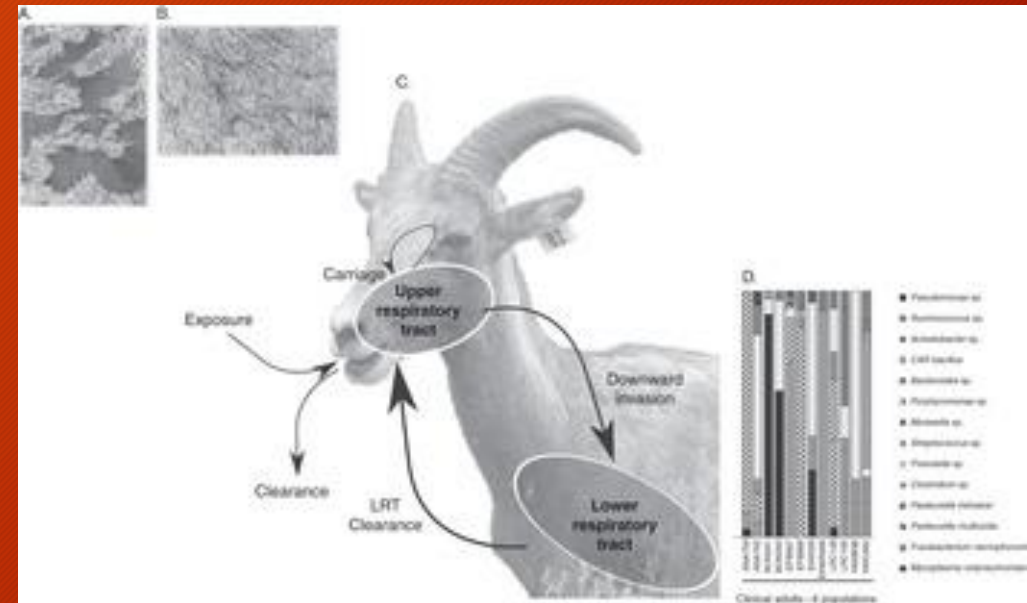


Mycoplasma ovipneumoniae
and bighorn sheep

The cough after the storm. What is the cause of pneumonia in wild sheep and goats?

- Respiratory disease in bighorn sheep is a complex disease, comprising many diverse bacteria in the lungs of fatally infected sheep.
- Where it occurs, bighorn sheep experience significant die-offs and population recovery is slow, if at all.
- The paradigm of the pneumonia infection pattern in bighorn sheep has shifted over the years, reflecting both the diversity of the agents found in sick sheep and availability of testing procedures.



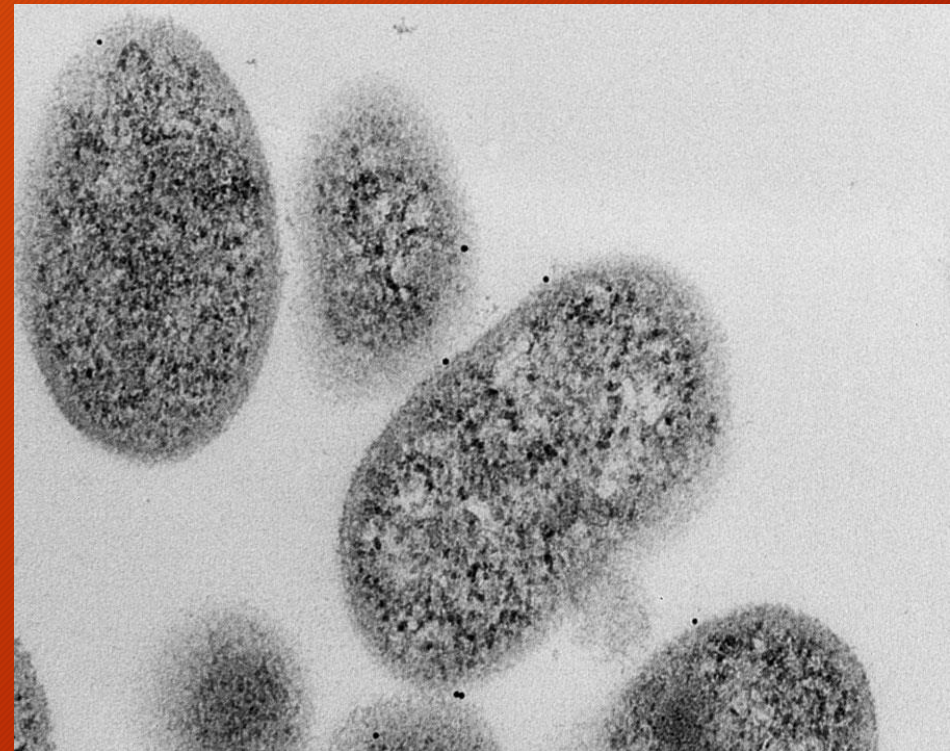
This or that?

