself and the world. Agriculturists also asserted that an agricultural industry would ensure an economic future based on renewable resources rather than oil and mineral agricultural developments.

In 1978, the State disposed of 60,000 acres (243 km^2) (principally Class II and Class III soils) which were to be rapidly cleared and put into production of barley, a small grain with a short growing season. So far, production and quality of barley have been much lower than anticipated, the infrastructure necessary to export crops has been slow to develop, and the State has made an extensive investment in very expensive, energy- and capital-intensive farmsteads. In addition, the State has made political promises to continue agricultural development.

Agriculturists now suggest that the best use of this low-quality barley is not the export market, as originally planned, but production of domestic red meat within Alaska. Applications for grazing leases on State land are becoming commonplace. One lease was recently issued for an area 3 miles (5 km) north of Dall sheep habitat which lies within Denali (formerly Mount McKinley) National Park.

Experience shows that wild sheep do not cope well with diseases which are routinely carried by domestic grazers. Recent literature indicates domestic sheep which appear to be healthy can in fact be carriers of diseases which can cause die-offs in wild sheep populations which they contact (Jessup 1981, Foreyt and Jessup 1982, also see Goodson's paper in this proceeding). As the red meat industry expands in Alaska, it seems inevitable that some Dall sheep habitat will be grazed by domestic livestock. Fortunately, the Alaska Department of Fish and Game (ADF&G) has the mandated opportunity to comment on grazing lease applications on State land. In the past, ADF&G has relied heavily on information from other locations for data regarding the potential threat posed by domestic species as carriers of diseases which may be transmitted to wildlife. We realize the limitations of this approach and seek to provide more well-informed comments on these potential threats to wildlife in general and, particularly, Dall sheep. Therefore, we have begun disease (primarily serologic) surveys. The purpose of this paper is to share preliminary results of these studies and solicit advice from others in the field regarding disease surveys.

METHODS

Dall sheep were captured at two naturally occurring mineral licks in the Alaska Range using methods described previously (Heimer et al. 1980). One mineral lick serves a low-quality (Geist 1971) population of sheep near Dry Creek, south of Fairbanks. The other serves a high-quality group of sheep near Tok, Alaska about 320 km to the east. Population characteristics for these two groups of sheep have been reported by Heimer (1978).

Sheep were bled and examined for overt signs of disease. Mandibles were palpated to determine whether lumpy-jaw was present. Biopsy specimens were collected from active lumpy-jaw lesions. Bacterial and fungal isolations were attempted on these biopsy specimens.

Blood samples were allowed to clot at ambient temperature; serum was collected by aspiration after 12 to 18 hours. Serum was kept cool by packing it in snow or storage in a cool spring before transport to Fairbanks where it was frozen and stored until analysis. When timely transport (2 to 5 days) was not possible, sera were stored in liquid nitrogen until they could be transferred to mechanical freezers in Fairbanks. Samples from the Tok capture site were analyzed at the Washington State Diagnostic Laboratory, Washington State University, Pullman, WA. Sera from the Dry Creek site were tested at the National Veterinary Services Laboratory, Ames, Iowa.

RESULTS

Results of the serologic tests performed on samples from the Tok, Alaska area (from Smith et al. 1982) show antibody titers to C. fetus, contagious ecthyma (CE) virus, Brucella spp., and parainfluenza III (PI III) virus (Table 1). Results of serologic tests performed on samples collected at the Dry Creek site showed antibody titers to Brucella, PI III, bovine viral diarrhea (BVD), infectious bovine rhinotrachetitis (IBR), and Liptospira spp. Prevalence of lumpy-jaw lesions from the present study and comparsions with data from past studies are presented in Table 3.

DISCUSSION

We shall briefly discuss those agents which were indicated to be present by serologic titers. Based on the results in Table 1, there is no evidence of exposure of the Tok area Dall sheep populations to Anaplasma spp., Leptospira spp., Toxoplasma spp., bovine viral diarrhea virus, bluetongue virus, infectious bovine rhinotracheitis virus, or ovine progressive virus.

Campylobacter fetus is the causative agent of the disease known as vibriosis which can cause abortion in domestic sheep. The prevalence reported here indicates that the disease is common in the Sheep Creek population. This is the first reported evidence of C. fetus infection in

Dall sheep (Smith et al. 1982). There have been no observations of widespread abortion in this population. The specificity of this test is sufficiently suspect that we doubt the presence of vibriosis in this population (Andrews and Frank 1974).

