

Pneumonia Disease Process in Bighorn Sheep and New BLM Wild Sheep Management Policy, Manual 1730



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and Mike Cox**



Primary limiting factor to bighorn herd growth: Pneumonia

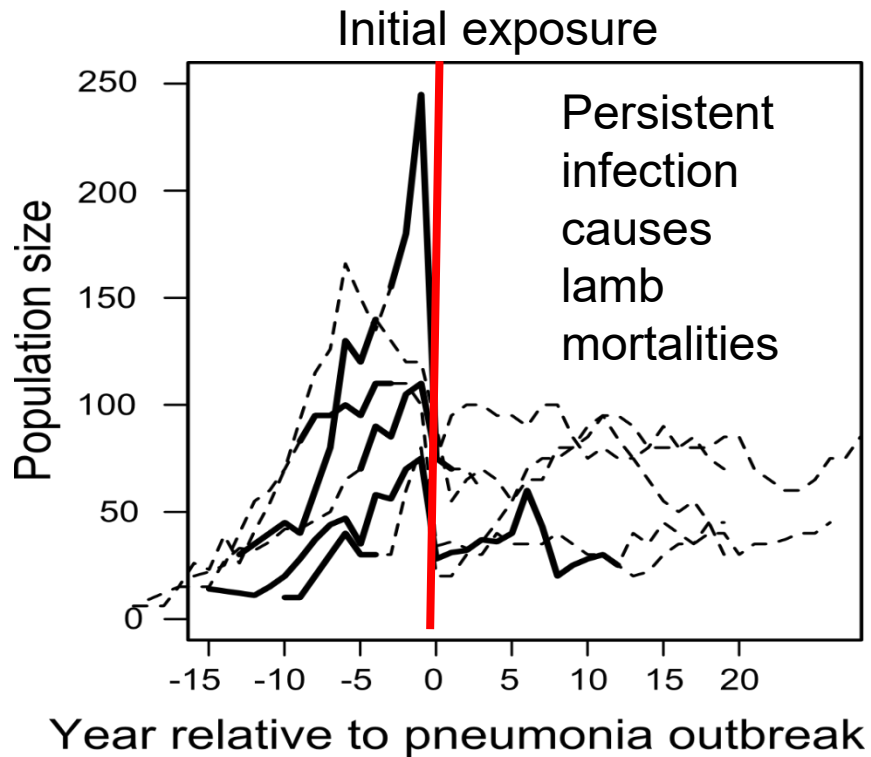


Figure by Kezia Manlove



**Bighorn Ewe with symptoms of pneumonia
(sneezing and head shaking)**



Polymicrobial pneumonia
cause disease events
in bighorn sheep

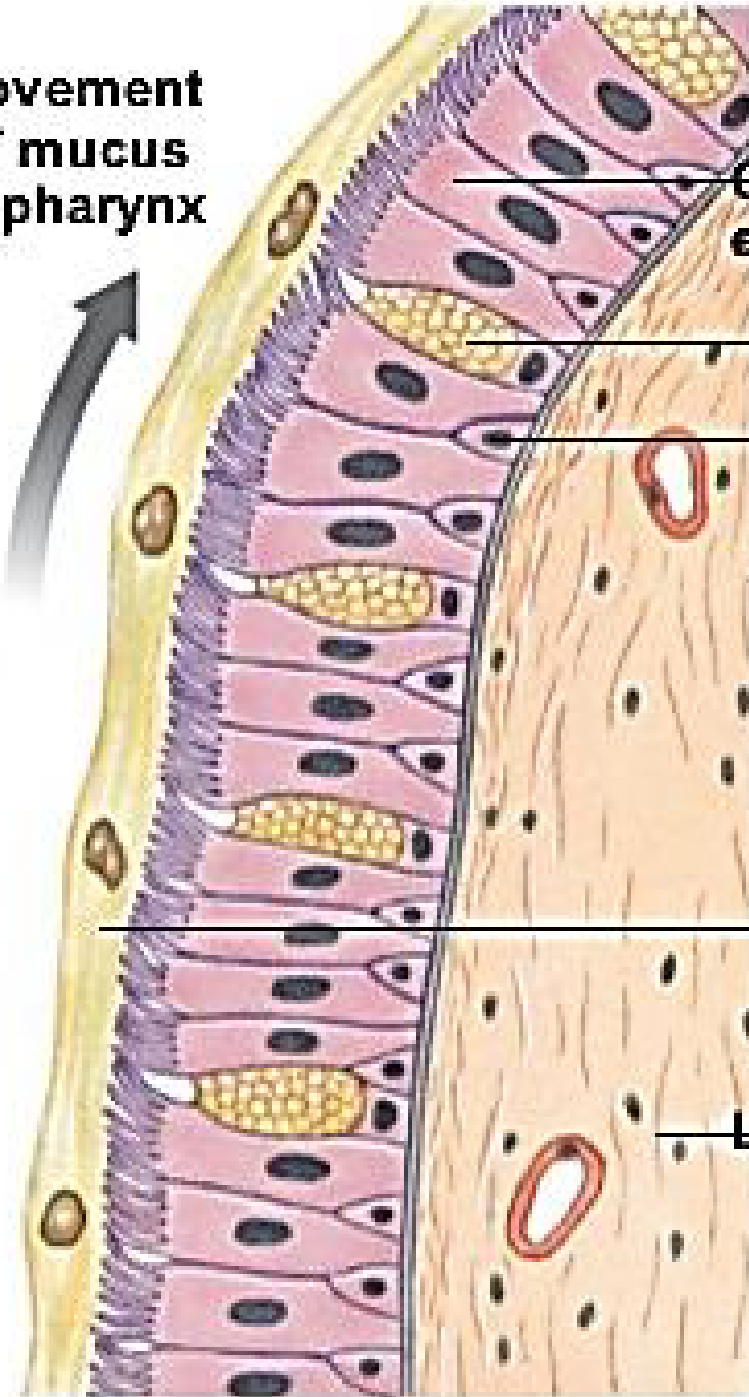
that are initiated by infection
with the bacteria

