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## **Disease considerations in the introduction of domestic sheep and goats to native big game range**

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### **Abstract:**

The introduction of domestic sheep and goats to Theodore Roosevelt National Park for leafy spurge control would be the introduction of an exotic species into an existing ecosystem. No government agency should take such actions without careful consideration of the resulting risks and benefits.

One major area of concern is the potential for the transmission of diseases from domestic sheep and goats to wild ruminants. Many disease agents of domestic sheep and goats could potentially infect wild ruminants. Three diseases of major concern are Pasteurellosis, Contagious Ecthyma, and Malignant Catarrhal Fever.

*Pasteurella pneumonia* has consistently spread from domestic sheep to bighorn sheep in captive and free-ranging conditions resulting in high morbidity and mortality in bighorn sheep with no clinical disease in domestics.

Contagious ecthyma is a common viral disease of domestic sheep and goats, which can produce severe skin lesions in bighorn sheep with secondary mortalities from starvation and predation.

Malignant catarrhal fever is a viral disease that produces sporadic severe disease with high case fatality rates in a wide range of wild and domestic

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ruminants. Domestic sheep and goats are considered to be important reservoirs of this disease.

The Leafy Spurge Advisory Panel must weigh the use of domestic sheep and goats for leafy spurge control against other options. They must consider that introduction of a new disease to free-ranging wildlife populations is usually irreversible.

The North Dakota Game and Fish Department recommends that the introduction of domestic sheep and goats into the Park not be considered an option at this time.

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## Introduction

This presentation is to inform the Leafy Spurge Scientific Advisory Panel appointed by the National Park Service of the relevant wildlife population health management questions that need to be addressed in considering the introduction of domestic sheep (*Ovis aries*) and domestic goats (*Capra hircus*) into Theodore Roosevelt National Park as a means of leafy spurge control.

The introduction of domestic sheep or goats to the Park would be the introduction of an exotic species into an existing ecosystem. The potential ramifications of the introduction of an exotic species to an ecosystem must be self-evident to this audience. There is no doubt that any such management action taken by a governmental agency must only proceed after careful consideration of the risks and benefits of the action.

For many years wildlife management agencies around the world have introduced, re-introduced, and translocated native and exotic game species. Some of these programs have been unqualified successes and some have been ecological catastrophes. As a result of these experiences wildlife management professionals have defined some guidelines for the translocation of wild animals. I believe that some of these guidelines should be applied in the consideration of any proposed introduction of domestic sheep and goats to Theodore Roosevelt National Park.

The researchers who authored these guidelines begin with the mandate that before any introduction or translocation of a species an exhaustive feasibility study should be conducted (Nielsen and Brown, 1988). The first important question that must be answered is... “Is the introduction ecologically and biologically sound?”

In determining the answer to this question one of the most important considerations to be addressed is the potential for introducing new disease agents with the introduced animals. All animal movements result in the movement of the biotic communities resident in or on the animal. Wildlife health professionals have come to refer to this phenomenon as “moving the zoo”.

Specific aspects that need to be addressed regarding disease include:

- What diseases could be introduced to native wildlife populations?
- What is the immune status of the native wildlife populations for disease of concern?
- What is the history of diseases of concern in the introduced animals?
- Can the disease status of the animals to be introduced be determined by testing?
- Can the disease agents be eliminated from the animals to be introduced by treatment?
- If a new disease is introduced into native wildlife populations could it be eliminated?

In considering answers to these questions I have assumed that the class of native wild animals in Theodore Roosevelt National Park most at risk for disease introductions by domestic sheep and goats would be the ruminants including bighorn sheep (*Ovis canadensis*), elk (*Cervus elaphus*), bison (*Bison bison*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), and pronghorn antelope (*Antilocapra americana*).

Reference books on the management and diseases of domestic sheep and goats (Sexton and Mitchum, 1992; Linklater and Smith, 1993) list a number of bacterial diseases, viral diseases, protozoal disease, and parasitic diseases that have been documented as disease agents in free-ranging or captive wild deer, sheep, bison, or pronghorn antelope (Davis and Anderson, 1971; Davis *et al.*, 1981; Thorne, 1982). Some of the most important of these diseases are listed in Table 1.