- Suspected causes over the years have included:
 - Lungworms
 - Bacteria such as *Pasteurella multocida*, *Mannheimia haemolytica*
 - Multi-factorial respiratory disease complex
- Each are significant, but they do not exhibit a clear association with disease outbreaks in wild, free ranging sheep and goats.
- Experimental evidence has shown that these agents alone do not pose the extreme threat as observed in the die-offs seen and the long term effects.
- Controlled studies has also shown that what ever is stimulating polymicrobial pneumonia in wild sheep is specific to Caprinae (see Besser et al 2013)



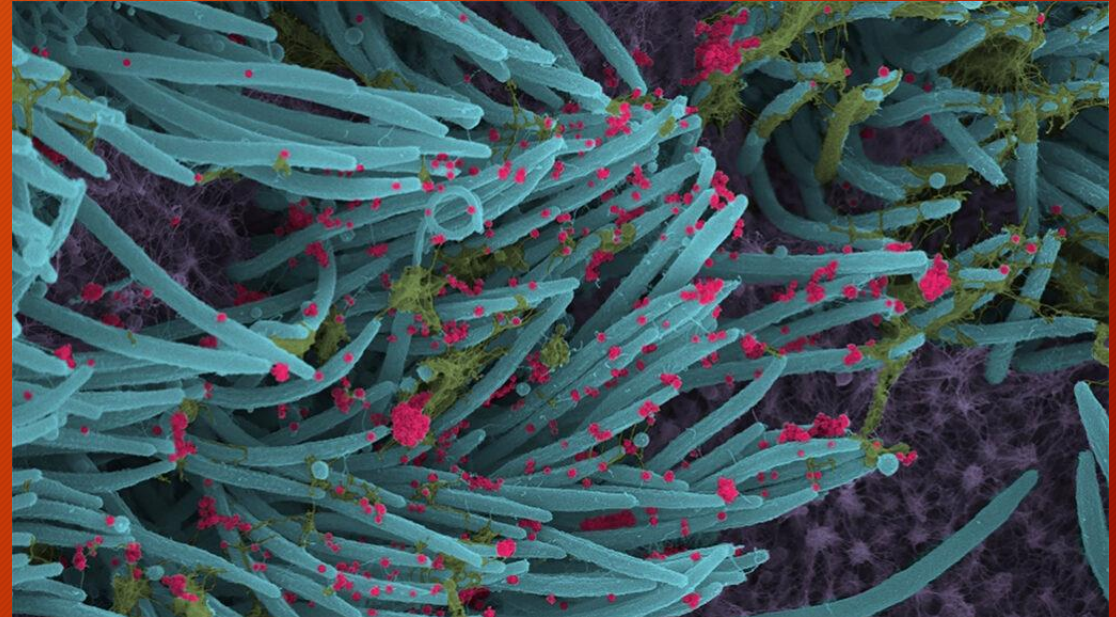
Mycoplasma ovipneumoniae (M.OVI)

- In 2006, it was learned that *Mycoplasma ovipneumoniae* first invaded the lungs of sheep/goats and predisposed the infected animal to poly-microbial pneumonia.
- This pathogen has met the criteria relevant to infectious disease cause than any of the other competing evidence and is considered the primary pathogen causing fatal pneumonia in BHS.
- *M. ovipneumoniae* is a respiratory bacterium that is associated with an impactful pneumonia in species of Caprinae (sheep, goats, muskox etc)
- *M. ovipneumoniae* can be pathogenic on its own but also predisposes animals to other respiratory infections.
- M.ovi has been associated with illness in both domestic sheep/goats and bighorn sheep in North America.
- Contact with domestic sheep and goats have resulted in pneumonia outbreaks.



How *M.ovi* functions?

