Wildlife Services

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National Wildlife Research Center

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Management of Ungulate Disease and Damage

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Major Cooperators
- Canadian Food Inspection Agency
- Colorado Division of Wildlife
- Colorado State University
- 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
- Wildlife Services Operations
- USDA/APHIS/Veterinary Services
- USDA/Agricultural Research Service
- U.S. Geological Survey
- Wisconsin Department of Natural Resources

Groups Affected By These Problems
- Captive cervid industry
- Consumers
- Livestock producers and farmers
- Meat processors
- Rural communities
- Sporting organizations
- State and Federal agriculture and wildlife agencies
- Wildlife and natural resource managers

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 (TB)—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 and perceived CWD threats have significant implications for Federal and State wildlife management agencies, 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 TB can be transmitted from livestock to humans and to other animals. The significance of the disease is reflected in APHIS' efforts to eradicate TB from the United States. The TB 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, cervids in Michigan, as well as a few other states, remain infected. Between 1975 and 1998, bovine TB was documented in Michigan's white-tailed deer with increasing prevalence, and scientific evidence revealed that infected deer transmitted the disease to some of Michigan's cattle.

In 2000, the Secretary of Agriculture enacted a Declaration of Emergency for bovine TB, 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 is especially critical in light of new bovine TB cases recently documented in New Mexico, Minnesota, and California.

Applying Science and Expertise to Wildlife Challenges

Detection of Volatile Organic Compounds in Animals as a Tool for Diagnosis of Bovine Tuberculosis—Volatile organic compounds (VOCs) are organic compounds that often emit unique odors and emission patterns. Because of these unique characteristics, VOCs have been identified as potential tools in disease surveillance. Recently, NWRC scientists and colleagues from APHIS Veterinary Services, the Tel-Aviv University and Technion-Israel Institute of Technology developed a method for collecting and analyzing VOCs from cattle. The scientists tested the method during an outbreak of bovine TB in cattle in the United States. Gas-chromatography and mass-spectrometry analysis

revealed the presence of two VOCs associated with a bovine TB infection in the exhaled breath of infected cattle. Based on these results, a nanotechnology-based array of sensors was then tailored for detection of bovine TB-infected cattle via breath. The system successfully identified all bovine TB-infected animals, while only 21 percent of the non-infected animals were classified as bovine TB-infected (were false positives). This technique could form the basis for a real-time cattle monitoring system that allows efficient and non-invasive screening for new bovine TB infections on dairy farms.

Detecting CWD from Cerebrospinal Fluid—NWRC researchers evaluated whether cerebral spinal fluid (CSF) could be used to diagnose CWD in elk. As part of the evaluation, NWRC collected the CSF from 6 captive and 31 free-ranging adult elk at necropsy and evaluated it for the presence of CWD via protein misfolding cyclic amplification (PMCA). In addition, each animal's obex (i.e., part of the brain) was examined by immunohistochemistry (e.g., process for detecting proteins in cells). Four of the six captive animals were CWD-positive and euthanized due to signs of terminal CWD. The remaining two were CWD-negative. None of the 31 free-range animals showed overt signs of CWD, but 12 tested positive for CWD by immunohistochemistry. PMCA detected CWD in only three of the four captive animals showing clinical signs of CWD. Furthermore, PMCA did not detect CWD in any of the nonclinical animals that tested positive by immunohistochemistry. NWRC researchers concluded that CWD prions can be detected in the CSF of elk but only relatively late in the course of the disease. Therefore, the use of PMCA with CSF could be used as a confirmatory test for CWD, but it should not be used as a diagnostic tool.

Role of Environmental Metals in CWD Transmission— Understanding the role of environmental metals, such as divalent cations (i.e., atoms missing two electrons), in the spread of CWD can provide valuable information for assessing risk and may lead to CWD therapies and prevention through dietary manipulation. NWRC researchers collected environmental samples from CWD-negative and CWD-positive ranches in Colorado and Canada and conducted a cation analysis. The researchers detected a statistically significant difference between cation ratios in positive and negative ranches. Based on this information, a bioassay was conducted utilizing CWD-inoculated, cervidized transgenic mice (i.e., mice containing deer genes) that were given either normal rodent food and normal water or a cation-modified diet and modified water. CWD-inoculated mice on the cation-modified diet lived significantly longer than those on the normal diet. These finding are significant considering that the mode of inoculation (intracerebrally) and dose were both unnatural, suggesting that the effects may be more pronounced in a host species (deer or elk) inoculated in a more natural manner. Work is currently underway to determine the mechanism responsible for these effects as well as the effect of dietary supplementation of omega fatty acids in the mouse model.

