



**Report to the Fish and Wildlife Health Committee
of the Association of Fish and Wildlife Agencies
from the USGS National Wildlife Health Center**

March 9, 2017

Contents

EMERGING WILDLIFE DISEASE SURVEILLANCE UPDATES	3
Global Persistence of Highly Pathogenic Avian Influenza in Wild Birds	3
National Surveillance Continues to Detect Spread of White-Nose Syndrome in Bats	3
Surveillance for Invasive Pathogens to Protect our Nation’s Amphibians	4
INVESTIGATIONS OF UNUSUAL MORTALITY EVENTS	5
Bisgaard Taxon 40-Associated Mortality	5
Gulf Coast Sanderlings Infected with Livestock Skin Bacteria	5
New World Screwworm Myiasis in Endangered Key Deer	6
DEVELOPING WILDLIFE HEALTH CAPACITY AND TOOLS	6
WHISPers: Building a National Wildlife Health Database	6
Building International Capacity for Wildlife Disease Surveillance and Risk Assessments	7
Power to the People: Developing Accessible Tools for Statistical Modeling	7
Peering Into the Crystal Ball: Forecasting Wildlife Diseases In the Face of Uncertainty	8
WILDLIFE HEALTH RESEARCH UPDATES	8
Sylvatic Plague Vaccine for Prairie Dogs	8
Avian Influenza Virus Ecology in the North Atlantic: A Route for HPAI introduction to North America	9
Another Emerging Fungal Disease: This Time It’s Affecting Snakes	9
Will Zika virus impact poultry or wild birds?	9
Chronic Wasting Disease in Deer, Elk, and Moose: An Epidemic in Slow Motion	10
AVIAN HEALTH EVENTS IN THE PACIFIC, CENTRAL, MISSISSIPPI, AND ATLANTIC FLYWAYS	11
2016 Avian Disease Update for the Pacific Flyway Council	11
2016 Avian Disease Update for the Central Flyway Council	11
2016 Avian Disease Update for the Mississippi Flyway Council	12
2016 Avian Disease Update for the Atlantic Flyway Council	13
ON-LINE PUBLICATIONS, WEBINARS, AND ON-GOING SERVICES TO PARTNERS	13
Field Manual of Wildlife Diseases, USGS Techniques and Methods Book 15	13
New Fact Sheet about the USGS National Wildlife Health Center	14
Disease Webinar Series Sponsored by USGS Ecosystems Mission Area and AFWA	14
Disease Investigation Services	14
USGS Wildlife Health Information on Twitter	14

EMERGING WILDLIFE DISEASE SURVEILLANCE UPDATES

Global Persistence of Highly Pathogenic Avian Influenza in Wild Birds

The U.S. Department of Agriculture's surveillance program for the detection of highly pathogenic avian influenza virus (HPAIV) continued in the 2016–2017 surveillance year. Between July 1, 2016 and February 1, 2017, a total of 33,695 birds have been sampled with 96 percent of those samples coming from dabbling ducks. During the current year's surveillance program, HPAIV has been detected in two mallards. The first mallard was sampled in Fairbanks-Northstar Borough, Alaska, during August and the second was sampled in Fergus County, Montana, during December. Both of the isolated viruses were the Eurasian-American lineage H5N2 that was previously detected in North America beginning in December 2014.

Globally, HPAIV detections have occurred in wild and domestic birds throughout Europe, Asia, and Africa in 2016 with nearly 50 countries reporting HPAIV H5 subtypes to the OIE (World Organisation for Animal Health). Many of the 2016 outbreaks occurred in the autumn. Since January 2017, 36 countries have already reported HPAIV H5 outbreaks. Similar to the outbreaks in 2015 in North America, the outbreaks in late 2016 through early 2017 have resulted in the death of large numbers of poultry in many countries due to both illness and culling. Reported mortalities of wild birds have also been substantial, particularly in Europe. More than 75 species of wild free-ranging or captive birds were documented with the virus in 2016, with tufted ducks (*Aythya fuligula*) being among the most common species. In January 2017, a large mortality event in wild birds was noted in Uganda where large numbers of white-winged terns and other species were reported dead (at least 1,200 birds). At this location HPAIV H5N8 has been isolated in a number of these birds. In addition to the wide spread nature of these HPAI viruses at least 7 different H5 subtypes were reported in 2016 with H5N8 being the most commonly detected subtype in Europe. **Contact:** Hon Ip, 608-270-2464, hip@usgs.gov

