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Pneumonia in Mountain West Sheep Populations

Bighorn sheep (*Ovis canadensis)* are native to the Western mountainous regions of North America, ranging all the way from South Canada to Mexico. Bighorn sheep prefer to inhabit rocky areas since they can easily escape predators by climbing on steep, narrow rocks or by jumping across wide crevices in their rugged environment. This is due to their hooves having a soft, sponge like inside that aid in traction and a hard outside rim that assist them in digging. Their hooves also have a split in them to allow them to grab and hold onto rocks. In the wild, Bighorn sheep will commonly graze on grass, including horsetail, bluegrass, June grass, needle grass and wheat grass. In the colder months they tend to feed on woody vegetation such as willow, alder, and evergreens (). Bighorn sheep are social animals that live in herds and there is estimated to fewer than 70,00 bighorn sheep left in North America today. In the warm months, male bighorn sheep will form herds of around ten sheep that is led by a dominant male. The female and young sheep will form a separate herd that is commonly led by an older sheep and will generally graze in different areas than the males. In the winter and during mating season, herds will mix and can contain up to one hundred bighorn sheep consisting of males, females and young (Bighorn Sheep Facts). During mating season, males will engage in wide ranging forays in pursuit to find a potential mates. A close relative of Bighorn sheep are domestic sheep (*Ovis aries)* however they originate from the old world and were one of the first animals to be domesticated. Sheep have been harvested for their meat, milk, hide and wool for centuries. A National Agriculture Statistics Service was released by the United States Department of Agriculture in January 2022 stated that there are approximately 3.71 million breeding sheep and 1.36 million market sheep (BLM). The North America bighorn population was once estimated to be between 1.5 to 2 million but now is less than 70,000 mainly due to disease and habitat loss.

One of the most common sheep diseases contracted by bighorn sheep is Pneumonia, an infection in the lungs often caused by a combination of bacteria, viruses and/or parasites. The crucially important infectious agents associated with sheep pneumonia is the Parainfluenza virus type-3 and the bacteria *Manehimia haemolytica.* Although there are other pathogens that infect sheep, these seem to be the most crucial. The disease effects all age classes but young sheep or sheep subjected to stressors are at higher risk. Stressors impact an animal’s immune system and can include transportation of sheep, inadequate ventilation, and climate change (). Most pneumonias develop intensely, are highly contagious and have the potential to cause outbreaks of disease. Often in bacteria pneumonias it is not detected until the sheep has already deceased. Most domestic sheep have tolerance or immunity to pneumonia and the infections go undetected. Symptoms associated with pneumonias are shallow breathing, coughing and nasal discharge. There is currently no cure for the disease in Bighorn sheep populations and the current alteration for domestic sheep isn’t cost-effective. One would think the solution is relatively easy, just keep the wild sheep ad domestic sheep separate from each other, but, in practice, policy and law the problem is more complex than it seems.

The Federal Land Policy and Management Act (FLPMA) and the National Forest Management Act (NFMA) mandated the U.S Forest Service manage lands for multiple uses, including grazing, timber harvest, and wildlife. This act dictates who gets to do what on public lands. The Bureau of Land Management is aware of the effects this has on the spread of disease and they are considering management actions. However, since both agencies are required to have public lands available for both wildlife habitat and grazing under FLPMA and NFMA, they are legally mandating the coexistence of domestic grazing sheep and wild bighorn sheep. As stated before, it is common for an infected domestic sheep to go undetected since they have built up some immunity to the disease. If a farmer doesn’t know their herd is infected, they will take them to graze on public lands and unintentionally infect wild big horn sheep. The disease is spread by direct physical contact or airborne particles can be up to 30-100m from the source (Cassier). Wild big horn sheep have not built-up immunity to the disease and mortality estimates range from 50-80% of individuals within the affected herd (USGS). Following a heard infection, lamb survival is poor since they do not have any immunity to the disease. For wild sheep conservationists, this is a big issue.

