

## **High Risk Behavior for Wild Sheep: Contact with Domestic Sheep and Goats**

### **Introduction**

The impact of disease on wild sheep populations was brought to the forefront in the winter of 2009-10 due to all age outbreaks of pneumonia with high mortality in Rocky Mountain bighorn herds in Montana, Wyoming, Washington, Utah and Nevada. As of spring, 2010, more than 1000 bighorn are thought to have died either from the direct effects of the infection or through efforts to cull sick sheep to prevent further spread of the disease. There was documentation of contact with domestic sheep and/or goats in some but not all of the outbreaks. (JAVMA News, 2010). See <http://www.avma.org/onlnews/javma/may10/100501c.asp> for article.

The controversy surrounding the grazing of domestic sheep in wild sheep habitat is longstanding and places those interested in protecting wild sheep populations and those trying to preserve domestic sheep ranching on public lands on opposing sides, often in court. There is abundant evidence in the wildlife scientific literature that bighorn sheep that come into contact with domestic sheep are at greatly increased risk of developing fatal respiratory disease. Due to their social behavior, infection spreads rapidly in wild sheep herds resulting in all age mortality and years of lamb losses, which can delay recovery of affected populations. This evidence is often denied as inadequate by domestic sheep interests. A recent publication (Lawrence et al, 2010) provides irrefutable evidence that pathogenic bacteria passed from healthy domestic sheep to healthy bighorn sheep resulted in fatal pneumonia in all the bighorn sheep while the domestic sheep remained healthy. This study provides further confirmation that if the conservation of wild sheep is a priority then the grazing of domestic sheep should not occur in or near wild sheep habitat. A summary of this publication can be found at: <http://www.avma.org/onlnews/javma/nov10/101101n.asp>

Less well documented are the risks of allowing domestic goats to be grazed in or near wild sheep habitat. Large scale grazing of domestic goats is not as common as with domestic sheep, but goats may be used for weed control or as pack animals for hikers on both private and public land. Jansen et al (2006, 2007) described an outbreak of infectious keratoconjunctivitis (severe eye infections) in a native population of desert bighorn sheep in the Silver Bell Mountains of Arizona resulting from contact with domestic goats. Infection resulted in blindness and mortality in affected bighorn sheep. A concurrent outbreak of contagious ecthyma (soremouth) further compromised the bighorn and most likely resulted in additional mortality. The disease outbreak ran its course after the domestic goats were removed from bighorn habitat. The bighorn population declined by an estimated 23% due to the disease outbreak.

### **Respiratory Disease (Pneumonia)**

The population effects of mortality in wild sheep from predation, falls, illegal hunting and winter kill pale compared to those from devastating pneumonia related die-offs. In the winter of 2009-2010 losses of Rocky Mountain bighorn in Montana, Wyoming, Washington, Utah and Nevada were estimated to be at least a thousand sheep (JAVMA News 2010). Some but not all outbreaks were thought to be associated with contact with domestic sheep or goats.

Determining the causes of an outbreak of respiratory disease in wild sheep is difficult and may involve severe weather, poor nutrition, stress or many other factors. However, scientific

literature documenting decades of experience and research have identified contact with domestic sheep as a significant risk factor in outbreaks of pneumonia in bighorn herds. This literature includes reports of pneumonia in bighorn herds in the wild after contact with grazing sheep; experimental pen trials where healthy domestic sheep are commingled with healthy bighorn sheep and all the bighorn die of pneumonia and the domestic sheep remain healthy; and trials where healthy bighorn are inoculated with bacteria isolated from healthy domestic sheep and the bighorn die of pneumonia. All these reports support the premise that contact with domestic sheep increases the risk of disease and death for wild sheep from pneumonia. Once contact with domestic sheep occurs, the social behavior of wild sheep, especially of rams, facilitates the spread of disease as rams seek out ewes during the rut, and as herd members make nose to nose contact when ewe groups meet. (See bighorn sheep page at the CDFG Marine Wildlife Veterinary Care and Research Center website for extensive wild sheep disease references.

<http://www.mwvrc.org/content/view/122/112> )

Sheep operators who graze domestic sheep on pastures in or near bighorn habitat refute the published scientific literature as inadequate proof that domestic sheep are a source of disease for wild sheep. However, a recent study conducted by researchers at Washington State University (Lawrence et al, 2010) provides irrefutable evidence of transmission of pathogenic bacteria from healthy domestic sheep to bighorn sheep, resulting in the deaths of 4/4 of the bighorn. The researchers isolated *Mannheimia haemolytica*, a bacteria known to cause pneumonia in wild sheep, from four healthy domestic sheep. They tagged the *M. haemolytica* with a fluorescent dye protein and an antibiotic resistance factor; then re-inoculated the domestic sheep with the tagged bacteria. Transmission of the tagged *M. haemolytica* from the domestic sheep to the bighorn was demonstrated after a period of fence-line contact, and all the bighorn died a short time after being commingled with the domestic sheep. Post mortem examination of the dead bighorn indicated all died of severe pneumonia and all had the tagged *M. haemolytica* in their lungs. All the domestic sheep remained healthy throughout the trial.

