Wildlife Services

Protecting People
Protecting Agriculture
Protecting Wildlife

National Wildlife Research Center

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Ecology of Emerging Viral and Bacterial Diseases in Wildlife

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Major Cooperators

- USDA/APHIS/Wildlife Services Operations
- USDA/APHIS/Veterinary Services
- DOI/USGS/Biological Resources Division
- DOD/Global Emerging Infections Surveillance and Response System
- Colorado State University
- Iowa State University
- Ohio State University
- State Departments of Public Health
- Mississippi State University
- Berryman Institute

Groups Affected By These Problems

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

NWRC Scientists Monitor and Assess the Roles of Wildlife in the Transmission and Spread of Emerging Infectious Diseases

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 acceptable methods, tools, and techniques.

Considerable concern exists around the world about recent emerging infectious diseases. Seventy-five percent of these emerging infectious diseases are zoonotic, meaning they are naturally transmitted between wildlife species and humans. Some zoonotic diseases carried by wildlife also can be transmitted to economically important domestic animals, such as avian influenza (AI) virus to poultry and pathogenic bacteria to cattle. Thus, wildlife populations often play a key role in many diseases that directly impact humans and agriculture. NWRC is at the forefront in the monitoring, surveillance and research of many of these diseases.

AI is found naturally in waterfowl and other wild bird species. There are 144 known subtypes of AI but few of these subtypes cause serious disease in birds. However, mutation of the virus can lead to infection of new wildlife species, domestic livestock (primarily poultry), and humans. These changes can result in AI strains that are highly pathogenic. Recently, highly pathogenic avian influenza (HPAI) H5N1 has spread from Asia across the Eastern Hemisphere and has caused considerable economic loss and mortality in domestic poultry, as well as some human deaths. The rapid geographic expansion of HPAI has prompted early detection and monitoring plans in the United States and increased research into how the virus may be spread through wildlife populations.

Applying Science & Expertise to Wildlife Challenges

Monitoring Highly-Pathogenic H5N1 Avian Influenza in the United States—One potential route for introduction of HPAI H5N1 into the United States includes migration of infected wild birds, including ducks, geese and shorebirds. Some waterfowl species may be only mildly affected by HPAI which makes them ideal dispersers of the virus over long distances. As part of the U.S. Interagency Strategic Plan for the Early Detection of Highly Pathogenic H5N1 Avian Influenza in Wild Migratory Birds, the NWRC was responsible for analyzing more than 80,000 fecal samples collected from wild birds over the last 2.5 years. NWRC scientists convened a committee of scientists to design a nation-wide monitoring program for the collection of environmental samples (both fecal and water), developed field sampling methods and guidelines, tested and evaluated various methods for collecting water samples from areas actively used by waterfowl, developed laboratory assays to detect AI in fecal samples, and analyzed approximately 80,000 fecal samples for the presence of AI. This effort is still ongoing and has expanded to other countries. For example, in collaboration with the U.S. Department of Defense, Kenyan nationals were recently trained in both laboratory and field techniques to establish a national surveillance program using environmental samples to detect HPAI H5N1 in waterbirds migrating from areas that have experienced HPAI H5N1 outbreaks, such as Europe, Asia, and northern Africa.

Potential Transmission and Spread of Avian Influenza from Waterfowl to Agriculture and Human Populations—In collaboration with other scientists, NWRC scientists are developing risk assessment models to identify potential routes of introduction and subsequent spread of AI by waterfowl in the United States. These models couple spatially explicit risk assessment models with field and laboratory data from AI samples collected from wild birds, band recovery data from waterfowl, the distribution of poultry operations, and genetic sequencing of detected AI subtypes in collected samples. Coupling the genetic information with band recovery data provides information about migratory patterns and gives insight on where birds exposed to specific AI virus genotypes originated, where they

moved to, and how they may further spread AI by mixing with other migratory populations. This allows scientists to identify areas where highly pathogenic strains of AI may be introduced into the United States and where they may subsequently spread in relation to domestic poultry operations and human populations. In addition to examining risks across the nation, NWRC scientists are also developing risk assessments at the local and state level through a variety of field and laboratory studies. These risk assessments will help individual farms develop more targeted measures to prevent contamination of poultry by AI carried by wildlife species and also assist networks of farms in preventing AI spread from neighboring outbreaks.

