

**DEPARTMENT OF FISH AND GAME**

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To: Ms. Pattie Soucek, Forest Planner
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From: David A. Jessup DVM, MPVM, Dipl. ACZM
Senior Wildlife Veterinarian, Supervisor

Re: Disease Transmission Between Domestic and Bighorn Sheep

I am in receipt of an undated memo from Dr. Marie S. Bulgin to you regarding the above topic. As per our phone communications I would like to offer you a somewhat different perspective on the subject. Throughout her memo Dr. Bulgin argues that "there is **NO** scientific basis" for the concept that domestic sheep can transmit diseases to bighorn sheep. That is quite simply not true. Please see my detailed comments below.

Throughout her memo Dr. Bulgin creates what is known as a false dichotomy, that being the assertion that there is only one right answer (in this case to how bighorn get pneumonia), and if evidence exists for one way, then all other answers, all other observations, evidence, research and experience to the contrary, must be wrong. Dr. Bulgin provides references (and one sided interpretations of them) that support only her views, despite the fact that she is very aware that evidence to the contrary or for alternative views exists. This kind of tactic and rhetoric may be accepted in arguing some points of religion or politics, but it is generally unacceptable in science.

One can argue about the value of historic observations, but it would seem that if a phenomenon is reported repeatedly by a number of observers in a number of locations with the same results (devastation of bighorn subsequent to contact with domestic sheep due to scabies or anything else) one needs to accept that the observations probably have some basis in fact, unless you believe all those people to be fools or liars. Many, many historic observation (some dating to the late 1800's) exist of previously healthy bighorn sheep herds suffering from scabies subsequent to domestic sheep being grazed in their ranges. I believe Nicki Goodson, then a US Forest Service Employee in Idaho or Montana back in the 1980's did a fairly extensive review of historic documents and cited several of the more pertinent on this subject. Perhaps you have that document. Obviously,

we can't go back 100-125 years in time to investigate these various incidents, and as Dr. Bulgin points out, scabies shouldn't be a real threat to bighorn as this disease is not a problem in domestic sheep now. I know of no efforts to blame domestic sheep for ear ticks or the lungworm that is specific to bighorn sheep (*Protostrongylus steelesi*). Information on scabies and lungworm in bighorn can be found in a peer reviewed book chapter entitled "Diseases of Wild Sheep" from the 1993 text "Zoo and Wild Animal Medicine" by Dr. Walter Boyce and me,-- which I have attached.

By far the biggest issue, the biggest problem, are the pneumonias caused primarily by *Pasteurella (Manheimia)* bacteria. I agree with Dr. Bulgin that there is evidence that bighorn sheep are less capable of processing pathogenic bacteria and thus resisting infection than domestic sheep (see Silflow, Foryet and Taylor et al 1989, Comparison of pulmonary defense mechanisms in Rocky Mountain bighorn (*O.C. canadensis*) and domestic sheep. J. Wildl. Dis., 25:514), in addition to the citation provided by Dr. Bulgin. This would all seem to argue strongly that free-ranging bighorn, who can not be treated for pneumonia or protected from many forms of stress, should be protected from exposure to pathogenic bacteria that may be carried by in the upper respiratory tracts of animals of similar genus and species, those that have been shown experimentally to have pathogenic flora, or those which have a history of being associated with outbreaks of pneumonia in bighorn. This is the very logical conclusion that many people wishing to protect bighorn sheep on public rangeland have come to. One of the only really effective ways to do that is to try and enforce separation between bighorn sheep and domestic sheep and goats. Contrary to Dr. Bulgin, it does not logically follow that "bighorn is extremely susceptible to its own disease". The bighorn immune system is a product of evolution of that species and, if they are left alone, has been adequate to protect them from pneumonia due to their own bacterial flora for hundreds of thousands of years.

