Wildlife Services

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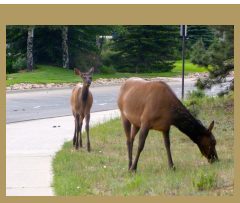
FY 2015

Reducing Impacts of Wildlife-Associated Pathogens to Agriculture and Food Safety



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Groups Affected By These Problems:

- Consumers
- Federal, State and local governments
- Livestock and poultry producers
- Public health organizations and hospitals
- U.S. citizens
- U.S. military
- Wildlife and natural resource managers

Major Cooperators:

- Colorado School of Public Health
- Colorado State University
- DOI/USGS/Biological Resources Division
- Private feedlot owners
- State Departments of Public Health
- The Ohio State University
- University of Wyoming
- USDA/APHIS/Wildlife Services Operations
- USDA/APHIS/Wildlife Services National Disease Program
- USDA/APHIS/Veterinary Services

National Wildlife Research Center Scientists Examine the Roles of Wildlife in the Transmission and Spread of Emerging Infectious Pathogens Affecting Agricultural Health, Human Health and Food Safety

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.

Considerable concern exists around the world about recent emerging infectious diseases, of which 75 percent are zoonotic, meaning the pathogens causing the disease can be transmitted between animals and humans. Wildlife plays a critical role in both the emergence and increased incidence of pathogens transmittable and causing disease in livestock and humans. New threats are emerging as well, such as highly pathogenic H5 subtypes of avian influenza virus that originated in Asia and subsequently entered North America in 2014 via migratory waterfowl. In addition, wildlife has increasingly been implicated in the spread of re-emerging pathogens, such as antibiotic-resistant bacteria that are causing significant problems associated with agricultural, animal, and human health. Thus, wildlife populations often play a key role in diseases that directly impact humans and agriculture. NWRC is at the forefront of research and surveillance for many of these pathogens. Much of this effort has focused on avian influenza viruses and pathogenic bacteria, including antibiotic-resistant strains.

Avian influenza viruses (AIV) are found naturally in waterfowl and other wild bird species. There are a substantial number of AIV subtypes found in birds but few of these subtypes cause serious diseases in birds. However, mutation of the virus can lead to infection of new wildlife species, domestic livestock (primarily poultry and swine), and humans. These mutations can result in AIV strains that are highly pathogenic. For example, the highly pathogenic Asian strain of H5N1 AIV originated from a low pathogenic strain of AIV in wild waterfowl that mutated into a highly pathogenic strain once it was introduced into poultry. This strain spread across the Eastern Hemisphere and caused considerable economic loss through mortality in domestic poultry and trade sanctions, as well as human deaths. Thus, understanding the ecology of low pathogenic strains of AIV in the wild is critical for identifying risk areas and points of control for the prevention of future influenza epidemics and global pandemics that affect both livestock and humans. NWRC scientists have played a key role in understanding the ecology of AIV in wildlife and how they may transmit AIV from natural systems to agricultural operations and humans.

Pathogenic bacteria have become an increasing health risk to both livestock and humans. These bacteria can cause illness in humans, ranging from food poisoning to life-threatening disease. In livestock, such bacteria can cause considerable loss in production. An additional complication is when these strains become resistant to antibiotics and, hence, are difficult to treat with traditional means. These "superbugs" have recently become a problem in hospitals, where they often defeat the last line of defense, antibiotics, in a physician's arsenal of drugs. Recently, a number of antibiotic-resistant strains of pathogenic bacteria have been found in wildlife but the role of wildlife in transmitting and spreading these bacterial strains is largely unknown. Research at NWRC is beginning to unravel the role of wildlife in maintaining and spreading both pathogenic bacteria and antibiotic-resistant strains of those bacteria.

Applying Science and Expertise to Wildlife Challenges

Understanding Avian Influenza Virus in Wild Waterfowl: Implications for Agricultural Health. — Avian influenza viruses (AIV) in wild birds contribute to new human influenza strains and threaten the domestic poultry industry with millions of dollars in losses. Avian influenza outbreaks, even low pathogenic outbreaks, result in significant economic losses to producers due to morbidity, mortality, and reduced production. Identifying and quantifying factors that have a significant impact on avian influenza dynamics allows for the development of quantitative models that can be used to assess risks and identify control points in order to optimize biosecurity, surveillance, and outbreak control. NWRC researchers have studied AIV in wild waterfowl to support such quantitative models including routes of AIV transmission from wild waterfowl, how long and how much virus wild waterfowl shed and whether previous infections

affect virus shedding if birds are re-infected. In addition, NWRC researchers have examined AIV at national scales to further examine the ecology of AIV across the U.S., AIV host associations, and AIV prevalence in wild birds over time. This information has been applied to identifying AIV "hotspots" where AIV in wild birds had the highest likelihood of spilling over into poultry.

Wild Mammals as Potential Transmitters of Avian Influenza Virus to Agricultural Operations. — Most research on avian influenza viruses (AIV) in the wild has focused on birds. However, the potential role of wild mammals as traffickers of AIV from wild waterfowl in aquatic habitats to agricultural operations has received little attention. NWRC researchers have examined the potential role of wild mammals through experimental infection studies to assess routes of transmission and shedding rates of several wild mammals species commonly associated with agricultural operations. Striped skunks and cottontail rabbits shed large quantities of viral RNA and their presence on poultry and waterfowl operations could influence the spread of AIV. In addition, water, rather than scavenging or egg predation, was the most probable mechanism for infecting wild raccoons with AIV. Researchers recommend biosecurity measures at poultry facilities to prevent access by these species.

