Wildlife Services

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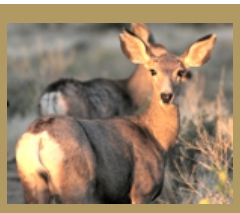
National Wildlife Research Center

FY 2017

Management of Ungulate Disease and Damage



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Groups Affected:

- Captive cervid industry
- Consumers
- Livestock producers and farmers
- Meat processors
- Rural communities
- Sporting organizations
- State and federal agriculture and wildlife agencies
- U.S. citizens
- Wildlife and natural resource managers

Major Cooperators:

- Canadian Food Inspection Agency
- Colorado Division of Wildlife
- Colorado State University
- Iowa State University
- Michigan Department of Agriculture and Rural Development
- Michigan Department of Natural Resources
- Michigan State University
- National Park Service
- Private elk and deer farmers
- State departments of public health
- University of Nebraska
- University of Wisconsin
- University of Wyoming
- USDA/APHIS/Wildlife Services
- USDA/APHIS/Veterinary Services
- USDA/Agricultural Research Service
- U.S. Geological Survey
- Wisconsin Department of Natural Resources

National Wildlife Research Center Scientists Study Chronic Wasting Disease, Bovine Tuberculosis and Other Diseases in Wild and Domestic Ungulates

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research organization devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective, and socially responsible methods, tools, and techniques.

As increased urbanization leads to a loss of traditional wildlife habitat, the potential for conflicts between people and wildlife increases. Such conflicts can take many forms, and recently potential for transmission of diseases among wildlife, livestock, and humans has received greater attention. Two diseases in particular—chronic wasting disease (CWD) and bovine tuberculosis (bTB)—can be found in wild and captive ungulates.

The spread of CWD is of nationwide concern and additional research is needed to learn more about CWD transmission at the interface between wild and domestic cervids. CWD infects elk, white-tailed deer, mule deer, and moose, but is not known to naturally infect other species of wildlife (including predators and scavengers), livestock or humans. There is no treatment for CWD, and it is typically fatal in cervids. Realized CWD threats have significant implications for Federal and State wildlife management agencies, as the disease is beginning to necessitate reduced recreational hunting opportunity in some areas. Thus CWD is a threat to domestic cervid farmers, hunters, and businesses and economies reliant on deer and elk. In addition, these groups need additional and improved tools and management techniques to reduce the transmission, prevalence, and persistence of CWD in wild and captive cervids.

Tuberculosis is a contagious, bacterial disease of both animals and humans. Bovine tuberculosis can be transmitted from livestock to humans and to other animals. The significance of the disease is reflected in APHIS' efforts to eradicate bTB from the United States. The bTB eradication program which started in 1917 has made significant progress over the years. By the mid-1990s, only a few known infected cattle herds remained, suggesting that the eradication of the disease in the United States was forthcoming. However, wild cervids in Michigan, as well as a few other states, remain infected. Between 1975 and 1998, bTB was documented in Michigan's white-tailed deer with increasing prevalence, and scientific evidence revealed that infected deer transmitted the disease to cattle herds in Michigan.

In 2000, the Secretary of Agriculture enacted a Declaration of Emergency for bTB, citing threats to livestock and public health and safety. In 2001, NWRC initiated research that could assist in reducing or eliminating the transmission of this disease to cattle and humans. This research has made great progress and has led to improved management. It is especially critical in light of new bTB cases recently documented in New Mexico, Minnesota, and California.

Applying Science and Expertise to Wildlife Challenges

Impacts of Dietary Minerals on Chronic Wasting Disease Progression. — Chronic wasting disease (CWD) is a neurodegenerative disease in deer, elk and moose caused by misshaped proteins called prions. To better understand the role of environmental and dietary minerals, such as copper (Cu) and magnesium (Mg), on the progression of CWD in elk and deer, NWRC, Colorado State University, Case Western Reserve University, and Canadian Food Inspection Agency researchers collected and analyzed soil and water samples from CWD-negative and –positive captive cervid facilities and natural areas. Results showed CWD-negative sites had higher concentrations of magnesium and a higher Mg/Cu ratio in the water than CWD-positive sites. Researchers also fed cervidized transgenic mice a diet lacking Mg and Cu then supplemented drinking water with varied Mg/Cu ratios. They observed that mice fed water with higher Mg/Cu ratios had longer survival times after being inoculated with CWD. These mice also expressed fewer neuroinflammatory gene expression changes, and had less neuroinflammation present in the brain 60 days after inoculation. Copper appeared to be the most significant factor in survival time. This work demonstrates that dietary factors may have the capacity to alter CWD disease progression.

Estimating Prion Infection in Elk. — It is estimated that CWD prevalence in wild elk may be as high as 13 percent in Colorado. Infected animals shed prions into the environment through saliva, feces, urine, and antler velvet, but little is known about how long animals live and shed prions once they become infected. Immunohistochemistry (IHC) is considered the gold standard for diagnosing CWD, but it may be unable to detect animals in the early stages of infection. NWRC researchers and partners compared and assessed the ability of IHC and serial protein mis¬folding cyclic amplification (sPMCA) to detect CWD prior to the onset of clinical signs. They analyzed brain and lymph tissue samples from 85 wild elk to estimate the IHC and sPMCA tests' sensitivity and specificity. Sensitivity estimates were higher for sPMCA than IHC. Further analysis and modeling predicted that the prevalence of prion infection in elk may be higher than previously thought—18.9 percent versus prior estimates of 13 percent. Data also revealed a previously unidentified sub-clinical prion-positive portion of the elk population that could represent silent carriers capable of signifi¬cantly impacting CWD ecology. These findings will aid in the management of CWD in captive and wild deer.