Those diseases in Table 1 that are of special concern due to their prevalence in domestic sheep and goats and the demonstrated or potential severity of their impact on wild ruminants have been highlighted. Although the possibility of introducing all of the diseases listed in Table 1 should be addressed before any introduction of domestic sheep or goats into Theodore Roosevelt National Park proceeds, time will allow the discussion of only three of the most crucial disease threats.

**Table 1. Diseases of domestic sheep and goats that could potentially effect wildlife populations.**

<u>Bacterial Diseases</u>
<b>Pasteurellosis</b>
<b>Foot Rot</b>
<b>Mycoplasmosis</b>
Dermatophilosis
Paratuberculosis
Ovine Brucellosis
Chlamydiosis
<u>Viral Diseases</u>
<b>Contagious Eethyma</b>
<b>Malignant Catarrhal Fever</b>
<b>Ovine Progressive Pneumonia</b>
Scrapie
Capripox Virus
Adenovirus
Bluetongue
<u>Protozoal Diseases</u>
<i>Anaplasmosis</i>
Toxoplasmosis
Cryptosporidiosis
<u>Parasitic Diseases</u>
<b>Psoroptic Mange</b>
<b>Lungworms</b>
<b>Eleaophorosis</b>
Ticks
Ostertagiasis
Trichuriasis
Nematodiriasis
Trichostrongylosis

## Pasteurellosis

Acute and chronic pneumonia produced by *Pasteurella haemolytica* and to a lesser extent by *Pasteurella multocida* are common disease problems in domestic sheep and goat populations (Linklater and Smith, 1993). These same disease agents have been associated with major pneumonia epidemics in captive and free-ranging bighorn sheep (Jesup and Boyce, 1993). Elk, white-tailed deer, mule deer, and pronghorn antelope are susceptible to *Pasteurella* spp. pneumonia, but large scale epidemics are less common in these species (Rosen, 1981; Thorne, 1982). The ability of bison, elk, white-tailed deer, mule deer, or pronghorn antelope to serve as vectors of pathogenic strains of *Pasteurella* spp. from domestic sheep or goats to bighorn sheep has not been investigated.

“In both penned studies and free-ranging herds, contact between bighorn sheep and domestic sheep has resulted in the deaths of all or most bighorns while domestic sheep remained healthy. Ten penned studies, some of which were circumstantial evidence, in six states or provinces resulted in: 7 cases where all bighorn died from pneumonia, while from 50% to 83% were lost in the other 3 studies. In addition, 15 incidents involving free-ranging bighorns in 8 states or provinces linked contact with domestic sheep to bighorn dieoffs. No studies reported any bighorn herds, penned or free ranging, that have come into contact with domestic sheep and remained healthy.” (Martin *et al.*, 1993).

At least 15 serotypes of *P. haemolytica* have been described (Foreyt, *et al.*, 1994). Based on work with serotypes bighorn sheep and elk in western North Dakota appear to share similar strains of *Pasteurella* spp. (Table 2).

More recent work using molecular biological techniques has demonstrated 50 to 100 DNA types of *P. haemolytica* exist and there may be many DNA types within one serotype (Martin, *et al.*, 1993). Any attempt to determine if the DNA types of *Pasteurella* spp. present in domestic sheep or goats matched the preexisting types found in resident bighorn sheep and other wild ruminants in Theodore Roosevelt National Park appears impractical at this time. If such tests were completed transmissions trials to bighorn sheep would still be required to demonstrate a lack of pathogenicity in the domestic sheep and goat strains.

Although antibiotics and vaccines are available for treatment and prevention of *Pasteurellosis* in domestic sheep and goats they have not been adequately proven to eliminate a potential carrier state in any species.