Mycoplasma ovipneumoniae

or

M. ovi

**Movement
of mucus
to pharynx**



**Ciliated columnar
epithelial cell**

Mucous cell

Stem cell

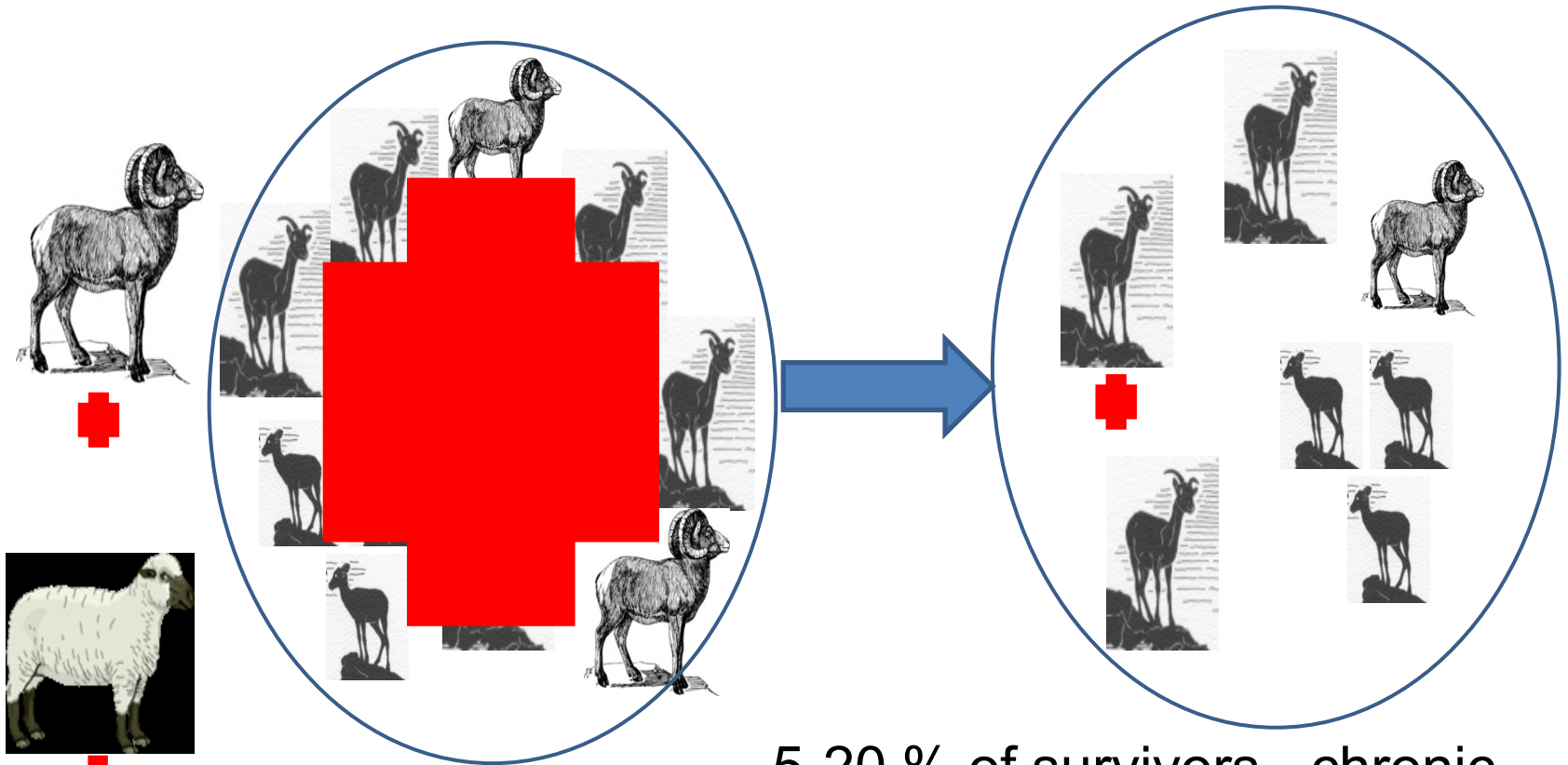
Mucus layer

Lamina propria

Bacteria that live in the back of the throat move down to the lungs causing pneumonia



Worst case scenario following *M. ovi* infection



All age die-off

5-20 % of survivors - chronic shedder of *M. ovi*
Chronic shedder ewe expose lambs in nursery groups
Significant annual lamb loss (> 5 yrs)

Evidence that *M ovi* causes bighorn sheep pneumonia

- *Movi* is the first bacterium to infect the lungs
- Single epidemic strains of *Movi* spread within all-ages outbreaks and persist causing lamb outbreaks
- All-age pneumonia outbreaks occur when *Movi* is introduced into a previously *Movi*-negative herd
- All-age pneumonia outbreaks occur when a new *Movi* strain is introduced into a herd previously infected with another strain
- Experimental exposure to *Movi* reproduces the naturally occurring disease

Where does Movi come from?