Thirty-five percent of 73 sheep sampled near Tok had serologic evidence of past exposure of contagious ecthyma (CE). Sixteen (70%) of 23 specimens from two earlier collections of Dry Creek also had serologic evidence of past infection. In addition, an active case of CE was documented in a ewe trapped near Tok in 1979 (Smith and Heimer 1982). This disease has also been diagnosed in captive Dall sheep and captive muskoxen (Dieterich et al. 1981). The disease has also been reported in bighorn sheep and mountain goats from the western U.S. and Canadian provinces (Carr 1968, Samuel et al. 1975, Lance et al. 1981). The prevalence reported here (Table 1) and other evidence of CE in Alaska suggests exposure to the agent is quite common. However, the disease does not appear to pose a major threat to Alaskan sheep populations as a whole. Both populations studied have lamb productions which approach 70 lambs/100 ewes (weather permitting), and survival to yearling age is considered normal (at about 55%) for Alaskan Dall sheep. The source of the virus is uncertain, but it is possible that Dall sheep throughout much of Alaska could have historically been exposed to the virus from domestic sheep and goats. These domestic grazers frequently accompanied white men who roamed Alaska in search of fur and gold. It is also possible that CE has been a natural element in the assemblage of diseases with which Dall sheep have evolved since long before the introduction of domestic sheep into Alaska. In such a case, Dall sheep may be susceptible and more adversely affected by a CE virus of domestic sheep previously foreign to them. Sample collections from remote populations where chances of previous exposure are lessened will provide more data about the historical presence of this disease agent. These collections are planned.

Brucellosis is a bacterial disease of both domestic and wild animals. There are several separate species and biotypes within the genus Brucella. These species are host specific to varying degrees, and one particular species, Brucella ovis, causes clinical symptoms in various types of domestic sheep. Aliquots of the 73 samples from the Tok population were tested by the same methodology (bovine) utilized in the study by Smith et al. (1982). A low titer was found in only one sample. This low titer may represent nonspecific agglutinating substances. Nieland (1968) reported Brucella titers in Dall sheep from the Brooks Range. Based upon the low prevalence of serum antibody, and the low titer of the specimen in which agglutination occurred, it appears brucellosis is not a major disease element in the natural history of these sheep populations.

Parainfluenza III virus is a member of a group of epizootiologically related agents commonly referred to as the bovine respiratory viruses (Dieterich 1981). These viruses are frequently found in domestic cattle and cause or initiate pneumonia. Wild sheep are very susceptible to pneumonia-like syndromes caused by bacteria and viruses as well as

Table 1. Results of serologic tests performed on sera collected from Dall sheep near Tok, Alaska during 1979.

Organism	Test Procedure[a]	Prevalence[b]	Range of Titers (median)
Campylobacter fetus	CG	22/73 (30)	1:100-1:200 (1:100)
Contagious ecthyma virus	SN	17/73 (23)	1:5-1:320 (1:10)
Brucella spp. (bovine)	SPT	3/73 (4)	1:50 (1:50)
Parainfluenza III virus	SN	1/73 (1)	1:100
Bovine viral diarrhea virus	SN	0/73	0
Bluetongue virus	AGID	0/73	0
Infectious bovine rhinotracheitis virus	SN	0/73	0
Ovine progressive pneumonia virus	AGID	0/73	0
Leptospira spp.	SPT	0/73	0
Anaplasma spp.	CG	0/73	0
Toxoplasma spp.	IHA	0/73	0

[a] CG = card agglutination, SPT = standard plate agglutination, SN = serum neutralization, AGID = agar gel immunodiffusion, IHA = indirect hemagglutination

[b] Number positive/number tested (% positive)

Table 2. Results of serologic tests performed on sera collected from Dall sheep near Dry Creek, Alaska 1977 and 1981.

Organism	Test Procedure[a]	Minimum titer for classification as possitive	Prevalence[b]
Brucella spp. (bovine)	SPT	1:25	0/17
Parainfluenza III virus	HI	1:10	0/17
Bovine viral diarrhea virus	SN	1:16	0/17
Infectious bovine rhinotracheitis virus	SN	1:16	0/17
Leptospira spp.	MAT	1:100	0/17

[a] SPT = standard plate agglutination, HI = hemagglutination-inhibition, SN = serum neutralization, MAT = microscopic agglutination

[b] Number positive/number tested.