I would agree with Dr. Bulgin that it is possible that suppression of the immune response in bighorn could result in pathogenic bacterial flora proliferating and causing infection. But no one has been able to do this experimentally or prove that it has occurred naturally. It is also possible that a viral agent or agents, or chlamydia or mycoplasmas infections could lead to bacterial overgrowth by *Pasteurella (Manheimia)* resulting in fatal bronchopneumonia. Black et al., 1988. (An epizootic of *Mycoplasma ovipneumonia* infection in captive Dall's sheep (*Ovis dalli dalli*), J. Wildl. Dis 24:627) documented such a situation, and interestingly it happened after domestic sheep from the petting zoo were commingled with Dall's sheep. There are at least three plausible routes by which bighorn may get fatal pneumonias (exposure to highly pathogenic bacteria from contact species, secondary to infections by another agent, immune suppression and autoinfection). **These routes to infection are not mutually exclusive, they can, and maybe are all true.**

Let's look at a pertinent analogy we are all familiar with. Humans have quite a number *Streptococci* in the throats, tonsils, nose and mouth. We live with them reasonably well. But, if your child, or someone who is reasonably naïve to infection with one species of Strep or another, are exposed, they may come home from school with a "Strep throat". Without careful hygiene it can spread through the household and to many contacts. In the bad old days, before modern medicine and antibiotics for serious cases, children and even adults commonly got very sick and died from Strep pneumonia and septicemia. It has clearly been shown that prior infection with viruses, like influenza, can open the human respiratory tract to bacterial overgrowth, with Strep or other bacteria, resulting in pneumonia. Observations on severely immune suppressed people also show that bacterial overgrowth of the upper respiratory tract can occur and lead to pneumonia. These three routes all result in a bacterial pneumonia and septicemia very similar in many respects to *Pasteurella* pneumonias of bighorn sheep. These routes to infection are not mutually exclusive. This same situation (although bacteria, viruses and sources of stress vary) has been shown to exist not only for humans, but in many domestic species (including cattle and sheep), most pets and some well studied wild animals. **Why should bighorn sheep be different ? Why, of all species, would they have one and only one way to contract bacterial pneumonias ?**

A large body of evidence exists that bighorn sheep get pneumonia following contact with domestic sheep, much larger and more convincing, I might add, than that they get pneumonias from their own flora. Fifteen years ago the most prominent veterinary research journal in world, American Journal of Veterinary Research published "Fatal *Pasteurella haemolytica* pneumonia in bighorn sheep following direct contact with normal domestic sheep-an experimental study" by W.J. Foryet et al (AJVR 50:341). I believe Dr. Foryet has repeated this now classic experiment 2 or 3 more times with the same results, the domestic sheep remain well and all or most of the bighorn die beginning a few weeks after introduction. Various iterations of this work have used the available bacterial typing methodologies of the time. The fact that they may not have used more sophisticated techniques that have since come into common use is not a reasonable criticism. I believe Dr. Foryet has repeated his experiments with cattle, llamas, perhaps other species, and the bighorn don't die of pneumonia.

In Canada, Dr. Detlief Onderka, who at the time I believe worked at the regional agricultural diagnostic lab, and his collaborators, reproduced fatal bacterial pneumonias in Rocky Mt. bighorn sheep both by isolation and inoculation of livestock and bighorn strains of *Pasteurella* and by exposure of clinically normal domestic sheep to bighorn (Onderka et al 1988. Susceptibility of Rocky Mountain bighorn sheep to pneumonia induced by bighorn and domestic livestock strains of *Pasteurella haemolytica*. Can. J. Vet. Res 52:439. and Onderka et al. 1988. Experimental contact transmission of *Pasteurella haemolytica*. from clinically normal domestic sheep causing pneumonia in Rocky Mountain bighorn. J. Wildl. Dis. 24:663). Similar experiments and results.