Detecting Bovine Tuberculosis in Deer Feces. — White-tailed deer serve as a reservoir for *Mycobacterium bovis*, a bacterium that causes bovine tuberculosis, and can be a source of cattle infection in the United States. Controlling tuberculosis in deer has relied on restricting baiting and supplemental feeding of deer and reducing deer populations through hunting. Experimentally treating deer with the *M. bovis* Bacille Calmette-Guerin vaccine has effectively protected deer from the disease and is being considered as an additional management tool. Currently, however, there is no simple method for monitoring tuberculosis in deer.

In a recent study, NWRC researchers evaluated whether fecal volatile organic compounds (VOCs) could be used to distinguish between vaccinated and non-vaccinated deer before and after *M. bovis* inoculation. VOCs are chemicals that emit unique odors and release patterns. Because of these unique characteristics, VOCs have been identified as potential disease surveillance tools. Using gas chromatography and mass spectrometry, researchers were able to identify 17 compounds to distinguish among vaccinated and non-vaccinated deer fecal samples before and after inoculation. Detecting disease-specific VOCs in feces could provide a simple method for testing captive deer and has great potential for use in remote disease surveillance efforts. This was the first study to use fecal VOCs to identify deer with tuberculosis.

Preventing Deer Access to Stored Cattle Feed. — Disease and damage from white-tailed deer threaten the livelihood of agricultural producers in Michigan. When high-quality cattle feed is stored for future use in areas adjacent to deer habitat, deer often attempt to access it. This can result in feed loss and contamination. However, recent efforts to keep cattle and deer apart and reduce the deer population in Michigan have helped to reduce the spread of bovine tuberculosis bTB) through contaminated feed.

Although fences used in disease management efforts are not new, they are most effective when maintained and used consistently. Results from an NWRC study tracking the movement of global positioning system (GPS)-collared deer at several sites with and without exclusionary fences showed that such fences reduced cattle feed loss and potential contamination by more than 82 percent. They also caused deer to move away from developed livestock-related areas, further decreasing deer and livestock interaction.

When combined with other management strategies like decreasing deer populations, fencing may further reduce bTB spread between free-ranging deer and livestock. Such strategies are examples of direct management actions that producers can take to help ensure farm biosecurity and create a broader, healthier environment for neighboring wildlife populations.

Selected Publications:

Lavelle, M.J., C.I.I.I. Henry, K. LeDoux, P.J. Ryan, J.W. Fischer, K.M. Pepin, C.R. Blass, M.P. Glow, S.E. Hygnstrom, and K.C. VerCauteren. 2015. Deer response to exclusion from stored cattle feed in Michigan, USA. Preventive Veterinary Medicine 121(1-2):159-164. doi: 10.1016/j.prevetmed.2015.06.015

Lavelle, M.J., S.L. Kay, K.M. Pepin, D.A. Grear, H. Campa III, and K.C. VerCauteren. 2016. Evaluating wildlife-cattle contact rates to improve the understanding of dynamics of bovine tuberculosis transmission in Michigan, USA. Preventive Veterinary Medicine 135:28-36. doi: 10.1016/j.prevetmed.2016.10.009.

Nichols, T.A., J.W. Fischer, T.R. Spraker, Q. Kong, and K.C. VerCauteren. 2015. CWD prions remain infectious after passage through the digestive system of coyotes *(Canis latrans)*. Prion 9(5):367-375. doi: 10.1080/19336896.2015.1086061.

Nichols, T.A., T.R. Spraker, T. Gidlewski, B. Cummings, D. Hill, Q. Kong, A. Balachandran, K.C. VerCauteren, and M.D. Zabel. 2016. Dietary magnesium and copper affect survival time and neuroinflammation in chronic wasting disease. Prion 10(3):228-250. doi: 10.1080/19336896.2016.1181249.

Stahl R.S., C.K. Ellis, P. Nol, W.R. Waters, M. Palmer, and K.C. VerCauteren. 2015. Fecal volatile organic compound profiles from white-tailed deer *(Odocoileus virginianus)* as indicators of *Mycobacterium bovis* exposure or *Mycobacterium bovis* Bacille Calmette-Guerin (BCG) vaccination. PLoS ONE online 10.1371/journal.pone.0129740. doi: 10.1371/journal.pone.0129740

Major Research Accomplishments:

- WS research discovered that higher levels of magnesium and copper in the diet of infected cervidized transgenic mice slowed the progression of CWD.

- WS research estimated that nearly 19 percent of wild elk may be infected with CWD.

- WS research identified 17 compounds in deer fecal samples that could potentially be used to identify tuberculosis-infected deer.

- WS research with collared deer showed the use of exclusionary fences reduced cattle feed loss and potential disease contamination by deer by more than 82 percent.