**Table 2. *Pasteurella* spp. isolates from bighorn sheep and elk (1990 - 1992).**

		Species	Biotype	Serotype	Isolates
North Dakota Bighorn Sheep					
		<i>P. haemolytica</i>	T	3	1
<u># Pasteurella +</u>	<u>24</u>	<i>P. haemolytica</i>	T	3,4	3
<u># animals cultured</u>	<u>24</u>	<i>P. haemolytica</i>	T	3,4,10	15
		<i>P. haemolytica</i>	T	untyped	3
		<i>P. haemolytica</i>	T	nd	3
		<i>P. haemolytica</i>	3	untyped	2
		<i>P. haemolytica</i>	3	nd	3
		<i>P. haemolytica</i>	A	1	1
Idaho Bighorn Transplants					
		<i>P. haemolytica</i>	T	3	9
<u># Pasteurella +</u>	<u>20</u>	<i>P. haemolytica</i>	T	3,4	1
<u># animals cultured</u>	<u>22</u>	<i>P. haemolytica</i>	T	3,4,10	12
		<i>P. haemolytica</i>	T	untyped	2
		<i>P. haemolytica</i>	T	nd	2
		<i>P. haemolytica</i>	A	5	1
		<i>P. haemolytica</i>	A	untyped	2
		<i>P. haemolytica</i>	A	nd	1
Killdeer Mountain Elk					
		<i>P. haemolytica</i>	T	3	2
<u># Pasteurella +</u>	<u>10</u>	<i>P. haemolytica</i>	T	3,4	4
<u># animals cultured</u>	<u>17</u>	<i>P. haemolytica</i>	T	nd	1
		<i>P. haemolytica</i>	3	nd	2
		<i>P. haemolytica</i>	A	6	2
		<i>P. haemolytica</i>	A	untyped	1
		<i>P. multocida</i>	A	nd	1
Theodore Roosevelt Park Elk					
		<i>P. haemolytica</i>	T	3	7
<u># Pasteurella +</u>	<u>43</u>	<i>P. haemolytica</i>	T	4	1
<u># animals cultured</u>	<u>-50</u>	<i>P. haemolytica</i>	T	3,4	15
		<i>P. haemolytica</i>	T	3,4,10	9
		<i>P. haemolytica</i>	T	untyped	10
		<i>P. haemolytica</i>	T	nd	3
		<i>P. haemolytica</i>	3	nd	1
		<i>P. haemolytica</i>	3-LIKE	nd	9
		<i>P. haemolytica</i>	nd	nd	1
		<i>P. multocida</i>	nd	nd	4
nd - not determined					

## Contagious ecthyma

Contagious ecthyma is an infectious disease of sheep and goats characterized by vesicular, pustular, and crusted lesions on the nose and lips. The infective agent is a pox virus of the Parapox subgroup (Karstad, 1981). Outbreaks in domestic sheep and goats are commonly seen in lambs and kids soon after birth or at 3 or 4 months of age. Older susceptible animals can become infected at any time.

All ovids and caprids, and some other wild ungulates may become infected with contagious ecthyma (Jessup and Boyce, 1993). Clinical contagious ecthyma has been seen in free-ranging bighorn sheep herds or mountain goats in Nevada, New Mexico, Colorado, California, British Columbia, and Alberta (Lance, 1982). Clinical signs of contagious ecthyma have never been observed in bighorn sheep in North Dakota.

In bighorn sheep severe oral lesions of contagious ecthyma can significantly increase lamb mortality through impaired feeding which leads to emaciation. Eye lesions in lambs may also lead to blindness. Occasional yearling and adult mortality may occur due to emaciation and secondary bacterial infections (Lance, 1982). Severe contagious ecthyma lesions may lead to increased predation in all age classes.

Contagious ecthyma is spread by direct contact with active lesions or scab material in the environment. The virus is highly resistant to normal environmental conditions and has been reported to be viable in dried scab lesion material after 20 years (Lance, 1982). Affected domestic rams and subclinical carriers can introduce the virus to previously uninfected flocks (Sexton and Mitchum, 1992).

A modified live virus vaccine is used in domestic sheep and goats to prevent outbreaks of clinical disease. Live vaccines should never be used in herds free from the disease (Sexton and Mitchum, 1992). A major disadvantage of the live vaccine is the potential spread of a virulent virus in the vaccinated population and into the environment (Lance, 1982).

Infection with contagious ecthyma may be diagnosed by gross pathology, histology, electron microscopy, or by serological tests. There is no treatment for the disease other than supportive care.

## Malignant Catarrhal Fever

Malignant catarrhal fever (MCF) is a fatal, sporadic, infectious viral disease of wild and domestic ruminants that is global in distribution (Richards, 1981). Elk, pronghorn antelope, bison, mule deer, and white-tailed deer are among the many wild ruminants, which experience clinical MCF (Heuschele *et al.*, 1988).