- Movi can't live in the environment; a live animal source is needed
- Movi infects only sheep and goat species (Caprinae)
 - Rare, unconfirmed reports from other species
- Therefore, the most likely Movi sources include:
 - Infected bighorn sheep
 - Infected domestic sheep
 - Infected domestic goats
 - Infected mountain goats

Movi in domestic sheep and goats

- Most farms carry Movi
 - Sheep:
 - 88% of 450 flocks; ~60% of 300 animals (USDA CEAH)
 - Goats:
 - 83% of 6 herds, 36% of 58 animals
 - 58% of 16 herds, 28% of 84 animals
- Domestic sheep farms typically carry multiple, diverse strains of Movi

Movi effects in domestic sheep and goats

Movi typically causes relatively little/mild disease

But:

- ‘Coughing syndrome’ in weaned lambs
- Associated with reduced weight gains
- Severe pneumonia has been reported, especially in goats
- USDA Sheep 2011 study: Movi negative herds less likely to report pneumonia, or if present, reported fewer pneumonia cases *
- WSU 2016 study: Movi decreased growth rates in lambs from weaning (50#) to slaughter (135#): 7% decrease in ADG *

Links between domestic sheep and bighorn pneumonia?



Mixing of bighorn and domestic sheep in research trials

- Mix domestic sheep with bighorn sheep -> pneumonia outbreak
 - Greater than 95% bighorn sheep death loss
- Mix cattle, llamas, or horses with bighorn sheep: No pneumonia outbreaks (occasional individual disease)
 - Less than 10% death loss
- Mix **Movi-negative** sheep or goats with bighorn sheep: **No epidemic pneumonia**

Movi transmission in the wild

- Movi genotyping (DNA fingerprinting) confirms Movi transmission under natural range conditions between:
 - Domestic sheep and bighorn sheep
 - Domestic goats and bighorn sheep
- Bighorn sheep or mountain goat sources of Movi are easily ruled out by failing to find the epidemic strain in nearby herds
- Domestic sheep or goat operations are more difficult to rule out: more operations; obtain permission for sampling; sorting out multiple stains

What can be done about bighorn sheep pneumonia?

Three principles for management of infectious disease*

- Reduce exposure to the causative agent*
 - Minimize contact with domestic sheep/goats
 - Alter management of public land domestic sheep grazing allotments and/or trailing routes with high risk to adjacent bighorn herds
 - Educating private land sheep producers on separation: fencing, preventing strays, reporting wandering bighorns
 - Reduce or eliminate Movi in nearby domestic sheep/goats
 - Minimize contact with infected bighorn sheep
 - Test and cull in infected bighorn sheep herds – promising to date!

What can be done about bighorn sheep pneumonia?

Three principles for management of infectious disease*

- Reduce exposure to the causative agent*
- Increase non-specific host resistance*
 - Preferred approach! But nobody knows if it can be done!
 - Nutrition? Genetics? Stress? Population size / structure?
 - Work in progress; no guarantee of success
- Increase specific host resistance*

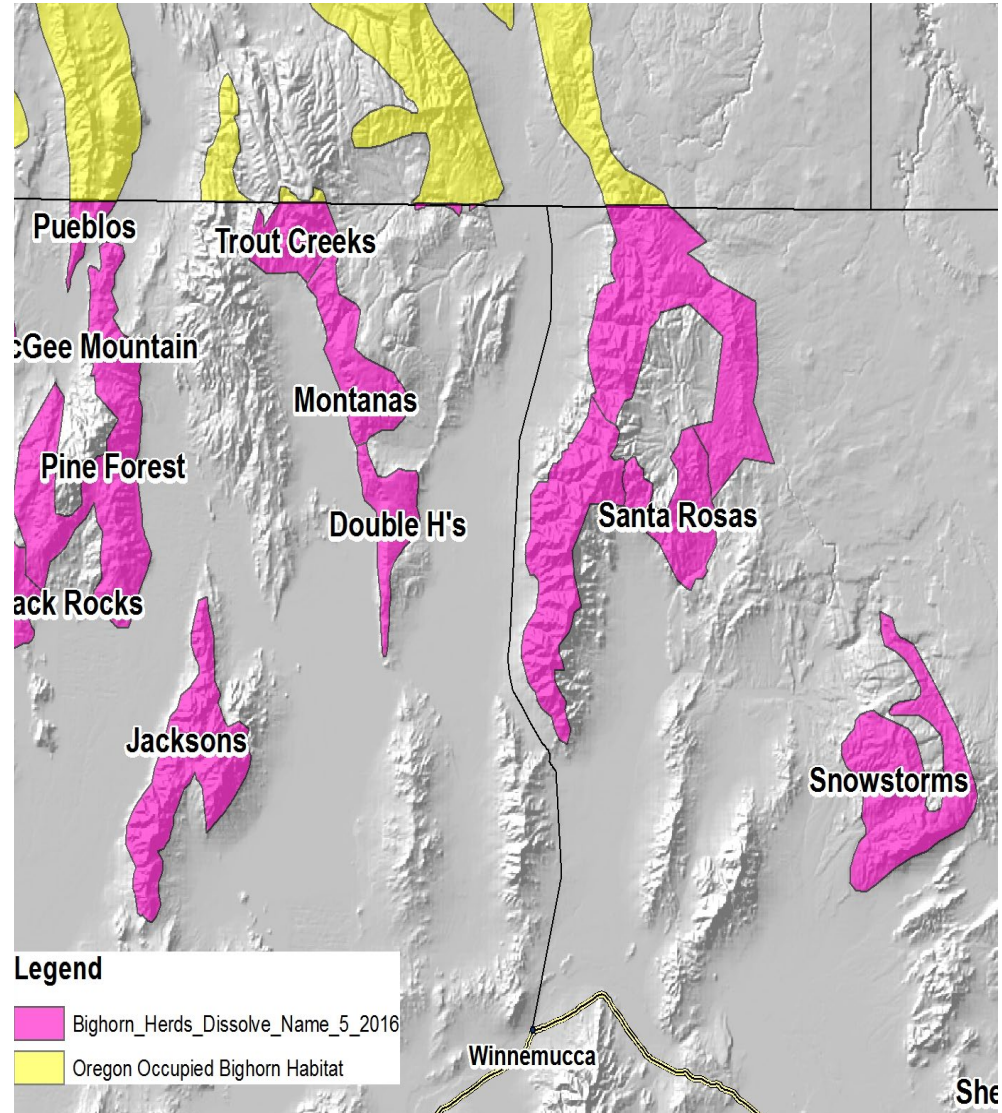
What can be done about bighorn sheep pneumonia?

