

# The USGS National Wildlife Health Center: Advancing Wildlife and Ecosystem Health



## Understanding Why Wildlife Health Matters

*The effects of emerging wildlife diseases are global and profound, often resulting in the loss of human lives, economic and agricultural impacts, declines in wildlife populations, and ecological disturbance. For example, at least 70 percent of emerging human diseases, including West Nile virus, plague, Ebola virus, acquired immunodeficiency syndrome (AIDS), severe acute respiratory syndrome (SARS), and influenza originated in wild or domestic animals (Jones and others, 2008). Understanding diseases of wildlife is important for the health and conservation of wildlife, for the health of humans and domestic animals, and for the health of ecosystems.*



**Figure 1.** The U.S. Geological Survey National Wildlife Health Center is a biosafety level 3 facility in Madison, Wisconsin, that investigates outbreaks of wildlife disease nationwide. (Biosafety level refers to a specific combination of work practices, safety equipment, and facilities that are designed to minimize the exposure of workers and the environment to infectious agents.) The Honolulu Field Station of the National Wildlife Health Center, located in Honolulu, Hawaii, [top right], investigates terrestrial and marine diseases throughout the Pacific region.

## Creating a “CDC for Wildlife”

In 1975, the Federal government responded to the need for establishing national expertise in wildlife health by creating the [National Wildlife Health Center \(NWHC\)](#), a facility within the Department of the Interior (DOI); the NWHC is the only national center dedicated to wildlife disease detection, control, and prevention. Its mission is to provide national leadership to safeguard wildlife and ecosystem health through active partnerships and exceptional science. Comparisons are often made between the NWHC, which strives to protect the health of our Nation’s wildlife, and the Centers for Disease Control and Prevention (CDC), which strive to protect public health. The NWHC, a science center of the U.S. Geological Survey (USGS) with specialized laboratories, works to safeguard our Nation’s wildlife from diseases by studying the causes and drivers of these threats and by developing strategies to prevent and manage them. In addition to the main campus, located in Madison, Wisconsin, the NWHC also operates the Honolulu Field Station (HFS), which addresses wildlife health issues in Hawaii and the Pacific Region (fig. 1). The NWHC is designated by the DOI as a USGS “mission essential” facility, provides support in animal health emergencies, and is registered with the CDC’s Select Agent Program.

Through a comprehensive program involving biomedical and ecological expertise and capabilities, the NWHC is a world leader in developing research solutions to the most deadly wildlife diseases, such as avian influenza, white-nose syndrome in bats, and other emerging diseases that have devastated wildlife populations around the world and pose significant public health and economic risks. This includes playing a key role in detecting novel pathogens, developing rapid diagnostic tests, conducting surveillance, and designing methods to control these diseases, not only in the United States, but globally.

## NWHC Capabilities

Scientists at the NWHC possess a wide array of expertise and capabilities, including wildlife biology, ecology, statistics, quantitative modeling, epidemiology, veterinary medicine, microbiology, molecular biology, toxicology, and immunology. The Center is organized into three science branches—Applied Wildlife Health Research, Wildlife Epidemiology and Emerging Diseases, and Wildlife Disease Diagnostic Laboratories—that operate on a national scale (figs. 2 and 3).

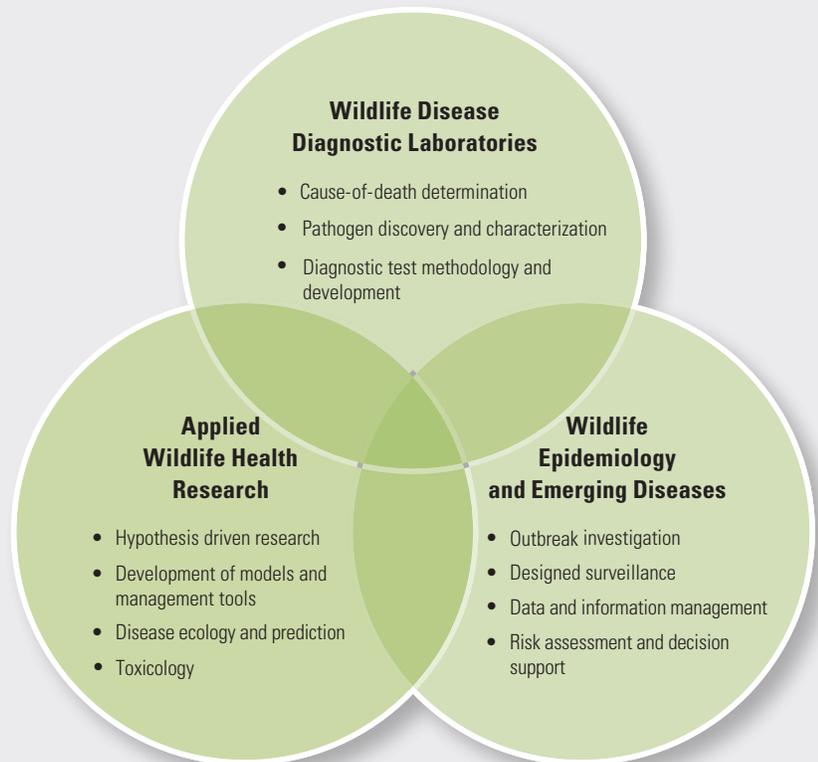
### Applied Wildlife Health Research Branch