- The clinical course of *Mycoplasma ovipneumoniae* from both experimental and natural infections show that this bacteria binds to cilia of the respiratory tract.
- This disrupts the ability of the animal to clear the lungs of opportunistic bacteria with lethal results.



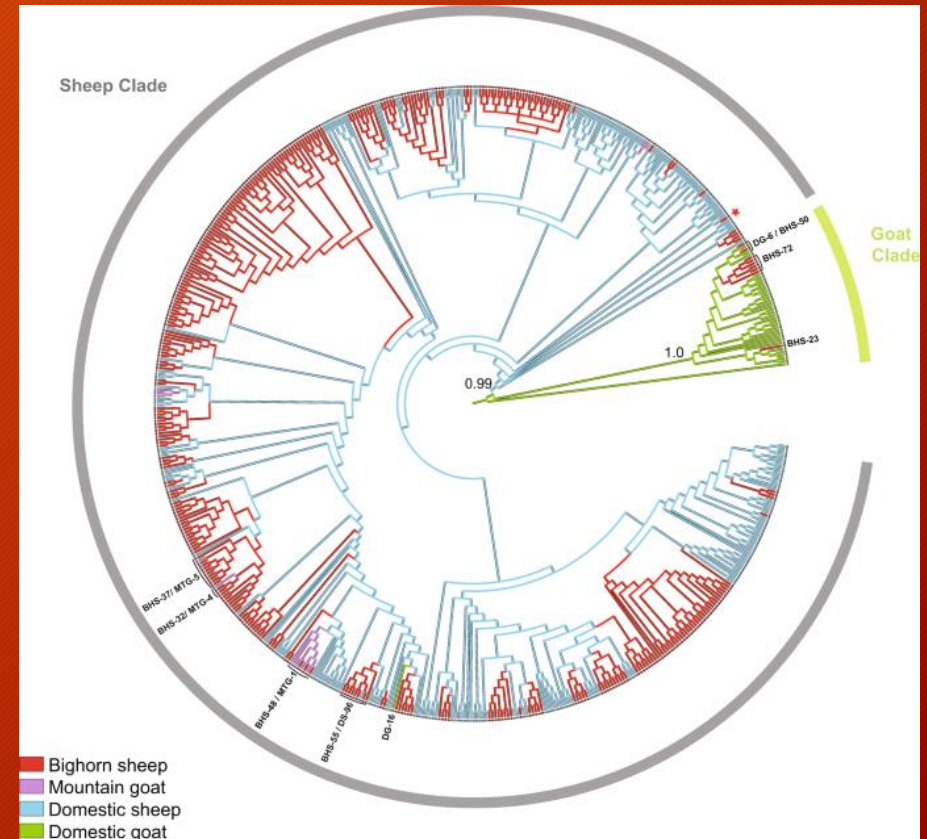
Wild vs. domestic

- *Mycoplasma ovipneumoniae* does infect both domestic and wild sheep/goats. But there are stark contrasts to morbidity and mortality.
- *M. ovi.* is associated with early pneumonia in domestic lambs/kids, but older sheep may be completely resistant to the bacteria, yet still harbour it.
- In wild sheep, when the pathogen is first introduced into a population all age die-offs occur and BHS lambs are completely susceptible.
- Comparably, this does not occur in domestic sheep.
- This is suggestive of an evolved tolerance in domestics, with their ability to shed *M.ovi.*, yet display low morbidity and mortality.
- There is evidence that *M.ovi.* can affect the growth and long term health of lambs/kids.