Intranasal CWD Inoculation of White-tailed Deer— Determining all potential CWD transmission routes in wild animals is important in controlling and preventing the disease. One method of transmission demonstrated experimentally has been the inoculation of massive dosages into the oral cavity. Based on pathological data, this route of infection does not seem to be compatible with the naturally occurring disease. Much time and effort has been spent by landowners to remove top soil in captive facilities in an effort to prevent indirect CWD transmission. However, this technique has been unsuccessful. If the CWD prion is located in the dirt and dust surrounding the farm, inhaling these particles may cause disease. The nasal passages of fourteen white-tailed deer were inoculated six times at 1 week apart with a mixture of either CWD-positive (12 deer) or CWD-negative (2 deer) brain homogenate and montmorillonite clay dust. The deer were euthanized and samples were collected at necropsy for immunohistochemistry analysis. Results show that montmorillonite clay dust is an efficient carrier of CWD. Positive tissues were observed in deer as early as 98 days after the last inoculation. This verifies that the intranasal route is a viable route of infection and that dust, a natural route of exposure, is capable of delivering the infected material intranasally.

Coyotes as a Biosurveillance Tool for Bovine Tuberculosis—Bovine TB has been documented in a variety of wildlife species, including coyotes. Localized prevalence of bovine TB in coyotes can be as high as 30 percent, versus 1.8 percent in deer. Thus, sampling coyotes may be an efficient method for detecting bovine TB in an area. To explore this concept, NWRC researchers collected biological samples from 171 coyotes in northeastern Michigan. Seventeen coyotes were positive for *Mycobacterium bovis*, the causative agent of bovine TB. Sixteen of the coyotes were from known bovine TB-infected counties, and one was found in a county with no previous documentation of bovine TB. The use of coyotes as sentinels may allow wildlife managers to detect the spread of bovine TB into uninfected counties before it reaches prevalence levels sufficient to be detected in deer. With earlier detection, managers may be able to take proactive surveillance and management measures to reduce the potential risk to domestic livestock and captive deer herds.

Elk and Fence-Line Disease Transmission—Direct and indirect contact through fences at captive elk farms may play a role in the transmission of diseases such as CWD and bovine TB. NWRC researchers examined the effectiveness of a baited electric fence, as an addition to an existing single woven-wire fence (2.4 meters high), for altering behavior and reducing fence-line contact between elk. Researchers documented 426 contacts between elk (direct transmission risk) or the woven-wire fence (indirect transmission risk) during trials without the electric fence. When the electric fence was installed, there were no contacts between adult elk or the woven-wire fence. Researchers note that this approach targets behavior modification of farmed elk routinely exposed to the electric fence, not wild elk that may occasionally approach from the outside. The results of this study suggest that adding a baited electric fence inside an existing woven-wire-fenced enclosure has the potential to provide a cost-effective means of minimizing contacts between farmed and wild elk.

Passive Integrated Transponders (PIT) in Darts—Methods to individually mark and identify free-ranging wildlife without the added expense of initial trapping and handling of animals would be useful to wildlife managers. A passive integrated transponder (PIT) is a tag that is injected under the skin or into the muscle of an animal. It contains a series of numbers and letters used to identify individual animals, and the numbers can be recalled by passing a "PIT Tag Reader" over the implanted tag. NWRC researchers successfully injected PIT into captive elk using dart guns. The PIT remained functional during recaptures for at least 4 months. The long-term use of PIT can increase the efficiency of monitoring efforts.

Selected Publications:

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Major Research Accomplishments:

- WS and colleagues developed a method for collecting and analyzing volatile organic compounds from the exhaled breath of cattle. This technique could form the basis for a real-time cattle monitoring system that allows for the non-invasive screening of bovine TB infections in cattle.
- WS determined that prions and thus diseases like CWD and scrapie can survive the crow digestive system. Consequently, a crow that scavenges on a CWD-positive carcass can potentially transport infective prions a long distance and deposit them via their feces in new locations.
- WS determined that CWD can be transmitted in deer via the inhalation of contaminated dust.
- WS discovered CWD-inoculated mice fed a cation-modified diet lived significantly longer than those on a normal rodent diet. A better understanding of the role of environmental metals, such as divalent cations, in the spread of CWD in deer and elk may lead to CWD therapies and prevention through dietary manipulation.