The Research Branch has core capabilities in infectious disease research, disease ecology and epidemiological modeling, and development of disease management tools. Partnerships with State, Tribal, and other Federal agencies and academic institutions are routinely created to facilitate holistic studies from the molecular to the landscape level. Through scientific investigations conducted in specialized laboratories and field settings, NWHC scientists work to understand the drivers and ecology of wildlife diseases and mitigate their effects to promote ecosystem health.

Examples of research at the NWHC include multidisciplinary studies of avian influenza (AI), understanding pathogenicity (the ability of a microorganism to cause disease) in wildlife and species susceptibility, characterizing genetic exchange between viruses of North American and Eurasian origin, mathematical modeling of viral transmission, and analysis of ecological factors that influence viral persistence and transmission. Other research accomplishments include: development of a sylvatic plague vaccine to support recovery of the endangered black-footed ferret; discovery of an enzyme produced by lichen that destroys prion proteins and that may be useful for managing chronic wasting disease (CWD) in deer and elk; and predictive modeling of emerging diseases, such as CWD, to support population management.

### Wildlife Epidemiology and Emerging Diseases Branch

The Epidemiology Branch conducts field investigations and disease ecology studies of emerging and recurring wildlife diseases suspected of having wildlife population impacts or with the potential to affect humans or agricultural animals. Scientists in this branch routinely provide support to resource managers through disease management consultation and training workshops. They also provide assistance to partners during mortality events through the development and coordination of enhanced disease surveillance programs (for examples, please see Wildlife Disease Surveillance section) and through quantitative and descriptive analyses to understand the causes and effects of diseases on wildlife populations. This branch is also responsible for the development and maintenance of one of the Nation's largest long-term data-management systems containing information on wildlife morbidity and mortality events, and it facilitates continual data sharing among partners through the [Wildlife Health Information Sharing Partnership event reporting system \(WHISPers; see text box\)](#).



**Figure 2.** The three science branches of the National Wildlife Health Center showing primary scientific activities.

### Wildlife Disease Diagnostic Laboratories Branch

The Diagnostic Branch conducts laboratory investigations to determine the causes of wildlife mortality events, especially large-scale die-offs or those that are otherwise unusual. Laboratories in this branch specialize in pathology, microbiology, virology, parasitology, and chemistry, and use microbiological, molecular-biological, and descriptive techniques to identify and characterize agents of infectious disease. Scientists in this branch also provide disease consultation services to external partners and conduct research to further elucidate emerging diseases and other pathogens of wildlife. Furthermore, the branch develops novel diagnostic tests to improve identification of unique pathogens of wildlife. For example, scientists in this branch discovered the fungus, *Pseudogymnoascus destructans*, that causes white-nose syndrome (WNS) in bats and have since developed and disseminated standardized molecular tests to rapidly identify this fungal pathogen.