Three principles for management of infectious disease*

- Reduce exposure to the causative agent*
- Increase non-specific host resistance*
- Increase specific host resistance*
 - Vaccine?
 - Respiratory mycoplasmas are a very challenging vaccine target – high strain variability; poor immunogenicity
 - TB prediction: vaccine unlikely next 20+ years

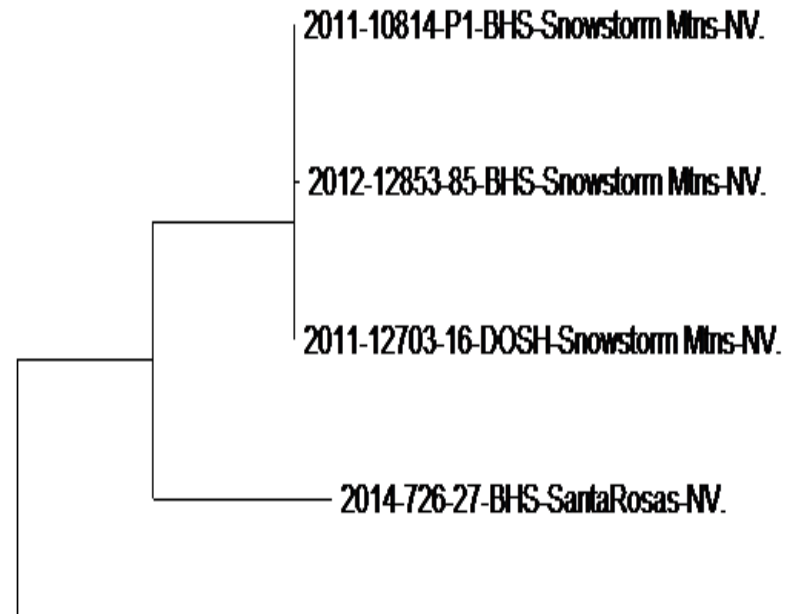
Snowstorm Mountains Bighorn Sheep Herd

- Reintroduced herd in 1986 (ID) and 1995(BC)
- 2011 - Prior to the disease event the population =160 adults
- Stable population for over a decade



Snowstorm Mountains

- 2011, 2 domestic ewes seen with the bighorn
- All age die-off estimated loss = 60% of herd
- Domestic sheep *M. ovi.* strain was exact match to strain found in bighorn ram by 4-locus sequencing



