Submitted to the Environmental Quality Council
By the Department of Fish, Wildlife, and Parks
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EQC: Description of the requisite steps necessary to eliminate the role of elk in brucellosis transmission to livestock

There are five theoretical approaches to eliminating the role of elk in brucellosis transmission to livestock: (1) eliminating brucellosis in elk, (2) maintaining complete separation between elk and livestock during the risk period, (3) protecting livestock with a highly effective vaccine, (4) eliminating elk, and (5) eliminating cattle. By outlining the details of the first three approaches, we illustrate why elimination of brucellosis transmission from elk to livestock has been difficult to achieve. We dismiss the fourth and fifth options as socially unacceptable if not also technically infeasible and consider them no further. We also offer a summary of what is being done to reduce, rather than eliminate, brucellosis transmission from elk to livestock.

Elimination of Brucellosis in Elk

Elimination of brucellosis in elk would require a multi-pronged approach using highly effective techniques. Most available tools that could be used to eliminate brucellosis in elk are not currently effective enough to be applied successfully. Some of the most commonly discussed tools for elimination of brucellosis in elk are listed below, along with an explanation of current challenges brought by each. We believe that with current technology, eradication of brucellosis in free-ranging elk is not possible.

Vaccination

Vaccination is one tool that has been proposed to help reduce prevalence of brucellosis in elk. Currently there is no effective *Brucella* vaccine for elk. Studies have shown that immune responses in elk vaccinated with S19 or RB51 are weaker and do not last as long as reported in cattle (Olsen et al., 2006). Roffe et. al. (2004) found that efficacy of single calfhood vaccination of elk with Strain 19 vaccine is too low (<60%) to effectively reduce prevalence or eliminate brucellosis in elk (Thorne et al., 1981; Herriges et al., 1989; Roffe et al., 2004). Efficacy of RB51, the brucellosis vaccine commonly used in cattle and bison has also been studied in elk with disappointing results. In challenge studies carried out in 2000 and 2002, vaccination of elk with RB51 failed to prevent abortion (Kreeger et. al., 2000; Kreeger et. al., 2002). In one study, abortion strictly due to the RB51 vaccine could not be ruled out (Kreeger et. al, 2000). In another study, 16/16 elk vaccinated once with RB51 aborted and 13/14 elk that received an initial plus a booster vaccine aborted (Kreeger et. al., 2002).

If an effective Brucella vaccine were developed for elk, vaccine alone would not be adequate to eliminate disease. Wildlife populations cannot be managed as closed herds due to the extent of emigration, immigration, and overlap of elk herd ranges, and therefore vaccination of free-ranging wildlife poses a challenge in vaccine administration. Intramuscular vaccination of elk on Wyoming feed grounds has been carried out using biobullet inoculation. Although biobullet vaccination appears to be safe, there is some evidence that suggests that oral vaccination may be more efficacious (Elzer and Davis, 1997; Kreeger et. al, 2002). Additionally, delivery of either an oral or intramuscular vaccine would be difficult because free-ranging elk span large and complex areas comprised of multiple ownerships. Further study is needed to determine true efficacy and deliverability relative to the route of administration in free-ranging elk populations.

Test and Remove

Test and remove (test and slaughter) is another tool that has been proposed to reduce prevalence of brucellosis in elk. However, even under more controlled circumstances in livestock operations, test and slaughter alone is not an effective tool for eradication. Combinations of tools such as test and slaughter, vaccination, and biosecurity measures are typically required to eradicate disease (Pérez-Sancho et al., 2015).

In Wyoming, seroprevalence in elk was reduced by 30% over a 5-year test and remove program on the Muddy Creek feed ground (WFGD progress report, 2009). Seroprevalence was also reduced by test and slaughter at both the Scab and Fall Creek Feedgrounds. The effort was very labor intensive and expensive, and it did not completely stop transmission (Scurlock et al., 2010). Minimum estimated cost for conducting two test and slaughter efforts annually at three Wyoming feedgrounds was $409,111 (Boroff et al., 2016), Wyoming spent $1.3 million during the 5 years of the study (Brandon Scurlock, Wyoming Game and Fish, personal communication). Once test and remove stopped, elk seroprevalence resurged (NAS, 2017; Brandon Scurlock, Wyoming Game and Fish, personal communication).

Immunocontraception

Further research is required to determine whether immunocontraception might have a role in control of brucellosis in wildlife populations. If pregnancy is prevented, the result would be fewer abortions and decreased risk of brucellosis transmission. Data from captive elk studies suggest that a single injection of GonaCon™ can prevent pregnancy in captive elk for 3 years (Killian et al 2009). In comparison, work with wild elk suggests that a single dose reduces pregnancy for only 1-2 years (Powers et al, 2014). Because Gonacon^{TM} is administered by injection, delivery of the immunocontraceptive to free-ranging elk populations poses similar difficulties as vaccination.

It is important to recognize that any effort to eliminate brucellosis in elk must acknowledge the fact that Yellowstone National Park bison represent a reservoir for brucellosis that still poses some risk of transmission of the disease to free-ranging elk in the Greater Yellowstone Ecosystem, further complicating such an effort.

Complete Spatial and/or Temporal Separation of Elk and Livestock During the Risk Period

Because the route of brucellosis transmission between elk and cattle is through exposure to aborted fetuses, or infectious tissues and fluids expelled during parturition or abortion, the role of elk in transmission of brucellosis to cattle could be eliminated if complete separation could be achieved between cattle and infected elk during the risk period. As stakeholders in the Greater Yellowstone Area are aware, complete separation is very difficult to achieve. In Montana, a sizable proportion of elk distribution during the transmission risk period occurs on private lands. FWP's Elk Management in Areas with Brucellosis 2018 Work Plan lays out the agency's management tools aimed at maintaining separation between elk and cattle during the risk period. These tools include fencing, hazing, habitat adjustments, and dispersal hunts. It is difficult, however, to move elk to areas away from cattle and to avoid creating problems for neighboring landowners. It is also expensive to delay cattle grazing in high-risk areas that overlap strongly with elk distributions (Roberts et al., 2012).

Highly Effective Livestock Vaccine

Even if brucellosis infection remains present in elk, protection of cattle with a highly effective vaccine could virtually eliminate the role of elk in transmission of the disease to cattle. The currently available cattle vaccine protects against abortion but not infection. Although vaccinated cattle are less likely to transmit the disease, they are not protected from becoming infected. To protect cattle from infection due to transmission from elk, a livestock vaccine must protect against infection. Although there seems to be general agreement that a highly effective vaccine for cattle is an urgent need, the status of *B. abortus* as a select agent hinders the ability for advancement of brucellosis vaccine technology (Olsen 2013).

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Summary

Completely eliminating the transmission of brucellosis from elk to cattle is not currently possible. Eliminating the disease in elk would require a combination of tools, but none of the available tools are adequately effective and publicly acceptable. Separation of elk and cattle during the risk period is something that MFWP and landowners attempt with some success, but complete separation is rarely if ever achieved even with significant effort. An effective cattle vaccine would likely be the most efficient and feasible tool for minimizing transmission from elk. However, a cattle vaccine may still need to be combined with elk management, since even effective vaccines are not 100% protective. Future research may also focus on developing an effective elk vaccine, but this approach also comes with difficult administration logistics. Until advances are made in vaccine development, our existing management tools to reduce or eliminate transmission of brucellosis from elk to cattle are unlikely to significantly change.

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