**Figure 3 (right).** National Wildlife Health Center scientists at work.

## Wildlife Disease Surveillance

In this age of rapidly emerging diseases and potential pandemics, the importance of disease surveillance is paramount. As mentioned previously, the majority of all novel, emerging, or reemerging diseases affecting humans have originated in wildlife. To provide early detection and warning of these biological threats, NWHC scientists conduct disease surveillance in collaboration with multiple partners. An important example of this type of collaboration is the role the NWHC plays in grappling with AI. The NWHC is a member of the Interagency Steering Committee for Surveillance for Highly Pathogenic Avian Influenza in Wild Birds and is a leading partner in conducting morbidity and mortality investigations in support of the [Interagency Strategic Plan for Early Detection and Monitoring for Avian Influenzas of Significance in Wild Birds](#). In December 2014, during the investigation of a seemingly routine waterfowl mortality event in Washington State in collaboration with the Washington Department of Fish

and Wildlife, NWHC scientists were the first to detect highly pathogenic AI (HPAI) in wild birds (specifically three duck species: northern pintail, mallard, and American wigeon) in the United States. Thus, ongoing surveillance for diseases of wildlife serves to maximize early detection, situational awareness, and management of emerging diseases.

Additional diseases of wildlife in which the NWHC plays a major role in interagency surveillance efforts include WNS in bats, snake fungal disease, and an emerging fungal disease in salamanders caused by the fungus *Batrachochytrium salamandrivorans* (also known as Bsal). The NWHC will continue to play a key role in monitoring these and other diseases and providing the information necessary to respond appropriately. In addition to surveillance efforts, the NWHC also informs and updates natural resource managers nationwide about wildlife disease issues through timely distribution of [Wildlife Health Bulletins](#).



## A Vision for Wildlife Health

*Drawing upon the expertise of NWHC scientists and support staff in diagnostics, epidemiology, and research, the Center is uniquely poised to coordinate, strengthen, and support a more proactive and collaborative approach to the investigation of emerging wildlife diseases. Collectively, the advent of new analytical models, diagnostic tests, and managements techniques will improve understanding of the distribution, dynamics, and impacts of emerging diseases, and ultimately provide better information and tools for managers to proactively respond to and manage disease threats to wildlife and our environment.*



### The NWHC Honolulu Field Station

The NWHC HFS, established in 1992, provides support to the natural resource communities of Hawaii and the Pacific Basin in the investigation of wildlife health-related issues. Efforts focus on forming partnerships and pooling expertise to quickly identify and mitigate wildlife health problems. Examples of wildlife diseases collaboratively investigated by staff at the HFS include fibropapilloma tumors in sea turtles and diseases of coral and urchins. Additionally, the HFS has worked collaboratively with the U.S. Department of Agriculture (USDA) to conduct surveillance for the early detection of West Nile virus in the Pacific Basin and has assisted the U.S. Fish and Wildlife in the reintroduction of endangered Laysan ducks to Midway Atoll by ensuring that the translocated birds are free of detrimental parasites.

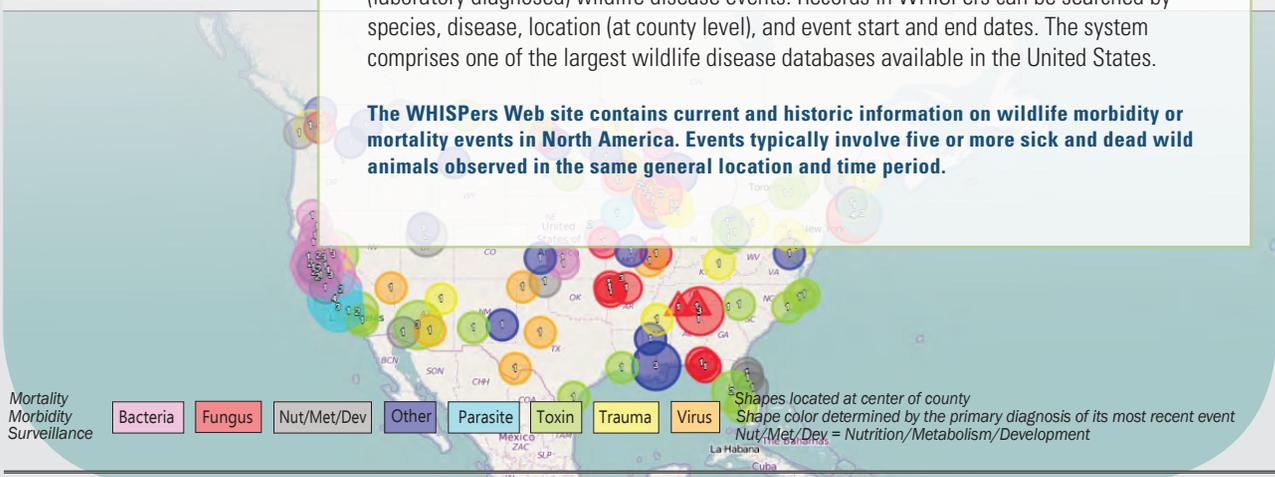
**A National Wildlife Health Center Wildlife Disease Specialist takes a sample from diseased coral on the north shore of Kauai, Hawaii.**