Table 3. Frequency of lumpy-jaw occurrence in Alaska Range sheep.

Location	Data gathered by	Prevalence[a]
Denali (McKinley) Park (Murie 1944)	skull collection	213/829 (26)
Dry Creek (1969-70)	trap and palpate	26/89 (29)
Dry Creek (1973-79)	collected by shooting	14/71 (20)
Dry Creek (1981)	trap and palpate	8/23 (35)
Dry Creek - total	all methods	48/183 (26)
Sheep Creek (1976-79)	collected by shooting	3/21 (14)
Sheep Creek (1979)	trap and palpate	10/86 (12)
Sheep Creek - total	all methods	13/107 (12)

[a] Number positive/number tested (% positive).

roundworms, so any penumonia-causing agents are of special interest where Dall sheep are concerned. Serologic evidence of past exposure to parainfluenza III has been reported for bighorn sheep (Howe et al. 1966). This virus was also isolated from clinically ill Rocky Mountain bighorns (Parks et al. 1972) which subsequently died with pneumonia (Thorne 1982, pers. commu.). The significance of the single sample with evidence of past exposure reported here is not known.

Both study populations have lumpy-jaw disease, and the frequency of the condition appears to be about twice as great among the lower quality group. The frequency of lumpy-jaw among the sheep from Mount McKinley (now Denali) National Park (Murie 1944) seems to confirm this higher prevalence among sheep of the western end of the Alaska Range. Denali National Park is about 70 km west of the Dry Creek area and has population characteristics, particularly density, which are similar to those of the Dry Creek area. We don't think lumpy jaw is a primary contributor to the observed differences in population quality. Heimer (1982) found more old ewes present in the Dry Creek area than near Tok. Lumpy-jaw frequency may be a function of age, but we doubt the differences in age are sufficient to account for a doubling in occurrence of lumpy-jaw.

So-called "sulfur granules" have been described in lumpy-jaw lesions caused by Actinomyces spp. infection. No such granules were found in five Dall sheep with active cases of lumpy-jaw. Further, attempts to culture this fungus from lumpy-jaw cases have failed. We have frequently found Corynebacterium pyogenes in these lesions. The ability of this bacterium to cause periodontal disease (Davis et al. 1973) suggests to us that it may be the cause of lumpy-jaw condition in Alaska's Dall sheep.

Dall sheep of Alaska appear to be in a relatively pristine condition with respect to exposure to disease agents of domestic grazers. The best course to advocate is separation of domestic species from Dall sheep populations. Mixing of the two groups of sheep should be precluded until further surveys have been concluded. If it becomes apparent that either group poses a potential health hazard to the other, such separation should become permanent policy.

LITERATURE CITED

Alaska Rural Development Council. 1974. Alaska's agricultural potential. Publ. No. 1. 152pp.

Andrews, P. J., and F. W. Frank. 1974. Comparison of four diagnostic tests for detection of bovine genital vibrosis. J. Am. Vet. Med. Assoc. 165(8):696-697.

Carr, R. W. 1968. A case of orf (ecthyma contagiousum; contagious pustular dermatitis) contracted by a human from a wild Alaskan mountain goat. Ak. Med., June. pp.75-77.

Davis, B. D., R. Dulbecco, H. Eisen, H. Ginsberg, and W. B. Wood, Jr. 1973. Microbiology. Harper and Row, Hagerstown, MD. 1562pp.

Dieterich, R. A. 1981. Respiratory viruses. Pages 23-30 in R. A. Dieterich, ed. Alaskan wildlife diseases. Univ. Alaska, Fairbanks.

_____, G. R. Spencer, D. Burger, A. M. Gallina, and J. Vanderschalie. 1981. Contagious ecthyma in Alaskan muskoxen and Dall sheep. J. Am. Vet. Med. Assoc. 179:1140-1143.

Foreyt, W. J., and D. A. Jessup. 1982. Fatal pneumonia of bighorn sheep following association with domestic sheep. J. Wildl. Dis. In press.

Geist, V. 1971. Mountain sheep: a study in behavior and evolution. Univ. Chicago Press, Chicago. 371pp.