Implications of Antimicrobial-resistant Bacteria in Wildlife to Food Safety. — Bacterial pathogens causing food-borne illnesses in humans are known to occur in many wild bird and mammal species. While wildlife are increasingly implicated in trafficking antimicrobial-resistant (AMR) bacteria, the degree of this transmission is poorly understood. NWRC researchers addressed whether wild mammals maintain and move AMR bacteria in livestock facilities by sampling wild mammals for AMR bacteria at livestock facilities. Raccoons had higher prevalence (36.7-87.7 percent) of AMR bacterial strains relative to other wildlife species. Most raccoons (72.7 percent) were infected with multiple strains of AMR bacteria, with 49 percent infected with more than three AMR strains. Based on information from raccoons fitted with passive integrated transponder (PIT) tags, researchers learned that raccoons frequently moved from surrounding areas into cattle feed troughs and most individuals frequented those troughs 75-100 percent of the days that they were tracked. Because raccoons are also associated with aquatic habitats, they may act as important traffickers of AMR bacteria to and from livestock facilities and water sources that could extend AMR bacterial contamination beyond livestock facilities.

Risk of E. coli Exposure From Elk. — Shiga-toxin-producing E. coli (STEC) has been implicated in many high-profile outbreaks of disease in humans, causing an estimated 265,000 clinical cases of intestinal illnesses, 3,700 hospitalizations, and more than 30 human deaths in the United States each year. Wildlife may contribute to these exposures in previously underappreciated ways. For example, in 2008, children playing on a soccer field in Colorado were sickened with a strain of STEC, which was later linked to feces from wild elk that had been grazing on the same field. In response to this outbreak, NWRC researchers set out to quantify the broader risks that wild elk and deer grazing in urban areas represent to public health. The results showed that the prevalence of STEC in wild elk feces was much higher in urban recreational areas (11 percent) than in natural, nonurban areas (2 percent). STEC in elk feces also increased as maximum daily temperatures increased. Serotypes O103 and O146 were found in elk and deer feces, which also have the potential to cause human illness. These findings show that elk feces may represent a public health risk, and management and mitigation actions are warranted.

Selected Publications:

Bevins, S.N., K. Pedersen, M.W. Lutman, J.A. Baroch, B.S. Schmit, D. Kohler, T. Gidlewski, D.L. Nolte, S.R. Swafford, and T.J. DeLiberto. 2014. Large-scale Avian Influenza surveillance in wild birds throughout the United States. PLoSOne 9(8): e104360. doi: 10.1371 / journal.pone.0104360.

Franklin A.B., K.C. VerCauteren, H. Maguire, M.K. Cichon, J.W. Fischer, M.J. Lavelle, A. Powell, J.J. Root, and E. Scallan. 2013. Wild ungulates as disseminators of shiga toxin-producing Escherichia coli in urban areas. PLoS ONE 8(12):e81512. doi:10.1371 / journal.pone.0081512.

Pepin, K.M., E. Spackman, J.D. Brown, K.L. Pabilonia, L.P. Garber, J.T. Weaver, D.A. Kennedy, K.A. Patyk, K.P. Huyvaert, R.S. Miller, A.B. Franklin, K. Pedersen, T.L. Bogich, P. Rohani, S.A. Shriner, C.T. Webb, and S. Riley. 2014. Using quantitative disease dynamics as a tool for guiding response to avian influenza in poultry in the United States of America. Preventive Veterinary Medicine 113(4):376-397. doi:10.1016 / j.prevetmed.2013.11.011.

Root, J.J., K.T. Bentler, S.A. Shriner, N.L. Mooers, K.K. VanDalen, H.J. Sullivan, and A.B. Franklin. 2014. Ecological routes of Avian Influenza virus transmission to a common mesopredator: An experimental evaluation of alternatives. PLoSONE 9(8): e102964. doi: 10.1371 / journal.pone.0102964.

Root, J.J., S.A. Shriner, K.T. Bentler, T. Gidlewski, N.L. Mooers, J.W. Ellis, T.R. Spraker, K.K. VanDalen, H.J. Sullivan, and A.B. Franklin. 2014. Shedding of a low pathogenic Avian Influenza virus in a common synanthropic mammal - the cottontail rabbit. PLoSOne 9(8): e102513. doi: 10.1371 / journal.pone.0102513.

Major Research Accomplishments:

- WS research found high percentages of wild mammals near livestock feedlots to be infected with antimicrobial-resistant strains of bacteria, with raccoons having the highest prevalence (87 percent of individuals).
- WS research found that wild mammals commonly associated with agricultural operations have a high potential for shedding and trafficking AIV and may play a role in spreading the viruses to poultry operations.
- WS research shed light on AIV infection, prevalence, distribution and shedding in wild waterfowl.
- WS research examining the human health risks associated with wild elk and deer feces found that 11 percent of elk fecal samples in urban areas contained Shiga toxin-producing E. coli which causes illness in humans.

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