### WHISPers

The Wildlife Health Information Sharing Partnership event reporting system ([WHISPers](#)), developed at the NWHC, is an online tool that provides wildlife managers with situational awareness regarding wildlife disease events throughout the United States. WHISPers is a partner-driven, Web-based repository for wildlife disease information. The system provides natural resource management partners with timely and accurate information on where reported wildlife disease events are occurring and includes a searchable archive of verified (laboratory diagnosed) wildlife disease events. Records in WHISPers can be searched by species, disease, location (at county level), and event start and end dates. The system comprises one of the largest wildlife disease databases available in the United States.

**The WHISPers Web site contains current and historic information on wildlife morbidity or mortality events in North America. Events typically involve five or more sick and dead wild animals observed in the same general location and time period.**



## A Vision for Wildlife Health

### White-Nose Syndrome in Bats

Since it was first discovered in New York in 2007, WNS has continued to spread westward across North America and has caused the deaths of millions of hibernating bats. The NWHC has made considerable advances in understanding WNS, including characterizing the fungus, *Pseudogymnoascus destructans*, that causes the disease; defining the pathology of WNS; devising molecular techniques to detect the fungal pathogen on bats and in the environment; conducting national surveillance for *P. destructans*; and investigating mechanisms by which the fungus infects and kills bats. The Center is also working to develop various disease management tools, including the development of a vaccine. As more is learned about the ecology of WNS through a greater understanding of the interactions among bats, fungi, and the environment, new opportunities may arise to interrupt the disease cycle. State and Federal land management agencies have relied on USGS science to support on-the-ground management actions and development of an interagency WNS National Plan (available at the interagency Web site: [www.whitenosesyndrome.org](http://www.whitenosesyndrome.org)).

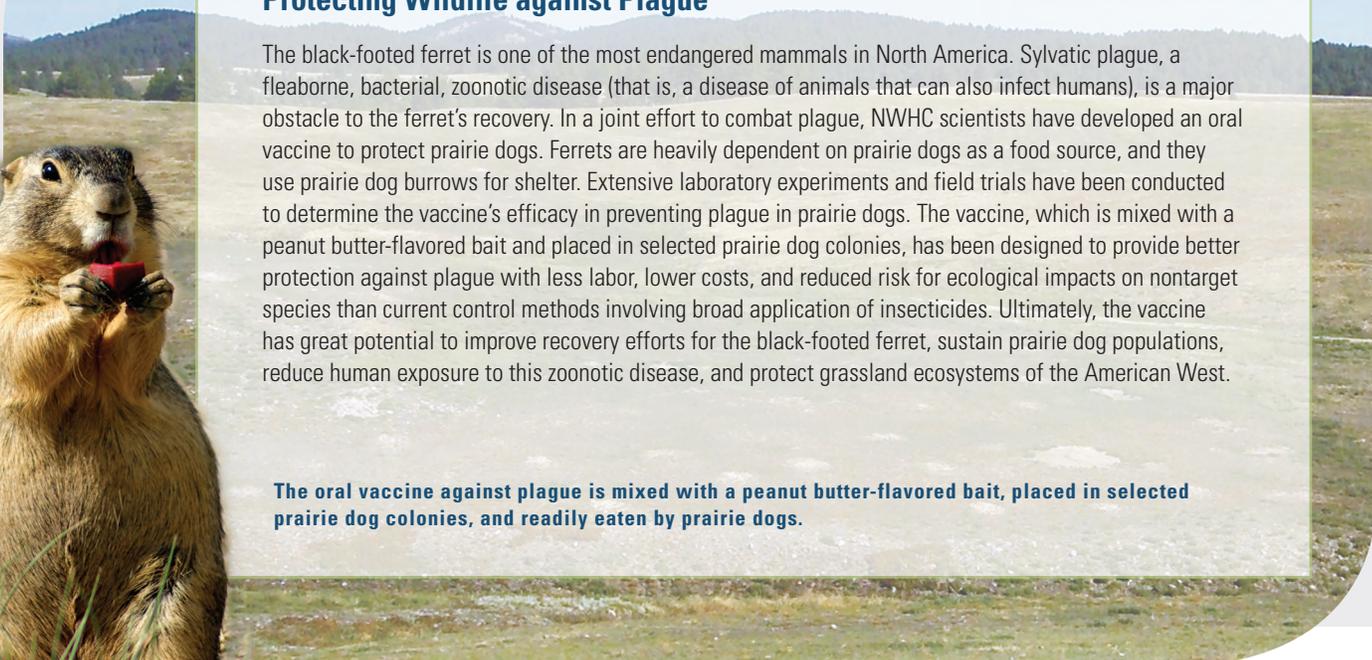
**Scientists collect samples from the cave environment, as well as from bats, to test for the presence of the fungus that causes white-nose syndrome in bats.**