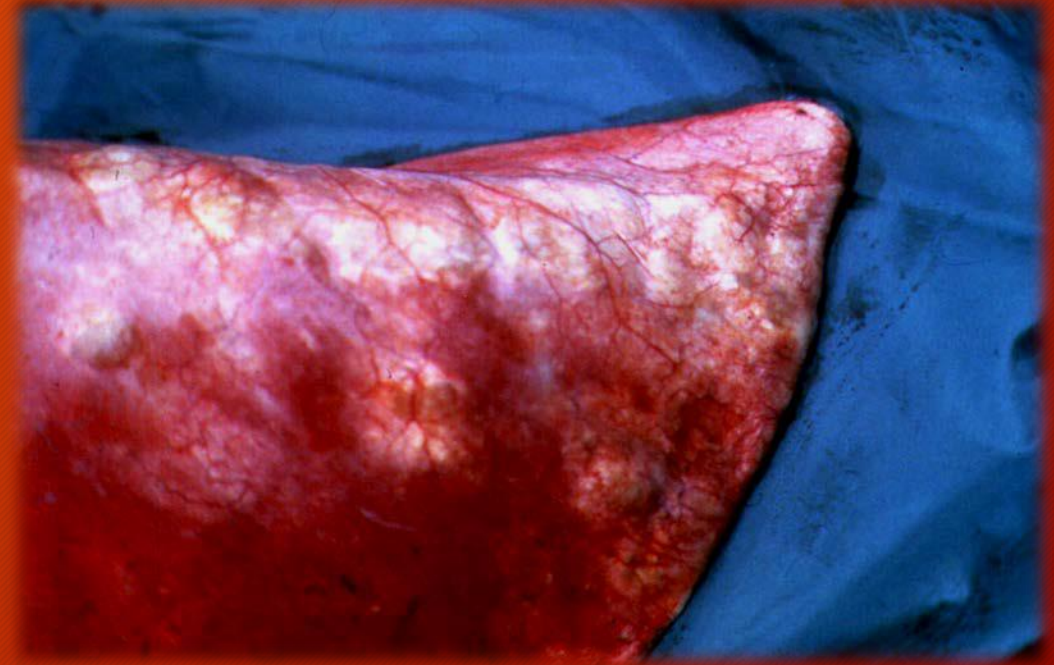
Mycoplasma ovipneumoniae strain types

- Domestic sheep and goats can also harbour different strains of *M.ovi.* simultaneously. Although the effect of various strains in domestic sheep can go unnoticed
- 28 different strains were detected in 45 bighorn sheep populations experiencing die-offs were found in domestic sheep (most) and goat strain groups. Kamath et al 2019
- New strains are introduced to wild sheep it can disrupt any immune response wild sheep have had to a previous strain and present all age die offs again
- Understanding these strain types is under consideration, and an important component to surveillance programs.
- There are no vaccines, and antibiotic treatment may only clear the infection but does not prevent reinfection



Clinical signs of *M. ovi*.

- In domestic sheep and goats, *M. ovi* is typically subclinical, and has low morbidity and mortality.
 - Mild respiratory disease, lethargy etc.
 - Can be asymptomatic.
 - Individuals are still infectious.
- In bighorn sheep, *M. ovi* typically presents a more severe clinical signs.
 - Coughing, ear paresis, fever and sudden death.
 - In many herds that become infected with *M. ovi*, the impact is described as population limiting epizootics.
 - There is no evidence that bighorn sheep adapt to this bacteria.