The results of this study support previous scientific research indicating that either direct or fence-line contact with domestic sheep results in the transmission of pathogenic organisms to wild sheep and greatly increases the risk of respiratory disease and severe declines in wild populations.

In California, respiratory disease in bighorn sheep herds currently result in excessive lamb mortality in herds in the White Mountains of Inyo County and in endangered desert bighorn sheep in the Peninsular mountain ranges in Riverside and San Diego Counties.

### **Infectious Keratoconjunctivitis (IKC) and Contagious Ecthyma (CE)**

(Jansen et al, 2006, 2007)

The Silver Bell Mountains in south central Arizona are home to a small native population of desert bighorn sheep. Prior to October 2003 there was no documented history of disease in this population. There was an ongoing demographic study initiated in May for which 9 bighorn had been radiocollared, and a helicopter population survey was conducted in October, 2003 in the sheep range. In late October, 2003, 4800 domestic goats were trucked in and released on a pasture about 7 miles from sheep range. Two weeks later, approximately 100 of these goats had escaped and were detected in occupied sheep habitat. Domestic goats persisted on bighorn range until all had been removed in January, 2004. Four weeks after goats were first seen on bighorn

range, symptoms of infectious keratoconjunctivitis, (IKC), a severe inflammatory infection of the eye, were observed in several bighorn sheep. IKC results in blindness and sometimes rupture of the eyeball. Biologists were able to capture and radiocollar affected animals in order to administer treatment and to follow the course of the disease. Between December, 2003, when the first signs of disease appeared, until March of 2004, when the last affected animal died, a total of 33 (39% of the estimated population before the outbreak) were blinded by the infection. Of the 28 affected sheep with known outcomes, 14 recovered and 14 died, with cause of death determined for 11 animals. Mortalities were attributed to lion predation (6), starvation (4) and injuries from falls (1). During the outbreak, the bighorn herd also contracted contagious ecthyma, (soremouth, CE), an inflammatory viral infection of the mucous membranes of the mouth, nose, anus and udders. CE infection further compromised IKC affected bighorn and most likely increased mortality. After another helicopter population survey in October, 2004, it was estimated that the population had declined by approximately 23%, with a marked reduction in ewe numbers. Because the affected animals were not able to feed, biologists speculated that the mortality rate from starvation would have been much higher in a location with a cold winter climate as in the Northern Rockies, or in California, the San Gabriel, San Bernardino and White Mountains and the Sierra Nevada.

Cultures and genetic diagnostic tests revealed that the eye infections were caused by a bacterium called *Mycoplasma* with a second bacteria, *Bramhamella*, worsening the inflammation. Sophisticated genetic techniques provided strong evidence that the domestic goats had transmitted the infection to the bighorn.

## **Conclusion**

Outbreaks of infectious disease in wild sheep are difficult if not impossible to manage. Tools used in domestic livestock such as treatment and vaccination are impractical and generally ineffective when applied to wild populations. Disease outbreaks in wildlife must generally run their course and, as seen in the outbreaks in the Rocky Mountain States, pneumonia can result in very high mortality in wild sheep populations. Prevention is the key. Although not all outbreaks can be attributed to transmission from domestic sheep and goats, there is overwhelming scientific evidence that contact with domestic livestock significantly increases the risk of disease in wild sheep populations. During the rut, bighorn rams will wander long distances to breed and are attracted to domestic sheep herds. Feral domestic sheep and goats have been found in bighorn range in many areas of California. If the conservation of wild sheep populations is a priority, geographic separation of sheep and goat grazing from bighorn habitat is the only sure method to prevent contact between bighorn and domestic sheep and goats and to reduce the risk of disease outbreaks. Stated simply and clearly, the presence of domestic sheep and goats in or near occupied bighorn habitat is incompatible with healthy populations of bighorn sheep.

Hunters and other outdoorsman are in a unique position to observe domestic goats and sheep in wild sheep habitat and to report them to the local Department of Fish and Game office. Early detection and removal of domestic sheep and goats from wild sheep habitat may limit the extent of a disease outbreak. Sportsman's organizations can also partner with wildlife agencies to influence land management agencies and private property owners to reduce the risks of disease in wild sheep by providing geographic separation between domestic sheep and goat grazing and wild sheep habitat.

## References

Jansen, B.D., J.R. Heffelfinger, T. H. Noon, P. R. Krausman, J.C. DeVos, Jr. 2006. Infectious Keratoconjunctivitis in Bighorn Sheep, Silver Bell Mountains, Arizona, USA. *Journal of Wildlife Diseases*, 42(2): 407-411.

