Wildlife Services

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National Wildlife Research Center

FY 2010

Management of Ungulate Disease and Damage

Contact Information:
Dr. Kurt C. VerCauteren
Supervisory Research Wildlife Biologist
NWRC Headquarters
4101 LaPorte Ave.
Fort Collins, CO 80521
Phone: (970) 266-6093
FAX: (970) 266-6138
kurt.c.vercauteren@aphis.usda.gov
www.aphis.usda.gov/wildlife_damage/nwrc/

Major Cooperators

- USDA/APHIS/Wildlife Services
- USDA/APHIS/Veterinary Services
- USDA/APHIS/Agricultural Research Service
- DOI/National Park Service
- United States Geological Survey
- Canadian Food Inspection Agency
- University of Nebraska
- Colorado State University
- State Departments of Public Health
- Wisconsin Department of Natural Resources
- Colorado Division of Wildlife
- Michigan Department of Natural Resources
- University of Wisconsin
- Private elk and deer farmers

Groups Affected By These Problems

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

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, but potential for transmission of diseases among wildlife, livestock, and humans has, recently, 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 required to fill information gaps 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 eradication program, which began in 1917, has made significant progress over the years. By the mid-1990's, 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, remains 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

Degrading CWD Prions in Soil— Prions, the infectious agent of CWD, bind to a wide range of soils and minerals potentially forming environmental reservoirs for infection. NWRC scientists assisted colleagues from the University of Nebraska-Lincoln and Creighton University to test the ability of the commercially available enzyme, Prionzyme™, to degrade CWD prions in soil. Investigators concluded the enzyme, produced by soil bacterium, successfully degraded CWD prions bound to contaminated soil. Although it may be impossible to totally eliminate prions in the environment, a topical enzyme treatment could help limit indirect disease transmission to cervids in some areas.

Influence of Magnesium and Manganese to CWD Risk— Certain trace minerals may affect CWD risk in cervids. Scientists from the NWRC, USDA Agricultural Research Service, Washington State University, and Colorado State University compared levels of copper, manganese, magnesium, zinc, selenium, and molybdenum in the brains of CWD positive and negative captive Rocky Mountain elk with differing prion genotypes. Brain tissue samples were collected from the cerebrum, parietal lobe, or optic lobe at necropsy.

Results indicated that magnesium levels were significantly lower in CWD-positive elk than in control elk. Researchers conclude that mineral levels in elk brain tissues may help to predict CWD infection.

Live Test for CWD— Rectal lymphoid tissue can be used to detect CWD in live Rocky Mountain elk. NWRC researchers took 1,361 rectal biopsies from captive elk to quantify sex and age-related variance in numbers of rectal lymphoid follicles in order to determine the influence of elk sex and age on the diagnosis of CWD. Results showed that the number of lymphoid follicles obtained from typical biopsy tissues decreased with the age of the animal. The acceptable number of lymphoid follicles for detection of CWD was not considered to be a problem for elk up to 8.5 years of age, but for elk over 8.5 years of age, the follicle count was considered to be low. The sex of the animal had no affect on the number of lymphoid follicles observed in each age group. Based on these results, the researchers conclude that rectal biopsies are an accurate test for diagnosing preclinical stages of CWD in elk, especially for elk less than 8.5 years of age.

Predicting CWD Progression in Elk— NWRC researchers examined sections of brain stem, lymph node, and tonsil from approximately 300 free-ranging and 15,000 ranch-raised adult Rocky Mountain elk for the presence of the abnormal isoform of the prion protein (PrP^{CWD}) that has been associated with CWD. Researchers then assisted colleagues from Colorado State University, DOI's National Park Service, USDA's Agricultural Research Service, the U.S. Geological Survey (USGS), and the Canadian Food Inspection Agency to develop a technique, called the "obex score," to predict in elk which structure or regions of the brain, spinal cord, and extra neural tissues contain PrP^{CWD}.

PrP^{CWD} spreads throughout the obex of the brain stem at a rate similar to the movement of PrP^{CWD} throughout the central nervous system and extra neural tissues. Therefore, the obex score has potential usefulness as a basis for evaluating the presence of PrP^{CWD} in peripheral tissues and brain. Current studies are evaluating approximately 100 peripheral tissues and 75 neuro-anatomical locations of the brain and spinal cord in 36 free-ranging and ranch-raised elk with naturally occurring CWD and known incubation times. These results will be compared with corresponding obex scores.