Role of Feral Pigs and Wildlife in the Transmission and Spread of Avian Influenza—Although AI can survive for extended periods in water (30-200 days), dilution of the virus in water beyond detectable limits may prevent the detection of the virus using current sampling methods. One alternative for sampling water is to use aquatic organisms, such as freshwater mollusks (mussels and clams), that naturally concentrate virus from the surrounding water. Mollusks accumulate a variety of viruses and can concentrate some viruses in their tissues 100 times greater than the surrounding water. NWRC scientists found that freshwater mollusks can concentrate AI from surrounding water and could be a useful tool for monitoring the presence of AI in water. In addition, NWRC scientists have developed more sensitive laboratory assays to detect AI in water, fecal samples, and tissues. These efforts could significantly reduce field surveillance costs and allow for more accurate and thorough risk assessments.

Development of Rapid Laboratory Tests for Avian Influenza Virus and Histoplasma—NWRC and its partners are working to develop rapid, reliable laboratory tests for detecting exposure of wildlife to various pathogens, such as AI and Histoplasma. Such tools are crucial to aid in the identification of wildlife species involved in the transmission and spread of these pathogens. As part of their larger research program on AI in wildlife, NWRC and Iowa State University scientists have developed a rapid and reliable method for detecting whether an animal has been exposed to AI. Another infection of concern is infection of humans with the soil-born fungus, Histoplasma capsulatum. As many as 200,000 people are infected annually in the United States with Histoplasma, which causes respiratory and systemic symptoms. Histoplasma is common in bird roosting areas because their feces promote the growth of Histoplasma in the soil. NWRC scientists recently completed a rapid laboratory test to detect Histoplasma in the soil and bird feces. This test has already been used by the City of Omaha, Nebraska to test soil samples for the presence of Histoplasma under large starling roosts before renovating park landscapes in order to protect public health.

Selected Publications:

Clark, L.; and J. S. Hall. 2006. Avian influenza in wild birds: status as reservoirs and risks posed to humans and agriculture. Ornithological Monographs 60:3-29.

Hall, J. S., K. T. Bentler, G. Landolt, S. A. Elmore, R. B. Minnis, T. A. Campbell, S. C. Barras, J. J. Root, J. Pilon, K. Pabilonia, C. Driscoll, D. Slate, H. Sullivan, and R. G. McLean. 2008. Influenza infection in wild raccoons. Emerging Infectious Diseases [Epub ahead of print].

Hall, J. S., R. Minnis, T. A. Campbell, S. Barras, R. W. DeYoung, K. Pabilonia, M. L. Avery, H. Sullivan, L. Clark, and R. McLean. 2008. Influenza exposure in United States feral swine populations. Journal of Wildlife Diseases 44:362-368

McLean, R. G., J. S. Hall, A. B. Franklin, H. Sullivan, K. VanDalen, S. Shriner, M. Farnsworth, P. Oesterle, G. Young, J. Carlson, K. Cobble, T. Deliberto, S. Swafford, S. Elmore, T. Anderson, S. Hauser, K. Bentler, N. Mooers, and K. Huyvaert. 2007 Avian influenza in wild birds: environmental sampling strategy for the rapid detection of avian influenza viruses. Pages 87-93 In: D. L. Nolte, W. M. Arjo, and D. H. Stalman, editors. Proceedings of the 12th Wildlife Damage Management Conference, Corpus Christi, Texas.

Major Assistance Activities:

- WS developed sampling and laboratory methodologies and processed approximately 80,000 environmental samples in support of the national avian influenza monitoring effort.
- WS conducted research on the roles of wildlife in harboring and transmitting avian influenza to domestic animals and humans.
- WS is developing large-scale spatial risk assessment models to predict routes of introduction and spread of avian influenza in the United States.
- WS is evaluating the role of wildlife as transmitters of bacterial pathogens to and among livestock facilities.
- WS is developing rapid laboratory tests to detect pathogens of concern to livestock and human health, such as avian influenza virus and Histoplasma.

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