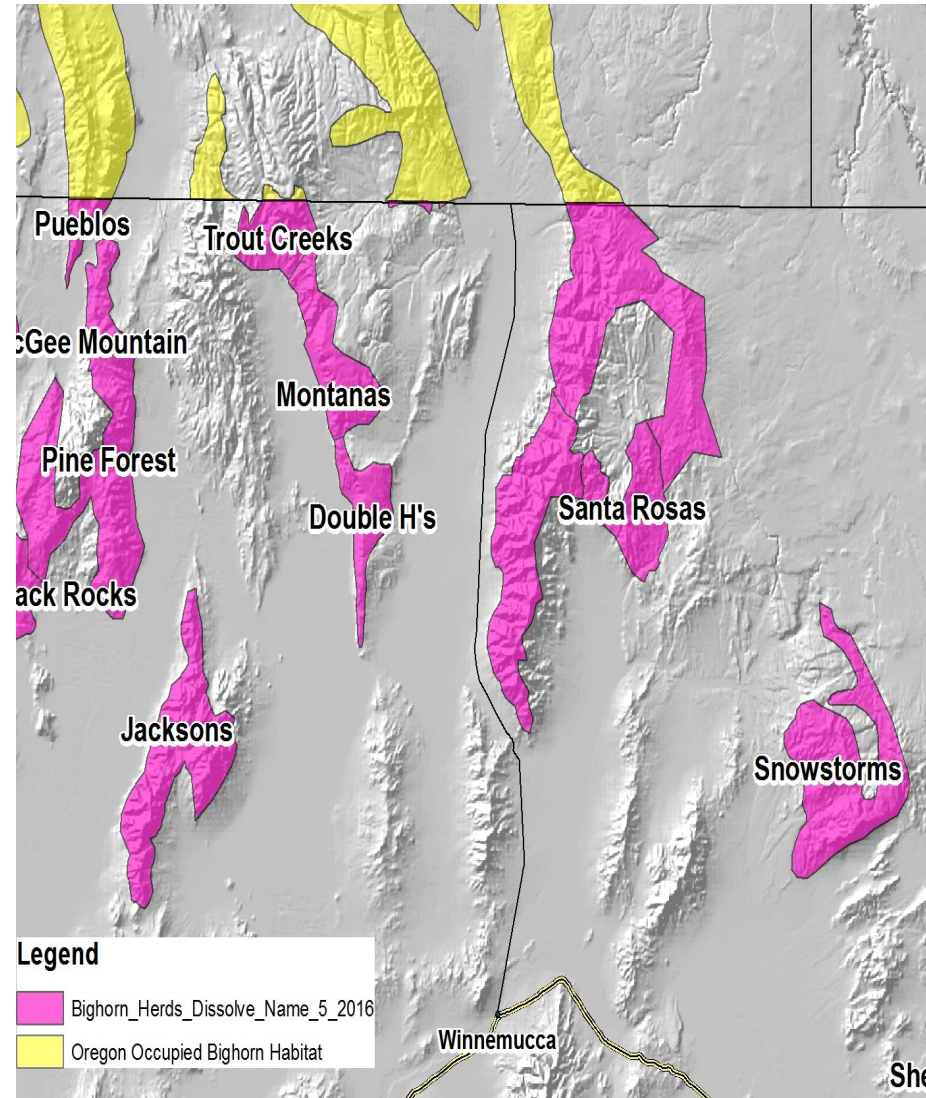
Snowstorm Mountains Bighorn Lamb Recruitment before and after disease transmission

Lambs:100 Ewes

| | |
|------------------|-----------|
| 1990-2009 | 48 |
| | |
| 2011 | 3 |
| 2012 | 3 |
| 2013 | 9 |
| 2014 | 27 |
| 2015 | 4 |
| 2016 | 12 |

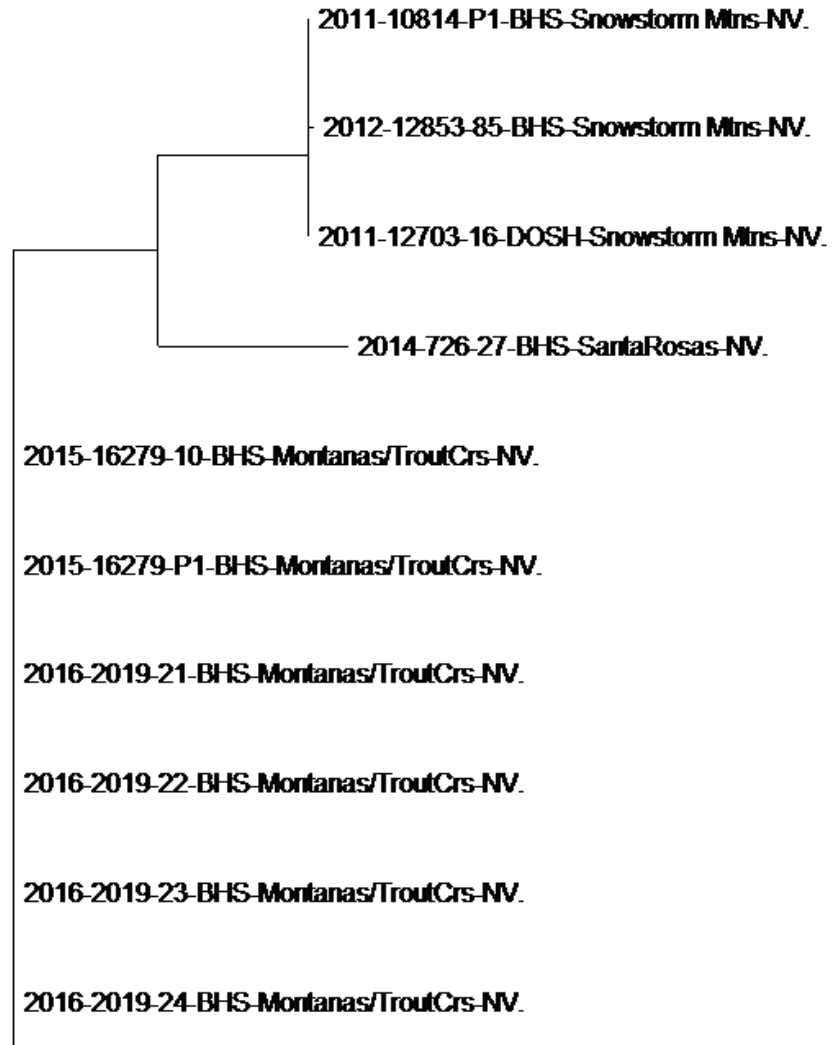
Montana Mountains

- Reintroduced herd 1991
- 2015 population est. =120
- Stable at this level
- 38 sampled in 2012 & 2014
Negative for *M. ovi*



