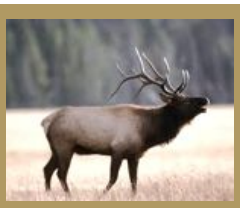
Wildlife Services

Protecting People
Protecting Agriculture
Protecting Wildlife

FY 2015

Management of Ungulate Disease and Damage



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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
- U.S. citizens
- Wildlife and natural resource managers

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
- 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 threatens 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 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 with increasing prevalence in Michigan's white-tailed deer, 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

Novel Fence Design for Excluding Deer From Stored Feed. — Where cattle and free-ranging white-tailed deer coexist, they often share space and food resources. Preventing deer from eating stored livestock feed reduces not only feed costs, but also the risks of disease transmission between deer and cattle. Woven-wire fences are considered to be the most effective barrier for excluding deer. However, identifying a quick and easy method for temporarily excluding deer could be useful, especially during late winter, when deer are most physiologically stressed and motivated to consume food meant for cattle. NWRC researchers demonstrated that a 4-foot (1.2-meter) electric fence consisting of 4 strands of bipolar tape was 80 percent effective at excluding deer from feed piles. This system could provide temporary protection of stored feed before a more permanent woven-wire fence is installed. Although effective, the fence should not be used as the only means of excluding deer in areas with known disease transmission risks because the risk could remain unacceptably high even if few deer access stored feed. Researchers note the bipolar fence may also reduce deer depredation in gardens, small orchards, or other localized or seasonal resources.

Contact Detection Systems Aid in Assessing Disease Risks. A first step in developing management programs for disease control is to better understand disease transmission risks. Toward this end, accurately

detecting contact rates among animals is critical. NWRC researchers simultaneously compared three methods of detecting contacts by mounting motion-activated cameras (for video evidence of contacts) and proximity loggers (which detect when other proximity loggers are within 16 feet) on global positioning system (GPS) collars (from which contacts are defined as when locations of two or more animals are within 16 feet of each other). The system was tested on 26 adult male deer to record their locations and proximity to other deer and capture video of deer interactions. From 17 of the 26 collars, researchers documented 33 contacts with cameras, 61 contacts with proximity loggers, and 16 contacts with GPS. Though GPS is the most common technique currently used to assess contacts, researchers demonstrated that GPS underrepresented contact rates. The cameras also underrepresented contacts among deer, but their video showing the nature of contacts was valuable for assessing and modeling risk of disease transmission. The results underscore the importance of accurate detection and contact rates when modeling disease transmission risks and indicate proximity loggers provide the most robust contact estimates.

Roles of Scavengers and the Environment in Spreading Chronic Wasting Disease. — Since it was first detected in Colorado in 1967, chronic wasting disease (CWD) has spread to 18 states in the United States. Much of the spread has been attributed to the movement of captive deer and elk, but some CWD-infected areas have no captive animal facilities. NWRC researchers studied whether scavengers, such as American crows and coyotes, may be able to pass CWD-positive tissue through their digestive systems and infect new areas. In laboratory studies, captive mice were inoculated with feces from American crows which were fed prion-positive material. All of the mice subsequently showed severe neurological dysfunction. Results suggest that prions can pass through a crow's digestive system intact. Therefore, if a crow scavenges on a CWD-positive carcass, it can potentially carry prions a long distance and deposit them, via feces, in new locations. A similar study with coyotes showed they also can pass infectious prions through their feces for at least three days following ingestion and may play a role in the geographic spread of prion diseases.

NWRC scientists also investigated whether inhaling CWD prions found in soil and dust can cause disease. Researchers inoculated the nasal passages of captive white-tailed deer with a mixture of CWD-positive tissues and montmorillonite clay dust- a common soil in the United States. The deer were euthanized and samples were collected at necropsy for immunohistochemistry analysis. Results showed that montmorillonite clay dust is an efficient carrier of CWD. CWD was observed in deer as early as 98 days after the last inoculation. This confirms that animals can be exposed to CWD by simply inhaling wind-borne infected dust. Understanding and quantifying the overall impacts of transmission risks from scavengers and the environment will be a difficult, yet critical, next steps in the fight against CWD.

Testing a Molasses-based Bait for Bovine Tuberculosis Vaccination of White-tailed Deer. — Mycobacterium bovis is a bacterium that causes bovine tuberculosis (bTB). In northeastern Michigan, white-tailed deer have been implicated as the source of M. bovis infection in over 57 cattle herds from 1988 through spring 2013. Eradication of bTB in cattle cannot succeed unless M. bovis is eliminated from wildlife or wildlife-to-cattle transmission is prevented. NWRC scientists and partners at the USDA Agricultural Research Service evaluated the palatability and stability of molasses-based bait for delivering a bTB oral vaccine to free-ranging white-tailed deer. In studies with captive deer, the bait was readily eaten; however, researchers caution the bait should also be tested with free-ranging deer to ensure its attractiveness and palatability. The physical stability test demonstrated that the bait matrix is stable in dry conditions but unstable when in contact with ice and water, indicating that bait stability is acceptable during winter with constant temperatures below freezing. However, if ambient temperatures result in melting snow and ice, bait stability will be compromised. Researchers recommend using a device to shield baits from ice and water.