National Surveillance Continues to Detect Spread of White-Nose Syndrome in Bats

The USGS National Wildlife Health Center (NWHC) continues to assist state and federal wildlife agencies nationwide with early detection of *Pseudogymnoascus destructans* (*Pd*) in new areas, and to address specific research priorities identified by partners in conjunction with the [White-Nose Syndrome National Plan](#). United States Fish and Wildlife funding support for this work has been extended through 2018. During annual bat population surveys, participating state agencies collect bat skin swabs, pooled guano, hibernaculum sediment, and environmental substrate swabs. If white-nose syndrome (WNS) clinical signs are observed in the population, carcasses or wing biopsies are collected for diagnostic testing.

To date, 226 unique hibernacula have been surveyed nationwide. These samples have resulted in the detection of *Pd* at 81 hibernacula of previously unknown *Pd* status from 13 states, including 28 sites where there was no physical or behavioral evidence of WNS observed in the bat population. Nearly 95 percent of all detections of *Pd* originated from samples collected from bats rather than from environmental substrates collected inside of hibernacula. Data analysis and modeling of risk factors associated with *Pd* movement from data collected during the past three years of the project are currently underway.

In February 2017, WNS was confirmed for the first time in Cass County, Nebraska where *Pd* has been present since 2015. This raises the number of states with confirmed cases of WNS to 30, while the number of affected Canadian provinces remains at five. Northern long-eared bats (*Myotis septentrionalis*), little brown bats (*M. lucifugus*), and tricolored bats (*Perimyotis subflavus*) remain the species most often positive for *Pd*, while the fungus has yet to be detected on southeastern myotis (*M. austroriparius*), cave myotis (*M. velifer*), or Townsend's big-eared bats (*Corynorhinus townsendii*), all of which have been sampled in sufficiently large numbers.

Despite national surveillance to detect the spread of WNS, the 2016 detection of WNS in Washington illustrates the ongoing importance of investigating wildlife mortality events as part of a comprehensive wildlife disease surveillance strategy, and we encourage wildlife managers to report unusual bat mortality or bats displaying clinical signs suggestive of WNS to the NWHC for further investigation. We can also answer questions about designing WNS surveillance and response plans relevant to your state, and help with testing samples collected as part of opportunistic or targeted surveillance efforts in accordance with the national *Pd* surveillance strategy. Tribal, state, and federal agencies who have questions about ongoing surveillance efforts or who may wish to participate, should contact Anne Ballmann (608-270-2445, aballmann@usgs.gov).

Please visit www.whitenosesyndrome.org for more information about the national multi-agency WNS response effort. A recently completed fact sheet titled "[White-Nose Syndrome in North American Bats – USGS updates](#)" is available online. For paper copies, please contact Gail Moede Rogall, gmrogall@usgs.gov. Also, a WNS poster and handout are available for use as needed at <https://www.whitenosesyndrome.org/resource/white-nose-syndrome-poster-available-your-use>

Surveillance for Invasive Pathogens to Protect our Nation's Amphibians

On-going national wildlife disease surveillance is essential for early detection and rapid response to diseases that threaten the lives of wildlife, humans, and livestock. *Batrachochytrium salamandrivorans* (*Bsal*) is an emerging fungal pathogen that has decimated populations of some salamander species in Europe. Salamanders contribute to forest health through invertebrate predation that results in increased litter retention and carbon capture in the soil. The U.S. has the highest biodiversity of salamanders in the world; the translocation of *Bsal* to the U.S. could result in ecosystem disruption in the many regions where they reside.