Head shaking and cough

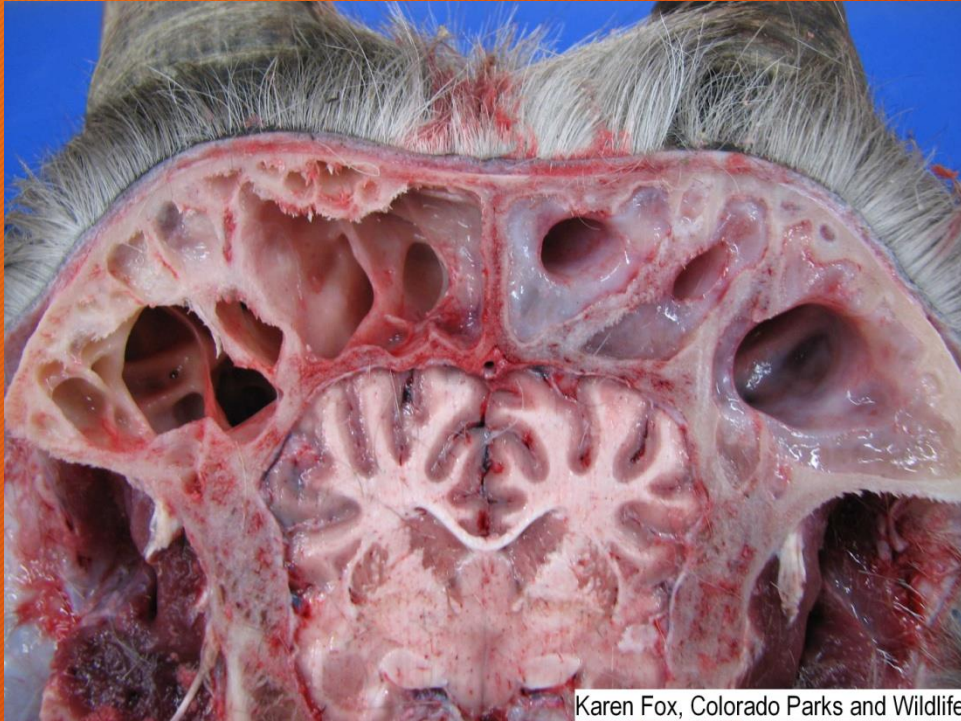


Video courtesy of Wyoming Game and Fish Department

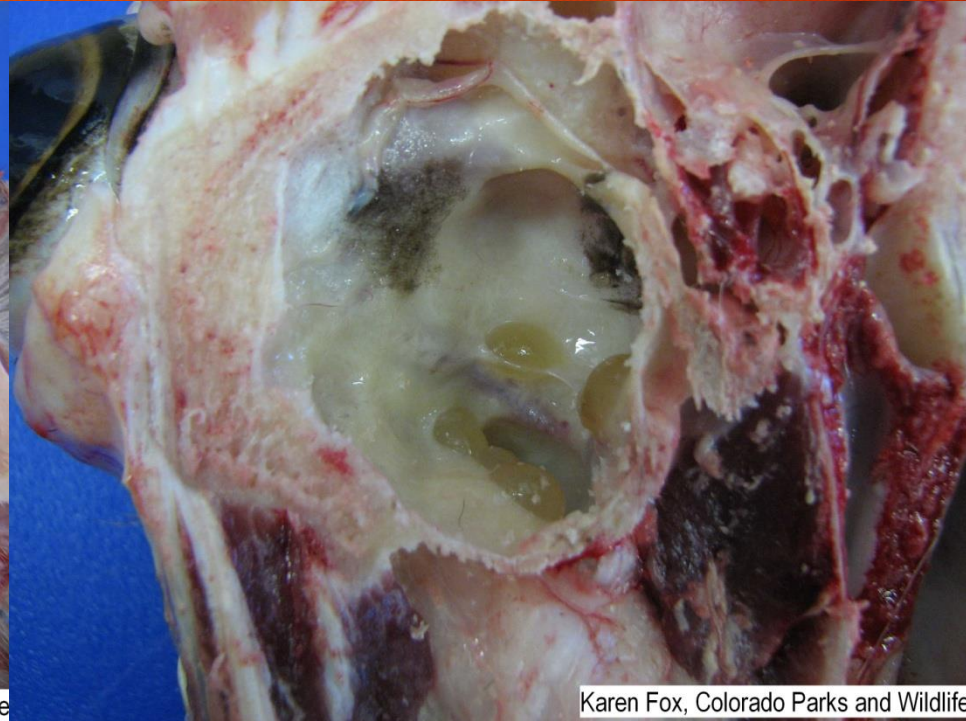


Video courtesy of Wyoming Game and Fish Department

Sinus tumors



Karen Fox, Colorado Parks and Wildlife



Karen Fox, Colorado Parks and Wildlife

How is this bacteria spread?

- M.ovi. is spread through aerosol (sneeze, cough) or direct contact. There is no evidence of disease spread through contaminated environment.
- M. ovi. is a bacteria that is specific to goats and sheep.
- Natural and experimental observations have shown that it is not spread through other livestock or wild species.
- There is more work to be done for llamas and alpacas.
- M.ovi. can persist in herds and flocks though chronic spreaders. Animals that have overcome initial infections, yet still are infectious.
- Not all pneumonia die-offs are related to contact with domestics, but they are the greatest risk to wild sheep.



Die off events

- Many of the bighorn populations in western North America have experienced all aged die-offs due to pneumonia.
- There have been at times high mortality die-offs that have led to extirpation, however the median loss is ~50% from 82 reported outbreaks.
- After the initial die-off events, herd recovery becomes difficult.
 - Chronic Shedders
 - Many of these populations experience 0 recruitment for many years.