Montana Mountains

- During routine health surveys Dec 2015, 2 rams died
- Necropsy revealed pneumonia
- 80% loss
- Proximity of neighboring healthy herds made decision to depopulate herd

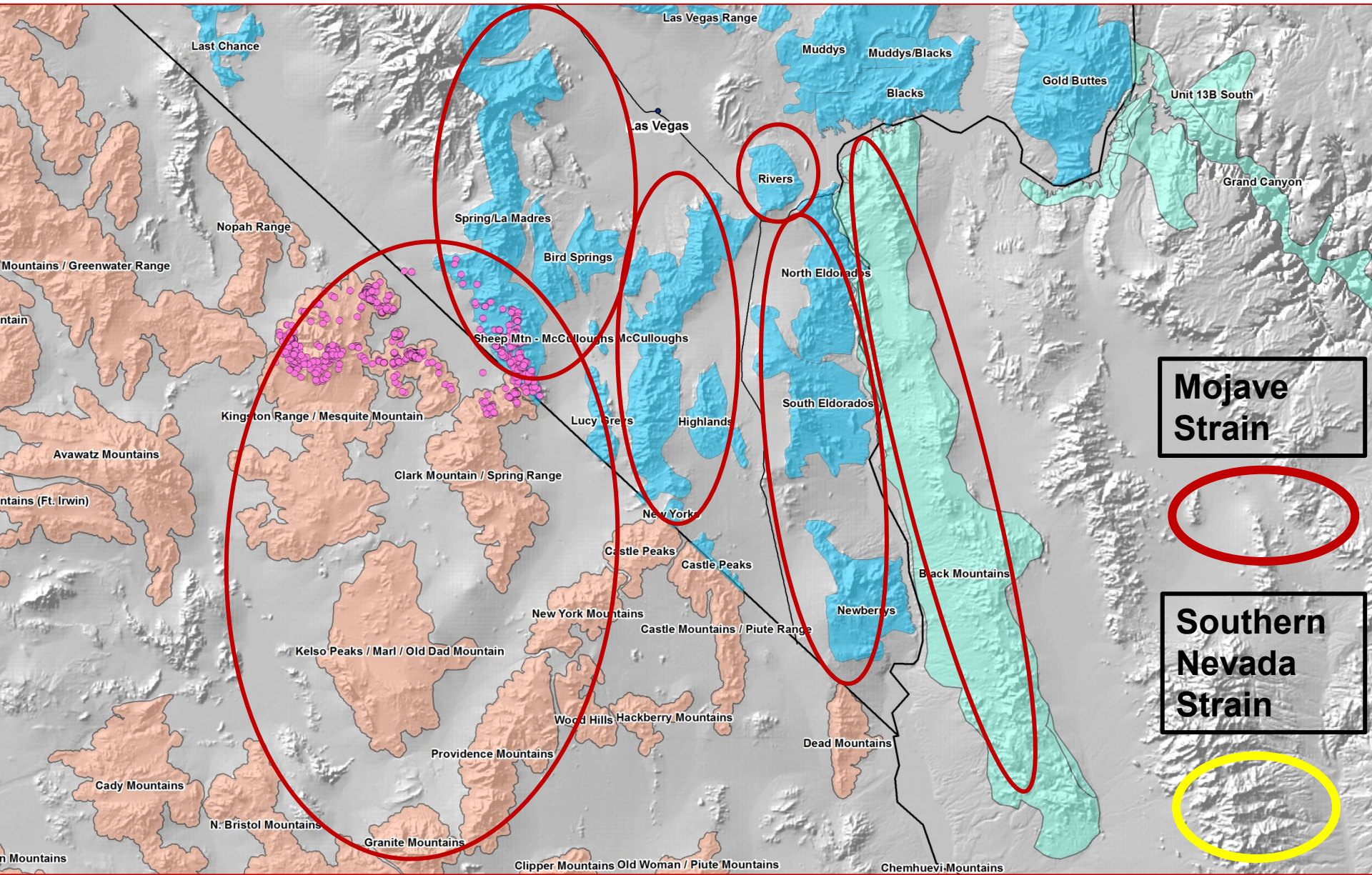


Southern Nevada Herds - 2013

- 2013 identified “Southern Nevada” M. ovi strain in 4 herds in Nevada and 1 across the Colorado River in Arizona
- This strain appeared to cause minimal disease in these herds = no all age die-off
- 2013 CA experienced a significant disease event in the Mojave Preserve
- “DNA fingerprinting” revealed a different strain referred to as “Mojave” strain