In 2016, the NWHC and the USGS Amphibian Research and Monitoring Initiative conducted a spatial risk analysis to determine where *Bsal* would most likely be introduced to the U.S. and which regions of the country would be the most impacted. The risk assessment was used to direct a coordinated collection and analysis of approximately 8,000 samples from over 30 amphibian species in 20 states to determine whether the pathogen had already been introduced. All samples were negative for *Bsal*, indicating that this pathogen is not yet present in the U.S. and affording additional time for USGS and partners to develop strategies to contain this pathogen should it be introduced. In the future, the NWHC will begin development of methods to test the environment for *Bsal* and other chytrid fungi. This method will allow for more efficient and widespread sampling by reducing the need to capture animals to determine pathogen presence and will also have potential applicability to other pathogens. The USGS fact sheet titled "[Early action to address an emerging wildlife disease](#)" (FS 2017-3013), available online, summarizes the *Bsal* risk analysis. For additional information on *Bsal*, please see this [Wildlife Health Bulletin](#) from April 2016. For questions regarding *Bsal* surveillance, please contact Daniel Gear, 608-270-2478, dgear@usgs.gov, or Natalie Nguyen, ntnguyen@usgs.gov.

INVESTIGATIONS OF UNUSUAL MORTALITY EVENTS

Bisgaard Taxon 40-Associated Mortality

Between August and October 2016, NWHC received a number of avian cases in which death was associated with a *Pasteurella*-like bacterium, *Bisgaard* taxon 40. The most significant of these was a mortality event involving rhinoceros auklets (*Cerorhinca monocerata*) that occurred in the Salish Sea area of Washington State. At this location, approximately 420 dead adult and juvenile auklets washed ashore and were observed by volunteer beach survey teams. Ten adult auklet carcasses were submitted to the NWHC for diagnostic evaluation. In seven of these birds, bacterial septicemia associated with *Bisgaard* taxon 40 was determined to be the cause of death. Following this event, NWHC continued to isolate this bacterium from dead birds collected from various locations in the Great Lakes region and the mid and north Atlantic coast of the U.S. (including Wisconsin, Maryland, Massachusetts, and Maine). These mortalities involved birds of the order Charadriiformes and included common tern (*Sterna hirundo*), roseate tern (*S. dougallii*), laughing gull (*Leucophaeus atricilla*), herring gull (*Larus smithsonianus*), and great black-backed gull (*L. marinus*). NWHC also received similar reports and diagnostic results on 44 birds examined by the Canadian Wildlife Health Cooperative in British Columbia. *Bisgaard* taxon 40 was first recognized in 2003 in gulls, but has not previously been associated with mortality in wildlife. NWHC is currently reviewing historical diagnostic cases where *Bisgaard* taxon 40 was identified, as well as trying to determine the extent of this bacterium's occurrence among apparently healthy gulls. **Contact:** NWHC Field Epidemiology Team, 608-270-2480, NWHC-epi@usgs.gov

Gulf Coast Sanderlings Infected with Livestock Skin Bacteria

During routine summer surveys of sanderlings (*Calidris alba*) on a Gulf Coast barrier island in Louisiana in 2016, biologists from the USGS Wetland and Aquatic Research Center in Gainesville, Florida, observed eye and beak lesions on an estimated 20-30 percent of individuals in foraging flocks. The lesions ranged from barely noticeable to severe with roughed and matted feathers, scab formation, and yellow waxy growths around the top of the bill, eyes, and head. Individuals with small lesions foraged and acted apparently normally. Those with severe lesions foraged lethargically and were less likely to stay with the foraging flocks. In the most severe cases, infected birds allowed biologists to approach them likely due to severe morbidity and probable blindness from the lesions. Sanderlings were the only species observed with lesions among mixed flocks of foraging shorebirds, with one exception: a single dunlin (*Calidris alpina*) showed similarly ruffled facial feathers, and photos appeared to show the same waxy growth on the face.