Further, there is a great deal of field evidence that free-ranging bighorn die of bacterial pneumonias caused by *Pasteurella* subsequent to contact with domestic sheep. Discussion of several of these are contained in the chapter from Zoo and Wildlife Medicine attached. I personally witnessed two of these, one at the Lava Beds National Monument, in 1979 and another in the Warner Mts. of California in 1988. In both cases stray domestic sheep had come into contact with California bighorn, I saw and photographed them myself. In both cases the entire herd of bighorn died. As with most investigations that take place days or weeks following the initiating events it was not possible to state with absolute certainty the details of what happened. Decades of effort to reintroduce these, now USFWS listed bighorn subspecies to their native habitat were lost along with irreplaceable genetics. Over the last 100 years dozens of similar incidents have taken place when bighorn and domestic sheep came into nose to nose contact in California, Nevada, Oregon, Washington, and Montana and perhaps other states. Sheep ranchers from Nevada have told me straight out that they didn't believe that healthy domestic sheep could cause pneumonia in bighorn so they dropped some off in the mountains north of Gerlack, Nevada, and sure enough the bighorn herd there died off.

Another assertion Dr. Bulgin makes is that "domestic sheep are always with a herder and under his control". To anyone who has experience with domestic sheep grazing in wilderness areas that statement would be laughable, if the consequences of it being untrue weren't so sad. Commonly a shepherd or two try to work with bands of a thousand sheep or more and losses and strays are quite common. That was exactly the case at the Lava Beds and the Warner Mts. Although Dr. Bulgin refuses to believe it, many people, including at least one of the authors of the publication, interpret the findings from the Hell's Canyon outbreak of 1995-96 as suggesting that the goat with the same *Pasteurella* as the bighorn, may have been the source. But, again retrospective field investigations are often not very satisfying.

Why are domestic sheep and goats such a problem ? Largely because they are the right size, shape, smell and have behaviors that bighorn can accept. Many observers have seen stray goats and sheep trying to keep up with herds of bighorn. Domestic and bighorn sheep will nuzzle each other, all that is necessary for transmission, and, as Dr. Bulgin notes, even breed with one another. Deer, elk, cattle do not. Also, as they are very close in the evolutionary sense, and they have evolved similar flora, although bighorn have not been selectively bred for disease resistance over thousands of years.

Another point, because domestic ruminants may carry pathogenic flora in the upper respiratory tracts and spread them to one another, it is common to separate animals from different sources in different pens, to leave one pen between them as a buffer, to isolate newly shipped and sick cows and sheep in isolation and hospital pens on ranches and at sale yards. I would be very

surprised if these common sense sanitary approaches were not in use at the Caine Veterinary Teaching and Research Center. If separation helps reduce diseases transmission between domestic ruminants, why categorically oppose its use to protect bighorn sheep ?

If one believes that trying to fulfill Koch's postulates, or the more modern Kelsey, Thompson and Evans modification of them, are the proper manner to show causality, then much more evidence exists that bighorn contract bacterial pneumonias from domestic sheep and die from it than that they get it from themselves or get it subsequent to viral infections. And again, **these routes to infection are not mutually exclusive.**

I actually agree with a number of the points Dr. Bulgin makes about the risks associated with mixing herds of bighorn. I hope that now that we are all more aware of how susceptible bighorn are to pneumonia the transplation of bighorn for perceived genetic gains will be more carefully weighed against the risk of disease transmission. Similarly I would hope that advances in veterinary care, stress reduction treatment, and the use of wildlife veterinarians to help with bighorn sheep conservation by government agencies will result in some improvements

I have briefly reviewed the "Risk Analysis of Disease Transmission.....on the Payette National Forest (2006)" as available on your website. Although it isn't a perfect document it appears to be an effort to determine the greatest risks to bighorn sheep populations on various parts of the Payette Forest and deal with them in a reasonable way. If I am not mistaken only portions of one or two management areas are effected. It even seems that the potentially effected grazers might have other options. Again, this goes with my experience over the last nearly 30 years, that for all the weeping, wailing and gnashing of teeth that goes on, I don't know of even one domestic sheep allotment holders who has been put out of business by accommodating the need to protect bighorn sheep, unless they simply wanted to be bought out.

I hope these comments help. In the interest of time and simplicity I will print and Fax them to you along with a few papers I have cited today

Sincerely,

David A. Jessup