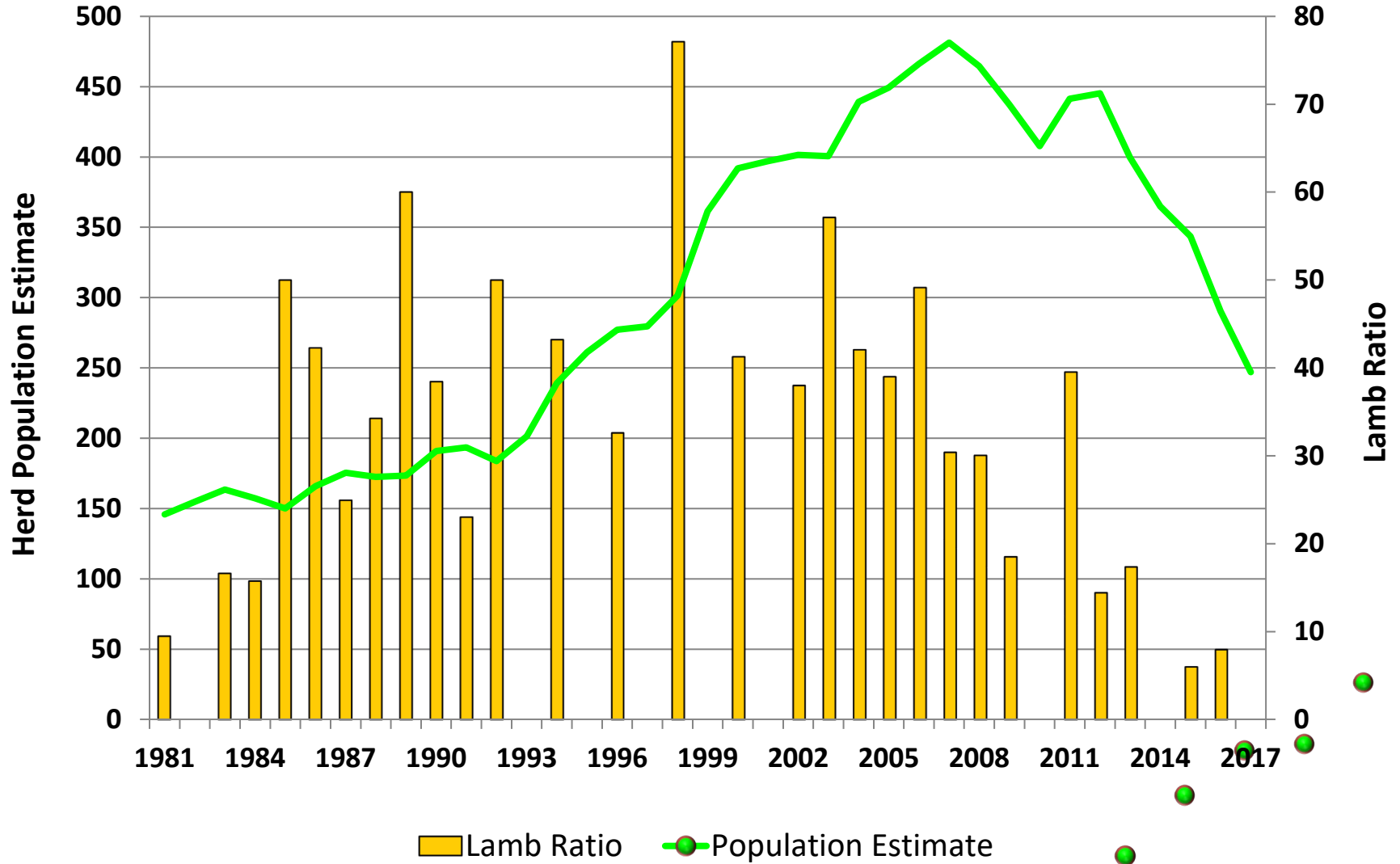
Southern Nevada Herds - 2015

- 2015 herd surveys
- decreased number of adults and few lambs in Nevada's 4 herds
- 25% of the 5-year average sheep survey #s were seen in Arizona's Black Mountains
- Subsequent sampling showed that the Mojave strain had replaced the Southern NV strain