The National Wildlife Health Center received several sanderling specimens with severe lesions and diagnosed dermatophilosis caused by the anaerobic bacterium, *Dermatophilus congolensis*. Overproduction of keratin (hyperkeratosis) resulted in waxy growths on the most severely affected sanderlings. Growths were evident on the wings, the side and the front of the head, and extended over the surface of the eyes of some individuals, although the cornea and conjunctiva were not infected. The *D. congolensis* infection was microscopically apparent and confirmed by sequencing PCR-amplified DNA extracted from the lesioned skin. **Contact:** NWHC Field Epidemiology Team, 608-270-2480, NWHC-epi@usgs.gov

New World Screwworm Myiasis in Endangered Key Deer

In late September 2016, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA APHIS) National Veterinary Services Laboratories confirmed New World screwworm (*Cochliomyia hominivorax*) infection in Key deer (*Odocoileus virginianus clavium*) from National Key Deer Refuge on Big Pine Key, Florida. New World screwworms had not been reported in the State of Florida in over 50 years due to an extensive and successful [eradication program](#) initiated by USDA during the 1950s-1960s in response to the parasite's significant economic impact on livestock production. Adult screwworms typically posit eggs in open wounds. Developing larvae feed on the living host and cause severe tissue damage which can quickly result in death. As of the end of December 2016, a total of 133 Key deer, representing > 10 percent of the estimated 1,000 deer, have been found dead or euthanized due to severe infestation. Peak mortality occurred in October and affected predominantly males, attributable to infestation of injuries sustained during the rut. A small number of cases have also been detected in other wildlife species, including raccoon (*Procyon lotor*), and domestic animals, including dog, cat, and pig. In all, 13 islands are known to be infested between No Name Key and Sugarloaf Key, Florida. The origin of the outbreak remains uncertain.

Since the initial detection, the Florida Department of Agriculture (FDACS), USDA APHIS, U.S. Fish and Wildlife Service (FWS), and other partner agencies have implemented multiple management strategies to eradicate screwworms from Florida and to conserve the remaining Key deer population. Increased surveillance by agency personnel, local veterinarians, and pet owners has been implemented to detect cases in wildlife and domestic animals from the resident populations. Inspection stations at Key Largo, the entrance to mainland Florida, to screen animals leaving the affected region have been instituted. Free-ranging Key deer are being treated both orally and topically with the anti-parasiticide, Doramectin. Sterilized male screwworm flies are being released in high numbers in the region to unproductively mate with female flies in order to eradicate the local screwworm population. Furthermore, sperm banking from all deceased male deer is underway in collaboration with the Southeast Zoo Alliance for Reproduction and Conservation. Ongoing monitoring efforts suggest that the combination of management efforts being implemented has been effective to date. For additional information on New World screwworm in North America and the current outbreak, please visit [USDA-APHIS](#), [FWS Wildlife Health Office](#), [FDACS](#), or the [Center for Food Security & Public Health](#) at Iowa State University. Contributions to this summary were provided by Dr. Samantha Gibbs, FWS, and Dr. Sherrilyn Wainwright, USDA-APHIS. **Contact:** NWHC Field Epidemiology Team, 608-270-2480, NWHC-epi@usgs.gov