### Protecting Wildlife against Plague

The black-footed ferret is one of the most endangered mammals in North America. Sylvatic plague, a flea-borne, bacterial, zoonotic disease (that is, a disease of animals that can also infect humans), is a major obstacle to the ferret's recovery. In a joint effort to combat plague, NWHC scientists have developed an oral vaccine to protect prairie dogs. Ferrets are heavily dependent on prairie dogs as a food source, and they use prairie dog burrows for shelter. Extensive laboratory experiments and field trials have been conducted to determine the vaccine's efficacy in preventing plague in prairie dogs. The vaccine, which is mixed with a peanut butter-flavored bait and placed in selected prairie dog colonies, has been designed to provide better protection against plague with less labor, lower costs, and reduced risk for ecological impacts on nontarget species than current control methods involving broad application of insecticides. Ultimately, the vaccine has great potential to improve recovery efforts for the black-footed ferret, sustain prairie dog populations, reduce human exposure to this zoonotic disease, and protect grassland ecosystems of the American West.

**The oral vaccine against plague is mixed with a peanut butter-flavored bait, placed in selected prairie dog colonies, and readily eaten by prairie dogs.**



## A Vision for Wildlife Health

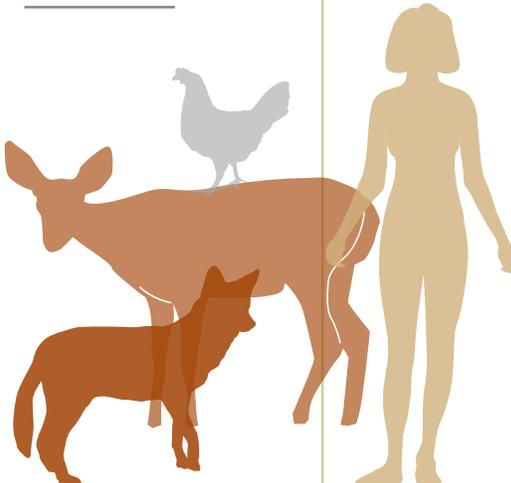


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### One Health and Collaborative Partnerships



“One Health” refers to the concept that the health of humans, animals, and ecosystems is inextricably linked and emphasizes the necessity for collaboration to address global health challenges to optimize outcomes for human, domestic animal, and wildlife health. For example, declines of insect-eating bat populations due to WNS can directly and indirectly impact humans from the loss of “ecosystem services,” such as allowing less pesticide use on crops and in forests, that these species provide.

Collaborative partnerships are imperative to the One Health approach for tackling these challenges, and the NWHC focuses on creating partnerships that use shared expertise. For example, the NWHC partnered with the [Canadian Wildlife Health Cooperative](#) to become a Collaborating Centre for Research, Diagnosis and Surveillance of Wildlife Pathogens within the World Organization for Animal Health (OIE). [OIE Collaborating Centres](#) provide their expertise to the international animal health community. Another example is the NWHC’s membership in the [USDA’s National Animal Health Laboratory Network](#), a network of State and Federal laboratories established to provide consistent, timely, and accurate testing for disease agents, such as highly pathogenic AI, of critical importance to national security and the economy.

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Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, Adam, Balk, Deborah, Gittleman, J.L., and Daszak, Peter, 2008, Global trends in emerging infectious diseases: Nature, v. 451, no. 7181, p. 990–993, accessed May 2, 2016, at <http://www.nature.com/nature/journal/v451/n7181/full/nature06536.html>.