



Issue Statement

Respiratory Disease and Mitigation in Wild Sheep

Historic population estimates, distribution, and restoration efforts

- Historically, wild sheep were distributed from Alaska, through western Canada, down into northern Mexico, and from the Pacific Coast mountains eastward to Alberta, the Dakotas, Nebraska, and Texas.
- Prior to European contact, numbers and distribution were much greater than today. By the mid-1950s fewer than 17,000 bighorns occurred in the West, with another 8,000 in Canada and Mexico.
- Disease contracted from domestic sheep or goats, combined with habitat loss and unregulated hunting, likely led to the declines.
- Restoration efforts began in the early 1900s, and the first surveys were conducted by naturalists in 1914.
- In 1922, bighorn sheep from Alberta were released in Montana ($n=12$) and South Dakota ($n=8$).
- Since then, approximately 22,000 animals have been moved to 17 of the 20 wild sheep jurisdictions in the U.S., Canada, and Mexico in ~1,500 separate translocations.
- These translocations, when combined with other management efforts, have restored bighorn numbers from around 17,000 to more than 85,000 in the U.S., Canada, and Mexico.

Respiratory disease in wild sheep

- Wild sheep are susceptible to a variety of diseases that affect herd viability, the most important of which is pneumonia.
- Bacterial pneumonia triggered by infection with *Mycoplasma ovipneumoniae* (*Movi*) is the primary cause of pneumonia, but viruses and environmental factors may contribute to respiratory disease outbreaks
- Bacterial infections are the primary cause of pneumonia, but viruses and ecological factors may contribute to respiratory disease outbreaks. Bacterial pneumonia often results in mortality of a large proportion of the population across all age classes (referred to as an all-age die-off), and is typically followed by multiple cohorts of apparently healthy wild lambs being born but dying of pneumonia a few months later.
- Research has confirmed that harmful bacteria are transmitted to wild sheep upon contact with, or close proximity to, domestic sheep or goats.
- There are some die-offs that cannot be directly attributed to contact with domestic sheep.
- Anecdotal reports from the 1800s show that many U.S. jurisdictions with bighorn sheep experienced population-level die-offs that were most likely associated with exposure to domestic sheep.
- The innate or inherent attraction and gregarious nature of wild sheep, combined with their dispersal, migratory, and exploratory behaviors, may increase the potential for contact with domestic sheep or goats, resulting in heightened risk of disease outbreaks. Intentional translocations of wild sheep may increase the potential for contact with domestic sheep or goats and the risk of pathogen transmission and disease outbreaks.
- Domestic sheep in large grazing allotments can become detached from the herd and wander into and among bighorn herds, increasing disease outbreaks.
- Wild sheep that are chronic carriers of respiratory pathogens can spread the disease to naïve wild sheep within or between populations, triggering extensive lamb losses for years to decades following the outbreak.
- Pneumonia can spread over great distances as a result of movement by bighorn sheep.
- This pattern of pneumonia and its effects are well documented in over 70 peer-reviewed scientific publications.

Respiratory disease in domestic sheep

- *Mycoplasma ovipneumoniae* (*Movi*) is abundant in U.S. domestic sheep flocks.
- Respiratory disease in domestic sheep and lambs can be a source of economic loss for domestic sheep producers.
- Domestic sheep have evolved resistance to several forms of respiratory disease, and adults are able to carry the disease-causing bacteria, without demonstrating clinical pneumonia.

Mycoplasma ovipneumoniae in wild sheep

- *Movi* has been implicated as the primary causative agent that drives pneumonia in bighorn sheep, and has its origins in domestic sheep. *Movi* breaks down the natural defense system and allows secondary agents to enter the lungs.
- Secondary agents including bacteria commonly associated with domestic sheep and other factors likely contribute to severity of disease in individuals or herds.
- Initial spillover of *Movi* most likely occurs via contact with domestic sheep or goats, but can subsequently be circulated by wild sheep or mountain goats.

Where does Movi come from?

- *Movi* cannot live in the environment, so a live-animal source is needed
- *Movi* infects only sheep and goat species (Caprinae), and the most-likely *Movi* sources include:
 - Infected domestic sheep
 - Infected domestic goats
 - Infected wild sheep
 - Infected Rocky Mountain goats
 - Infected muskox

Mitigation

- Proactively protecting and managing the health of wild sheep populations is essential to the continued success of conservation efforts in North America.
- Other than effective separation, very few options exist to reduce the likelihood of disease transmission.
- What might be done to minimize the occurrence of pneumonia in bighorn sheep:
 1. Reduce exposure to the causative agent or minimize contact with domestic sheep/goats.
 - Close public lands grazing allotments with high risk of contact
 - Educate private-land producers about the need for effective separation
 - Reduce or eliminate *Movi* in nearby domestic sheep or goats
 - Minimize contact with and between infected bighorn sheep
 2. Increase non-specific host resistance (i.e., create disease-free domestic sheep)
 - Work in progress, but no guarantee of success
 3. Increase specific host resistance (i.e., create *Movi*-resistant bighorns)
 - Vaccine – No effective vaccine or treatment is currently available for pneumonia in bighorn sheep.
- Maintaining appropriate and reasonable spatial and temporal separation between wild sheep and domestic sheep and goats is currently the most effective tool available for minimizing risk of disease transmission between these species.