Jansen, B.D., P.R. Krausman, J.R. Heffelfinger, T.H. Noon, J.C. DeVos, Jr. 2007. Population Dynamics and Behavior of Bighorn Sheep with Infectious Keratoconjunctivitis. *Journal of Wildlife Management*, 71 (2): 571-575.

JAVMA News. 2010. Severe Pneumonia Outbreak Kills Bighorn Sheep. *Journal of the American Veterinary Medical Association*. May 1, 2010: 395-396.

Lawrence, P.K., S. Shanthalingam, R.P. Dassanayake, R. Subramanian, C.N. Herndon, D.P. Knowles, F.R. Rurangirwa, W.J. Foreyt, G. Wayman, A.M. Marciel, S.K. Highlander, and S. Srikumaran. 2010. Transmission of *Mannheimia haemolytica* from Domestic Sheep (*Ovis aries*) to Bighorn Sheep (*Ovis canadensis*): Unequivocal Demonstration with Green Fluorescent Protein-Tagged Organisms. *Journal of Wildlife Diseases* 46(3): 706-717.



Photo by Bighorn Institute. This 6 year old Peninsular bighorn ram and domestic goat were removed from the San Jacinto Mountains due to concerns of disease transmission to an adjacent highly endangered bighorn population.

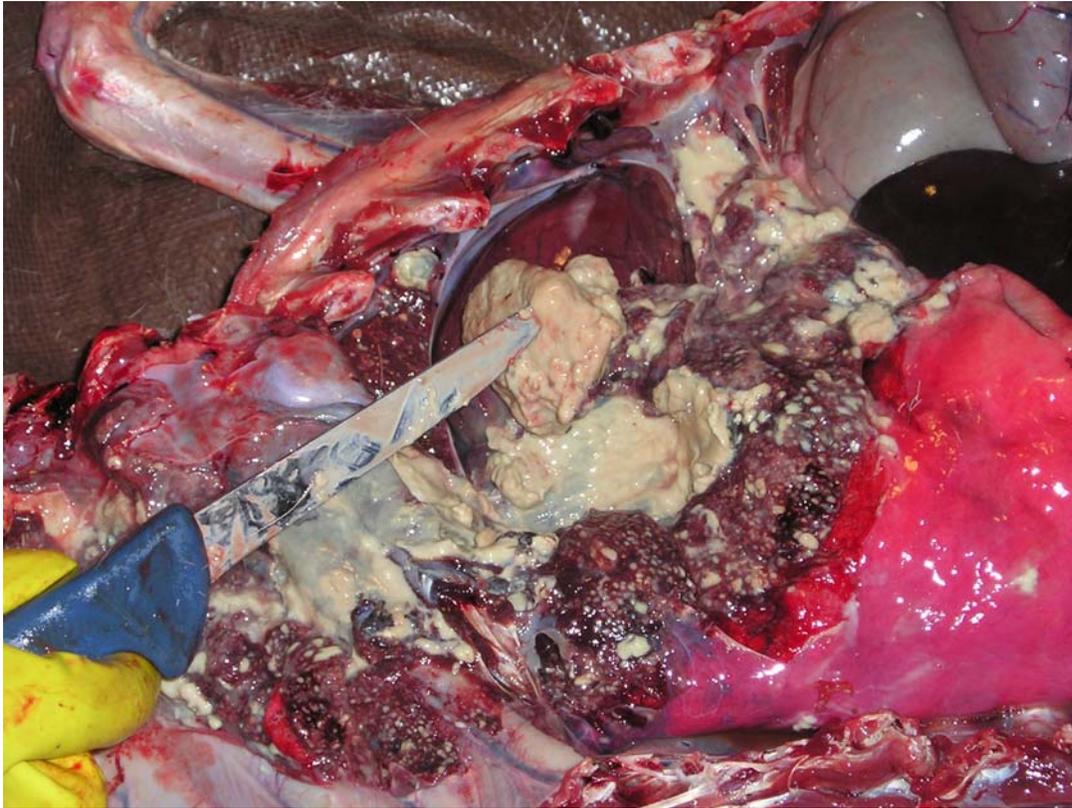


Photo by Janene Colby. Severe pneumonia in a desert bighorn sheep with extensive abscesses in lungs. Many bighorn die well before pneumonia develops to this point.



Photo by Brian D. Jansen. Domestic goats in bighorn habitat, Silver Bell Mountains, Arizona



Photo by Brian D. Jansen. Desert bighorn ram blinded by eye infection (Infectious Keratoconjunctivitis). Silver Bell Mountains, Arizona.



Photo by Brian D. Jansen. Desert bighorn ewe with contagious ecthyma. (soremouth). Silver Bell Mountains, Arizona.