Using Breath Analysis to Differentiate Healthy Cattle from Cattle Experimentally Infected with Mycobacterium bovis. — Breath can contain volatile organic compounds (VOCs) that often emit unique odors and emission patterns. Because of these unique characteristics, VOCs have been identified as potential tools in disease surveillance. NWRC scientists and partners collected breath from healthy cattle and cattle experimentally infected with Mycobacterium bovis (the pathogen that causes bTB, which impacts approximately 10-14 percent of cattle in developing countries) and analyzed it using gas-chromatography/mass-spectrometry technology. Results demonstrated that it is possible to distinguish between healthy and infected cattle based on changes in their breath VOC profiles. These results suggest that VOC analysis may allow diagnosis of disease in cattle. This new technique could form the basis for a real-time cattle monitoring system that allows efficient and non-invasive screening for new bTB infections at dairy and beef farms.

Linking Bovine Tuberculosis on Cattle Farms to White-Tailed Deer and Environmental Variables. — To better understand the long-term survival and viability of M. bovis on farms and surrounding habitats, 762 cattle farms in Michigan were evaluated based on a multitude of environmental factors. Cattle farms test positive for M. bovis annually in the study area suggesting that the potential for an environmental source either on farms or in the surrounding landscape may be contributing to new or re-infections with M. bovis. Results showed that deer prevalence and the amount of sandy soil in the sampling area were most strongly tied to the presence of M. bovis. Analysis of cattle farms tested for M. bovis identified that every 1 percent increase in sandy soil resulted in an increase in odds of infection of 4 percent. Additionally, the impacts of potentially-infected deer were still a concern even after considerable efforts took place to prevent cattle interactions with white-tailed deer through on-farm mitigation and reduction in the deer population. This research provides an initial assessment of environmental factors that should be considered when modeling M. bovis prevalence and risk.

Selected Publications:

Lavelle, M.J., J.W. Fischer, G.E. Phillips, A.M. Hildreth, T.A. Campbell, D.G. Hewitt, S.E. Hygnstrom, and K.C. VerCauteren. Assessing risk of disease transmission: Direct implications for an indirect science. Bioscience 64(6):524-530. doi: 10.1093 / biosci / biu055.

Johnson, H.E., J.W. Fischer, M. Hammond, P.D. Dorsey, W.D. Walter, C.A. Anderson, K.C. VerCauteren. 2014. Evaluation of techniques to reduce deer and elk damage to agricultural crops. Wildlife Society Bulletin 38(2):358-365. doi: 10.1002 / wsb.408.

Nichols T.A., T.R. Spraker, T.D. Rigg, C. Meyerett-Reid, C. Hoover, B. Michel, J. Bian, E. Hoover, T. Gidlewski, A. Balachandran, K. O'Rourke, G.C. Telling, R. Bowen, M.D. Zabel, and K.C. VerCauteren. 2013. Intranasal inoculation of white-tailed deer (Odocoileus virginianus) with lyophilized Chronic Wasting Disease prion particulate complexed to montmorillonite clay. PLoS ONE 8(5): e62455. doi:10.1371 / journal.pone.0062455.

Walter, W.D., R. Smith, M. Vanderklok, and K.C. VerCauteren. 2014. Linking bovine tuberculosis on cattle farms to white-tailed deer and environmental variables using Bayesian hierarchical analysis. PLoS One 9(3): e90925. doi:10.1371 / journal.pone.0090925.

Walter, W. D., C. W. Anderson, R. Smith, M. Vanderklok, J. J. Averill, and K. C. Vercauteren. 2012. On-farm mitigation of transmission of tuberculosis from white-tailed deer to cattle: literature review and recommendations. Vet Med Int 2012:616318.

Major Research Accomplishments:

- WS research demonstrated that a 4-foot (1.2-meter) electric fence consisting of 4 strands of bipolar tape was 80 percent effective at excluding deer from feed piles.
- WS research determined proximity loggers provide the most accurate estimates of contact among collared deer compared to motion-activated cameras and global positioning systems.
- WS laboratory studies indicate that infectious prions can pass through the digestive systems of American crows and coyotes and be deposited via the animals' feces in new locations. Prions may also be transmissible to animals who inhale infected dust.
- WS and Agricultural Research Service studies indicate new molasses-based baits for delivering a bTB oral vaccine to free-ranging white-tailed deer are stable in dry conditions, but unstable when in contact with ice or water.
- WS, APHIS-Veterinary Services, and Agricultural Research Service 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 bTB infections in cattle.
- WS research determined that deer prevalence and the amount of sandy soil in an area are most strongly tied to the presence of M. bovis.