Wilbebeests (*Connochaetes* spp.) and sheep and goats are considered to be the principal reservoirs of MCF virus. The causative agent of wildebeest associated MCF is a herpes virus. Current virological and serological evidence suggest that sheep and goat associated MCF are similar and related to alcelaphine herpesvirus 1. Sheep, goats, and alcelaphine antelope rarely if ever have clinical MCF, being usually asymptomatic carriers (Heuschele, 1993).

The clinical signs of MCF in most wild ruminants are similar to those seen in domestic cattle including high fever, ocular and nasal discharge, corneal opacity, generalized lymphadenopathy, and oral and nasal mucosal erosions. In some deer species MCF occurs as a peracute hemorrhagic enterocolitis characterized by a brief course of hemorrhagic diarrhea. The case fatality rate of MCF is generally 95 to 100% with death occurring in 2 days to 2 weeks (Heuschele, 1993).

Viral isolation of wildebeest associated MCF has permitted the development of experimental serological tests for detecting antibodies and immunological techniques for identifying virus in tissues and cell cultures. No proven diagnostic techniques have been developed to determine virus exposure or shedding for sheep associated MCF.

No vaccine for MCF is available. There is no treatment for MCF other than supportive care.

Therefore a major consideration with sheep associated MCF virus in domestic sheep and goats is that there is no test or treatment available. The advisory panel must therefore consider one of the main precepts of regulatory agencies responsible for the protection of animal health. If a group of animals potentially harbors an important pathogen for which there is no test and no treatment, then no introduction of those animals is allowed.

A second question that any feasibility study of animal introductions conducted by a wildlife management agency should answer is... "Is the introduction consistent with the goals and objectives of the agencies overall wildlife management plan?"

The recently completed draft resource management plan for Theodore Roosevelt National Park states that the basic goal of resource management is to restore or maintain the physical and biological resources and processes that interact to form the park's ecosystem. Additionally management activities should be managed to prevent adverse impacts on the natural resources integral to the purposes of the Park. The section of the plan dealing with Park fauna management states... "The park's objective for bighorn sheep management is to perpetuate a natural population with the normal interrelationships with the park ecosystem, and to minimize the influence of man upon that population." Certainly the introduction of disease with domestic sheep or goats would interfere with the goal of a stable, healthy population of bighorn sheep in the Park.

In considering the proposed introduction of domestic sheep and goats into Theodore Roosevelt National Park as a management strategy for the control of leafy spurge the advisory panel must consider two additional relevant questions. Does the documented benefit of the introduction of a new species outweigh the potential risks? Are there other options for obtaining the desired benefits that entail lower risk?

One important concept that I would reemphasize to the panel members is that in almost all cases the establishment of a new disease in free-ranging wildlife populations is irreversible.

In response to concerns about the transmission of disease agents from domestic sheep to free-ranging bighorn sheep on public rangeland two federal agencies have recently adopted policies to restrict the interaction of the species.

In 1992 the Director of the Bureau of Land Management issued guidelines for domestic sheep management in bighorn sheep habitats on BLM land. These guidelines state that

domestic sheep grazing and trailing should be discouraged in the vicinity of bighorn sheep ranges, bighorn sheep and domestic sheep should be spatially separated, buffer strips of no domestic sheep grazing of up to 9 miles should be established around bighorn sheep range, and domestic sheep should be closely managed to prevent them from straying into bighorn sheep areas.

In 1994 the United States Forest Service completed an environmental assessment for the bighorn/domestic sheep compatibility analysis on the Hells Canyon National Recreation Area in Idaho and Oregon. As a result of this analysis domestic sheep will be permanently removed from six grazing allotments in the recreation area.

In conclusion the North Dakota Game and Fish Department maintains there are documented diseases of major concern that might be transmitted to the free-ranging wildlife populations of Theodore Roosevelt National Park and subsequently to wildlife populations outside of the Park by the introduction of domestic sheep and goats. The North Dakota Game and Fish Department therefore recommends that the introduction of these domestic species to Theodore Roosevelt National Park for leafy spurge control not be considered at this time.

I wish to thank the National Park Service for inviting the North Dakota Game and Fish Department to present our comments on the proposed leafy spurge control programs in Theodore Roosevelt National Park.

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