DEVELOPING WILDLIFE HEALTH CAPACITY AND TOOLS

WHISPers: Building a National Wildlife Health Database

Emerging infectious diseases have increased globally in the past two decades with the majority of new pathogens originating in wildlife. On-going national wildlife disease surveillance is essential for early detection and rapid response to protect the lives of wildlife, humans, and livestock. Hundreds of wildlife disease events are investigated throughout the U.S. each year by state and federal natural resource agencies, but the results are stored in individual internal databases. Although managers have long recognized that wildlife do not respect jurisdictional boundaries, sharing disease information across agencies or with the public was difficult and inefficient. The Wildlife Health Information Sharing Partnership (WHISPers) is a centralized web-based repository for wildlife health surveillance data on thousands of events investigated by the NWHC and partners. In 2015, WHISPers went live to partner agencies and the public and has significantly increased the availability and accessibility to information

on over 7,000 morbidity and mortality events collectively spanning over 40 years. Data are provided in map and table format that can be searched, sorted, and downloaded by anyone, anywhere. Since 2015, new data have been uploaded quarterly, increasing the utility of WHISPers as a mechanism for situational awareness of emerging pathogens and wildlife disease events. Soon, data will load in near-realtime from the internal NWHC wildlife morbidity and mortality event database to the public WHISPers interface. Future goals are to create a front-end feature and application to allow state and federal agencies to enter and analyze data on additional on-going or historic wildlife health events in WHISPers. These features will increase the acquisition, preservation, availability, and use of these data by the entire wildlife health field. As a result, we will also improve our ability to understand, predict, and manage the effects disease on wildlife, humans, and agriculture. **Contact:** Neil Baertlein, 608-270-2460, nbaertlein@usgs.gov.

Building International Capacity for Wildlife Disease Surveillance and Risk Assessments

Most wildlife associated diseases that threaten the U.S. have an international origin. Consequently, enhanced pre-border surveillance and management of these diseases, and better information sharing among international partners, will help protect this nation from these emerging disease threats. NWHC, as a World Organisation for Animal Health (OIE) Collaborating Centre for Research, Diagnosis and Surveillance of Wildlife Pathogens, provides assistance and expertise to other countries to build wildlife health science capacity in the regions where these emerging diseases originate. In 2016, in collaboration with Seoul National University and the Korea Ministry of Environment, NWHC conducted a risk assessment to identify potential hazards from wildlife diseases, determine priority diseases, and provide recommendations for disease surveillance and management. Recommendations based on this study included initiation of wildlife morbidity and mortality surveillance, focusing active surveillance on migratory birds, and taking a One Health approach with coordination among the Ministries of Environment, Agriculture, and Health and Welfare. The USGS has also established a Letter of Intent with the Korea National Institute of Environmental Research to facilitate scientific exchange and collaborative research. An additional outcome of this study was the development of unique, online decision support tools that facilitated the elicitation of subject matter experts' opinions, and these tools have now been used in other projects. In August 2016, NWHC held a workshop of leaders that manage or operate national wildlife health programs to use available evidence and subject matter expertise to define the essential functions of a national wildlife health program, and we have also created a network of these experts that participate in regular conference calls to enhance information sharing among countries. NWHC have been invited to formally twin with Mahidol University, Bangkok to assist in the formation of the Thai National Wildlife Health Center. **Contact:** Jonathan Sleeman, 608-270-2401, jsleeman@usgs.gov

Power to the People: Developing Accessible Tools for Statistical Modeling

A wealth of new analytical techniques developed for analyzing ecological data exists, including analysis of fish and wildlife disease investigations. Unfortunately, these developments are often highly technical and require computer programming acumen, and often remain inaccessible to the average scientist as well as fish and wildlife managers. This inaccessibility prevents both scientists and managers from learning when and how to apply appropriate statistical tools, which slows the progress of science and the effectiveness of management programs. To address this problem, NWHC, in collaboration with the University of Montana, has begun development of web applications that make sophisticated statistical modeling techniques easily accessible to the average scientist. In 2016, an application was developed that focused on providing an efficient means of gathering and quantifying expert opinions. Expert elicitation is an important scientific technique for understanding problems which are not well studied or are novel (e.g., new emerging diseases). This application provided the ability to quickly gather and

quantify a large number of experts' opinions for further sophisticated statistical analyses. In 2017, a new application is being developed for designing and conducting weighted surveillance programs for Chronic Wasting Disease (CWD), which is a type of surveillance that focuses on detecting new disease foci in a cost-efficient and statistically rigorous manner. Weighted surveillance is gaining in popularity among wildlife agencies trying to manage the spread of CWD with limited resources, but tools for its application are not readily available. Additional applications will be developed for the modeling of population demography and disease processes. The fruits of these research efforts will be used by the scientific and wildlife management community at large. **Contact:** Dan Walsh, 608-270-2481, dwalsh@usgs.gov.