Surveillance Program

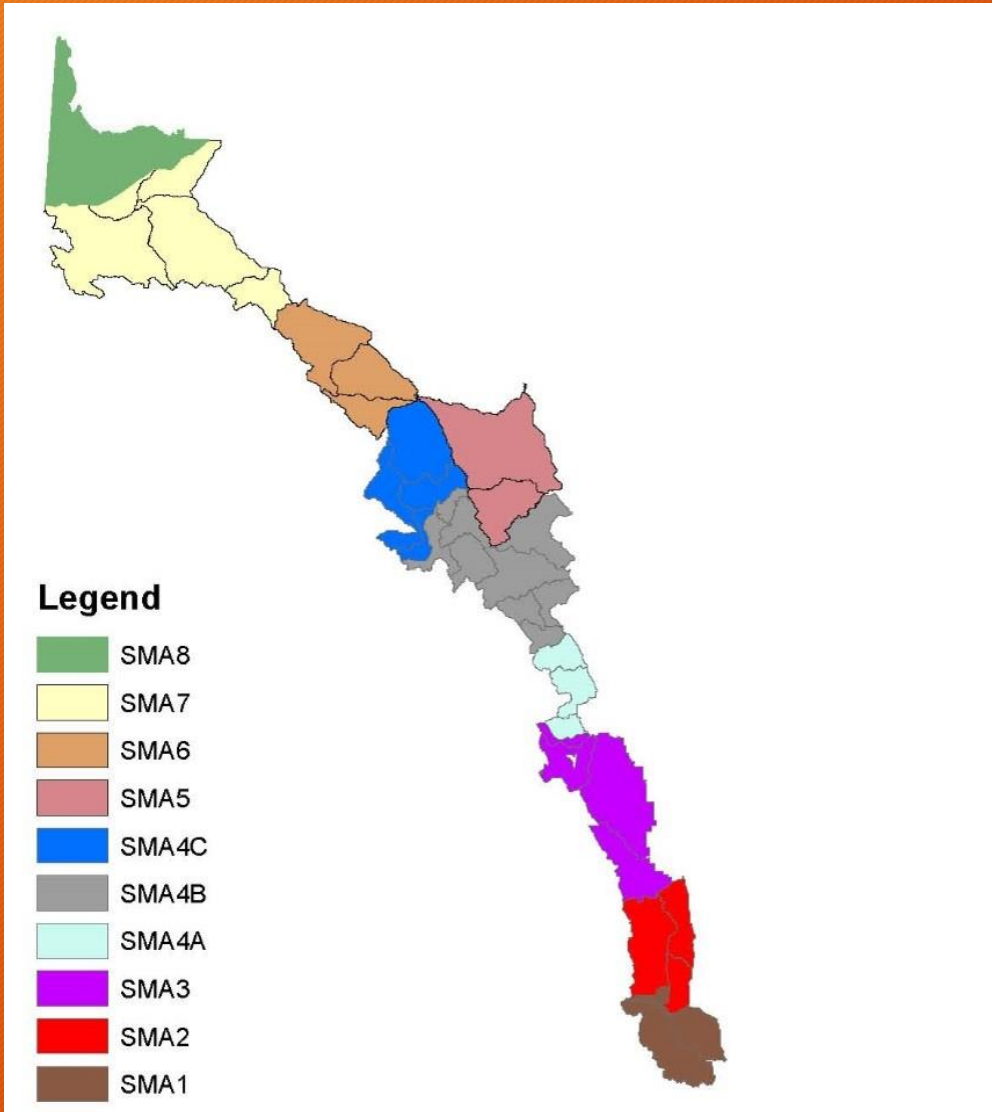


Why We Initiated Testing

WAFWA / WSWG Wild Sheep Disease Management Venture



Ongoing Monitoring



- We have tested ~400 of these samples. All negative.
- We have reached sample size required for detection at 5% prevalence.



Testing Domestic Sheep & Goats

- Testing of domestics should include those farms/animals that are in live close proximity to bighorn sheep ranges (within 50km)
- We have some funding (WSF) to do testing on animals that present the greatest risk to contact.
- Benefits to producers:
 - Promote healthy animals
- Our focus here would be to:
 - Educate
 - Work with stakeholders that utilize domestic sheep and goats (4H)
 - Develop a testing criteria for domestics in BHS sheep areas, this may require voluntary testing by these groups with assistance from AEP.



Helen Schwantje

The Future?

- Studies on bighorn immunity - can it be improved?
- Regional approach across west
- Focus on working together – animal health specialists and producer groups finding common ground.
- Incorporate science and social values to make decisions with shared goals.