Concurrent work with live animals is relating the level of CWD infection with changes in behavior. Cumulative results could lead to strategies for detecting infected animals before they show clinical signs, which could be useful in the treatment of infected individuals and management of CWD.

Protecting Fenced Resources from Deer Damage— As white-tailed deer populations continue to increase across the United States, so do deer-human conflicts. Fences are a common and effective tool used to exclude deer from valuable agricultural resources, but the weakest link in this system is often human-operated gates. NWRC scientists examined the efficacy of two gate alternatives: a modified cattle guard and a commercially available gate kit for mechanically opening and closing gates. The gate kits prevented deer from entering exclosures; however, supplemental testing revealed high mechanical failure rates. Modified cattle guards initially proved effective, but efficacy declined with time. Given some refinements, gate kits and modified cattle guards may be useful components of an integrated biosecurity strategy.

bTB Transmission Between Raccoons and Livestock— *Mycobacterium bovis*, the causative agent of bovine tuberculosis (bTB), is endemic to white-tailed deer in north-central Michigan, and is capable of causing disease in both cattle and humans. Recently, an extensive surveillance program conducted by the Michigan Department of Natural Resources identified raccoons as a host for *M. bovis*. NWRC scientists examined the potential for disease transmission between raccoons and livestock in the bTB endemic region of Michigan. Results showed raccoons used anthropogenic features, such as loafing sheds, barns, and feed storage facilities when they were located adjacent to forested habitat. Additionally, while simultaneous use of resources by raccoons and cattle was documented, it was determined that pathogen transmission was most likely to occur through indirect means, such as consumption of infected feed or water. Based on these findings, the best way to reduce the likelihood of disease transmission between cattle and raccoons is to place feeding and watering facilities away from forested patches.

Deer Visitation to Cattle Farm Yards— NWRC scientists investigated farm yard visitation by white-tailed deer in order to evaluate the extent to which deer and livestock intermingle and potentially spread disease. Global positioning system radio collars were placed on 25 deer captured on cattle farms in Michigan. Movement data showed deer visited 80 percent of farm yards within their annual home ranges, although only 13 percent of deer accounted for 80 percent of all farm yard visits. A higher proportion of visits occurred at night and multiple visits of farm yards during the same day were common. Visitation increased through spring and peaked during the fawning season. These findings suggest that frequency and timing of deer visitation should be incorporated into mitigation and control efforts to guard against potential transmission of bTB between cattle and deer. In particular, mitigation efforts targeted toward individual deer that are most likely to visit farm yards may reduce potential bTB transmission to cattle and between farms.

Using Coyotes to Detect Bovine Tuberculosis— Bovine tuberculosis (bTB) has been documented in a variety of wildlife species, including coyotes. Localized prevalence of bTB in coyotes can be as high as 30 percent, versus 1.8 percent in deer. Thus, sampling coyotes may be an efficient method of early detection of bTB in an area. To explore this concept, NWRC scientists collected biological samples from 171 coyotes in bTB positive and negative counties in northeastern Michigan. Seventeen coyotes were positive for *Mycobacterium bovis*, the causative agent of bTB. Sixteen of the coyotes were from known bTB-infected counties and one was found in a county with no previous documentation of bTB. The use of coyotes as sentinels may allow wildlife managers to detect the spread of bTB 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.

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Major Research Accomplishments:

- WS determined Prionzyme™, a commercially available an enzyme, successfully degraded CWD prions bound to contaminated soil.
- WS concluded that mineral levels in elk brain tissues may help to predict CWD infection.
- WS concluded that rectal biopsies are an accurate test for diagnosing preclinical stages of CWD in elk, especially for elk less than 8.5 years of age.
- WS and partners developed a technique, called the “obex score,” to predict in elk which structure or regions of the brain, spinal cord, and extra neural tissues contain the CWD prion protein.
- WS evaluated gate kits and modified cattle guards to exclude deer from valuable agricultural resources.
- WS examined the potential for disease transmission between raccoons and livestock in the bTB endemic region of Michigan. Results showed raccoons used anthropogenic features, such as loafing sheds, barns, and feed storage facilities when they were located adjacent to forested habitat.
- WS investigated farm yard visitation by white-tailed deer in order to evaluate the extent to which deer and livestock intermingle and potentially spread disease.
- WS used coyotes as sentinels to detect the spread of bTB into uninfected counties in northeast Michigan. Localized prevalence of bTB in coyotes can be as high as 30 percent, versus 1.8 percent in deer. Thus, sampling coyotes is an efficient method of early detection of bTB in an area.

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