Currently, Wildlife management agencies and non-governmental organizations are actively trying to reduce contact between wild bighorn sheep and domestic sheep through a combination of regulations on public lands, outreach programs and education on private lands. Regulation on public lands was developed by the Bureau of Land Management and the U.S Forest service and had the goal of effective separation. The regulation in forces spatial or temporal separation between wild sheep and domestic, minimizing the rick of contact. It provides guidance to Bureau of Land Management field officers to analyze and assess risk, and to make informed decisions on minimizing contact. Bureau of Land Management also can assist the state, as well as other governmental and non-governmental partners, with regulations to sustain healthy sheep populations (BLM). Some methods that have been practiced on domestic sheep populations to reduce contact includes double-fencing herds in wild sheep habitat, the use of additional guard dogs, penning domestic sheep at night and counting domestic sheep more frequently. These methods have been proven impractical, expensive and not ideal for private farm owners. Other strategies that wildlife managers have tempted is administering antibiotic, selective culling, and partial or complete depopulation. The issue with having an effective antibiotic is that there are multiple pathogens that cause pneumonia, making it hard to eliminate from the body. A variety of antibiotics have been administered to infected bighorn sheep, with very little success (For managers). There is currently no effective vaccine against sheep pneumonia, and no effective treatments, therefor wildlife managers have focused on the prevention of contact and transmission. In 2012, the Western Association of Fish & Wildlife Agencies released recommendations for domestic sheep and management in wild sheep habitat. First, they gave suggestions for wild sheep managers. They recommend that risk assessments should be completed at least once per decade and they should identify where and to what extent wild sheep could interface with domestic sheep. The higher the risk of infections are, the more intense the wild bighorn sheep populations should be monitored and managed. Wild sheep managers should identify, analyze, and evaluate corridors between herds. The analysis should include distribution and continuity among wild bighorn sheep populations. Another effective suggestion they have is removal of wild sheep that are known or suspected to have close association with domestic sheep. They also state wild sheep populations should have pre-determined population objectives that are agreed-upon to minimize the potential of contact. Agencies should develop an implemented written protocol for when contact between domestic and wild sheep occur. Suggestions for domestic sheep managers was also provided and included ensuring all domestic sheep are individually marked and traceable to herd, and conducting full counts when trailing, especially after any scattering occurs (recommendations for). The management alterations to reduce contact is limited and maintaining effective spatial between wild and domestic sheep seems to be most current effective method.

Big horn and domestic separation policies are typically associated with federal grazing permits or are included in land management plan (Interaction Policies). In 1995, the Desert Bighorn Council became the Bureau of Land Management advisory policy and they proposed four key separation recommendations (BLM). One being buffer zones, zones where no domestic sheep grazing should be allowed within. These strips are typically in surrounding bighorn habitat, but managers also understand each situation and there are exceptions. Another recommendation is livestock supervision, basically stating that domestic sheep that are trailed or graze on public lands should be supervised by efficient, capable ad well informed herders. The Desert Bighorn Council also recommended trail restrictions; domestic sheep should be trucked rather than trailed to reduce contact. The final limitations imposed by the Desert Bighorn Council is prohibiting the reintroduction of bighorn sheep to sites where domestic sheep have grazed during the previous four years. Implementing these policies is easier said than done, and they rely on cooperation between Wildlife management agencies and non-governmental organizations, as well as knowledgeable herders and sufficient funds. My group and I interviewed Dr. Cassirer, a senior wildlife research biologist for the Idaho Department of Fish and Game. Her focus was on managing pneumonia in bighorn sheep throughout Idaho and collecting data that can be used for restoration of bighorn sheep. She informed us that preventing spillover of the disease to bighorn sheep from domestic sheep is key to managing the health of the populations. We asked her what complications are involved in dealing with private farmers when managing the disease, or populations in general. She exclaimed that the issue is that wildlife managers and natural resource managers only have jurisdiction over managing wildlife and public lands. They have zero authority over livestock on private lands which complicates management of disease or wildlife that crosses public or private lands. She also pointed out that since private ownership of domestic livestock is a protected value in our society, we tend to not gear towards private owners holding themselves accountable for the effect of their actions.

In a perfect world where there is sufficient funds, unlimited resources, and corporation, along with well communication between wildlife management agencies and non-government organizations there are solutions to this issue. First, more research should be conducted into vaccine development and implementation. Since there are multiple strains and pathogens for sheep pneumonia, this has been proven difficult. Also, more research should be performed on studying the differences in immunity between domestic and wild sheep populations. Not only does immunity differ among the two species but also among individuals of the same species. Some individuals remain unaffected by this disease, yet others are fatally infected, the difference in their immunity is poorly understood. Even if an effective vaccine was successfully developed, farmers must be willing to vaccinate their livestock. Also, there should be an increase in education about management practices in area near wild sheep communities. This would include discussing what private landowners can do to prevent contact and how to keep their sheep healthy.

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