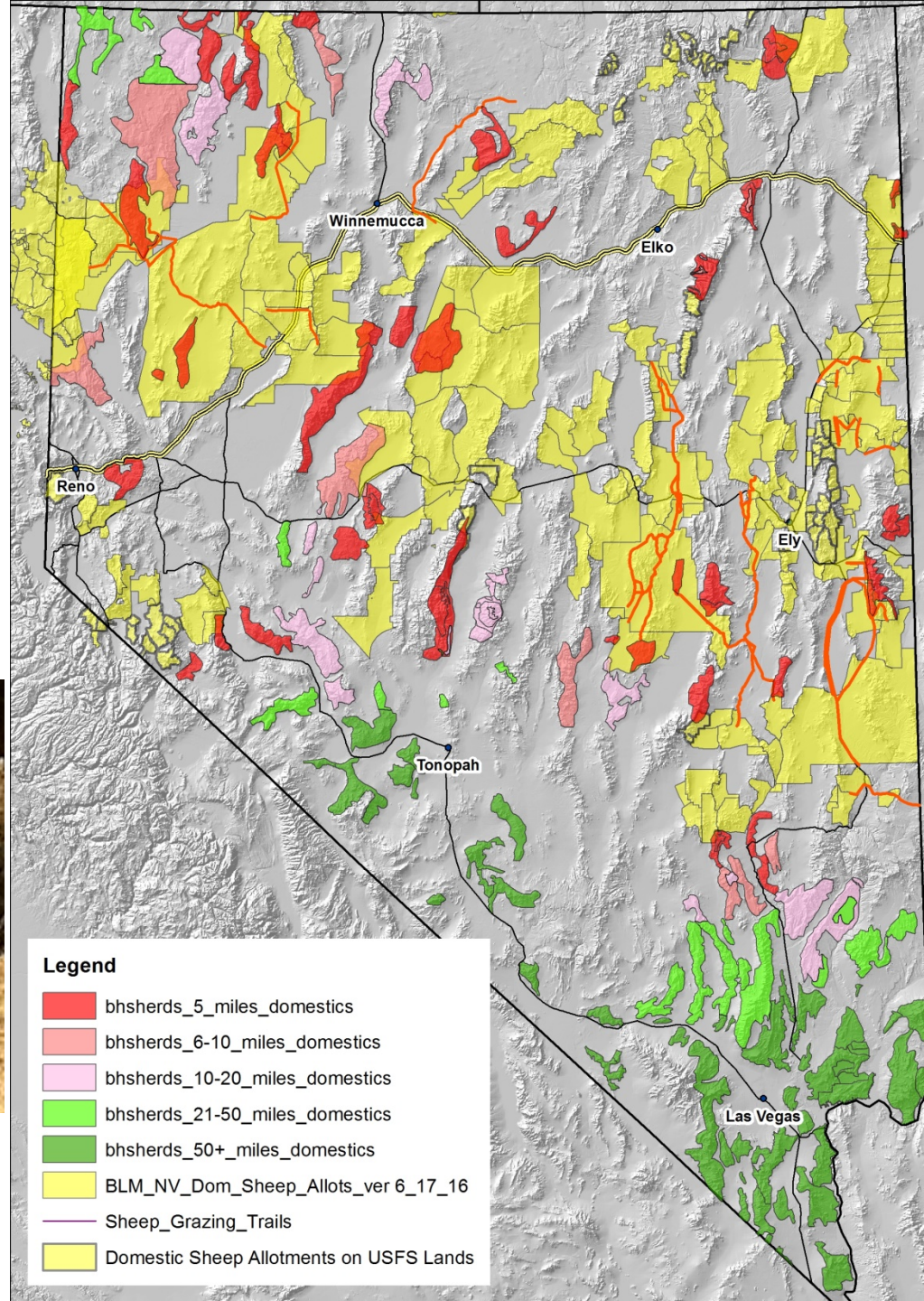


November 2015

McCullough Range, Unit 263



Risk of Public Land Domestic Sheep Allotments and Trailing Routes to Cause Pathogen Transmission to Bighorn Herds in Nevada





UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

MANUAL TRANSMITTAL SHEET

Release
1-1771

Date

3/2/2016

Subject

1730 - Management of Domestic Sheep and Goats to Sustain Wild Sheep (Public)

1. Explanation of Materials Transmitted: This release establishes policy for the management of domestic sheep and goats to sustain wild sheep on public lands administered by the Bureau of Land Management (BLM). This release acknowledges wild sheep habitat as a resource that may require special management considerations in the context of BLM authorized domestic sheep or goat grazing, trailing, or other (e.g., recreational) use within and adjacent to wild sheep habitat.
2. Reports Required: None.
3. Materials Superseded: This manual updates and supersedes policy guidance contained in Instruction Memorandum No. 98-140 – Revised Guidelines for Management of Domestic Sheep and Goats in Native Wild Sheep Habitats.
4. Filing Instructions: File as directed below.

REMOVE

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None

13 Pages

Steven A. Ellis
Deputy Director, Operations

1.6 Policy

The BLM's policy will be to (1) achieve effective separation of BLM authorized domestic sheep or goats from wild sheep on BLM lands, and (2) to minimize the risk of contact between the species. Effective separation is defined as the spatial or temporal separation between wild sheep and domestic sheep or goats, resulting in minimal risk of contact and subsequent transmission of respiratory disease between animal groups (see glossary). Currently, physical separation of domestic sheep or goats from wild sheep is the only effective means to reduce the potential for pneumonia-type disease transmission. Domestic sheep and goat authorizations and other uses will be implemented to ensure that effective separation results in a high degree of confidence that there will be a low to no risk of contact with wild sheep.

The BLM will execute this policy by including goals and objectives within land use plans, implementation-level plans, and land-use authorizations to support sustainable wild sheep and wild sheep habitat in fulfillment of the BLM's multiple-use and sustained yield mission. Where appropriate, the BLM will consider the potential for disease transmission in NEPA analyses, land use plans, implementation-level planning documents, and land-use authorizations. Wild sheep and domestic sheep and goat management activities will be planned, implemented, monitored, and evaluated in consideration of current and desired conditions and the potential for future changes in landscape and environmental conditions.

The BLM will use the best available science and information and carefully assess the stressors on wild sheep and habitat, including but not limited to the potential for disease transmission from domestic sheep or goats. Stressors will depend on local conditions but may include proximity to domestic sheep on private land, development pressure, degraded habitat and fragmentation, and translocation efforts, among other stressors. The BLM will consider the needs of the public through land use planning efforts so that it can make informed decisions on the management of domestic sheep and goat use and wild sheep and habitat on BLM lands. Further, the BLM will communicate, coordinate, and collaborate with stakeholders of BLM lands to achieve wild sheep and domestic sheep and goat management objectives. See also Coordination Section 1.9.

Manual's Guide to Manage for Sheep Separation

- Coordinate with state agency to acquire wild sheep occupied habitat maps and movement patterns
- Conduct risk of contact analysis on domestic sheep allotments and trailing routes to adjacent wild sheep herds
- Evaluate the levels of risk and potential management practices to implement in cooperation with permittee and state wildlife agency to achieve effective separation between wild sheep and domestic sheep or goats