Heimer, W. E. 1978. Alternate-year reproduction in a low-quality, declining Dall sheep population. Pages 30-41 in D. Hebert and M. Nation, eds. Proc. Biennial Symp. Northern Wild Sheep and Goat Council, British Columbia Wildl. Branch, Victoria, B.C.

_____. 1981. Interior sheep studies: Dall sheep condition and nutritional profile. Alaska Dep. Fish and Game, Fed. Aid Wildl. Restoration, Proj. Final Rep. W-17-98 through W-21-1, Job 6.12R. Juneau. 52pp.

_____, S. DuBois, and D. Kelleyhouse. 1980. The usefulness of rocket nets for Dall sheep capture compared with other methods. Pages 601-614 in B. Hickey, ed. Proc. Biennial Symp. Northern Wild Sheep and Goat Council, Idaho Dep. Fish and Game, Salmon, ID.

Howe, D. L., G. T. Woods, and G. Marquis. 1966. Infection of bighorn sheep (Ovis canadensis) with myxovirus parainfluenza III and other respiratory virusus. Results of serologic tests and culture of nasal swabs and lung tissue. Bull. Wildl. Dis. 2:34-37.

Jessup, D. A. 1981. Pneumonia in bighorn sheep: effects on populations Cal.-Nev. Wildl. Trans. 1981:71-78.

Lance, W., W. Adrian, and B. Widhalm. 1981. An epizootic of contagious ecthyma in Rocky Mountain bighorn sheep in Colorado. J. Wildl. Dis. 17:601-603.

Murie, A. 1944. Wolves of Mt. McKinley. Fauna of the National Parks of the U.S. Fauna Ser. No. 5. U.S. Govt. Print. Off., Washington, DC. 238pp.

Neiland, K. A., B. E. Huntley, and R. O. Skoog. 1968. The diseases and parasites of Alaskan wildlife populations, Part 1, Some observations on brucellosis in caribou. Bull. Wildl. Dis. Assoc. 4:27-36.

Parks, J. B., G. Post, T. Thorne, and P. Nash. 1972. Parainfluenza III infection in Rocky Mountain bighorn sheep. J. Am. Vet. Med. Assoc. 161(6):669-672.

Samuel, W. M., G. A. Chalmers, J. C. Stelfox, A. Loewen, and J. J. Thomsen. 1975. Contagious ecthyma in bighorn sheep and mountain goat in western Canada. J. Wildl. Dis. 11:26-31.

Smith, A. C., and W. E. Heimer. 1982. Contagious ecthyma in an adult Dall sheep (Ovis dalli dalli) in Alaska. J. Wildl. Dis. In press.

_____, _____, and W. J. Foreyt. 1982. Hematologic, serum chemistry, and serologic values of Dall sheep (Ovis dalli dalli) in Alaska. J. Wildl. Dis. 18:111-112.

U.S. Department of Agriculture Office of Experimental Stations. 1898. A report to Congress on agriculture in Alaska. Bull. No. 48. Govt. Print. Off., Washington, D.C.

Comment

I have two quick comments. One of them is about the serology of Campylobacter bacteria. Serologic tests for Campylobacter are nearly worthless. From what I understand, many labs hardly run this test any more. The reason is there are several intestinal flora of the Campylobacter group that do cross-react with Campylobacter fetus. There are some research labs in the United States that do this test on an experimental basis, but if you just run it in a routine lab, I sure wouldn't consider the results dependable. Second, we've seen the lumpy-jaw problem in captive antelope in Wyoming. Seven or 8 years ago we went through the same testing you did, trying to isolate the organism, and we came up with Corynebacterium just as you did. From what I can understand with domestic sheep, there is a condition like lumpy jaw called broken mouth. In domestic sheep, they do culture several different types of bacteria from these cases, but it is not the classical lumpy jaw or Actinomyces bovis like you first suspected. I think you are on the right track. Sometimes you can look at these animals and see the erosion of teeth and stair-stepping of the teeth. This might point to rougher forage which causes these symptoms.

NORTHERN WILD SHEEP AND GOAT COUNCIL

Proceedings
of the Third Biennial Symposium

March 17-19, 1982
Fort Collins, Colorado

Edited by: James A. Bailey
Gene G. Schoonveld

Chairman: Gene G. Schoonveld
Colorado Division of Wildlife
Fort Collins, Colorado

CO-HOSTED BY: Colorado Division of Wildlife

Department of Fishery & Wildlife Biology
Colorado State University