Peering Into the Crystal Ball: Forecasting Wildlife Diseases In the Face of Uncertainty

Disease in wildlife represents a growing threat to the well-being of wildlife populations, as well as human and domestic animal health. Understanding the processes that allow for their growth and spread is critical to permit development of effective management actions for protecting the health of humans, animals and the environment, and to forecast the risk and spread of these threats to new populations and regions. However, developing models to understand disease processes is challenging because of the scale and large uncertainty inherent in wildlife disease systems as well as the lack of suitable analytical tools. To overcome these obstacles, NWHC in collaboration with the Colorado Cooperative Fish and Wildlife Research Unit developed a novel analytical framework to model disease dynamics within wildlife populations while rigorously accounting for uncertainty in the system. They applied this statistical framework to model the spatial and temporal changes in CWD using surveillance data collected by the Wisconsin Department of Natural Resources. These efforts clearly demonstrated its usefulness in describing historic disease patterns as well as forecasting future growth and spread of CWD. Further development of these exciting modeling tools will occur in 2017 and 2018. In particular, future work will use these new analytical techniques to evaluate the effectiveness of historic disease management actions, rigorously assess the origin of disease outbreaks, and link individual animal dynamics to system-wide outcomes. Ultimately, we believe these approaches will be used across a wide array of diseases to understand the critical drivers of disease and its spread, predict future disease states, and determine appropriate interventions for the protection and improvement of human, domestic animal and ecosystem health. **Contact:** Dan Walsh, 608-270-2481, dwalsh@usgs.gov.

WILDLIFE HEALTH RESEARCH UPDATES

Sylvatic Plague Vaccine for Prairie Dogs

Laboratory studies have demonstrated that oral vaccination of prairie dogs against plague using raccoon pox-vectored vaccine is feasible, resulting in significant protection against challenge with *Yersinia pestis*, the bacterium that causes sylvatic plague. The Sylvatic Plague Vaccine (SPV) Subcommittee, under the direction of the Executive Committee of the Black-footed Ferret Recovery Implementation Team, is continuing its work to complete development and delivery of the sylvatic plague vaccine as a management tool to combat plague in prairie dogs and promote the recovery of the endangered black-footed ferret. Field trials completed by Colorado Parks and Wildlife and the NWHC in 2012 confirmed the safety of the vaccine in wild prairie dogs and non-target animals. NWHC and numerous federal, state, and tribal partners have recently completed field trials in seven western states (Arizona, Colorado, Montana, South Dakota, Texas, Utah, and Wyoming) to assess vaccine efficacy in free-ranging prairie dogs. Analysis of data and samples demonstrated that relative abundance of prairie dogs in general was higher on SPV treated sites and survival was improved during plague outbreaks, suggesting SPV may be

useful as a management tool to advance prairie dog conservation and possibly the recovery of the endangered black-footed ferret. Additional field trials to determine optimal use of SPV began in 2016 in western states and will continue in 2017. **Contact:** Tonie Rocke, 608-270-2451, trocke@usgs.gov.

Avian Influenza Virus Ecology in the North Atlantic: A Route for HPAI introduction to North America

The National Wildlife Health Center in collaboration with National Institutes of Health, University of Iceland, and others continue their research on the ecology and movement of avian influenza viruses in the North Atlantic region. This research has demonstrated the importance of this region's migratory bird to the intercontinental movement of viruses between Europe and North America. Avian influenza viruses from both continents, as well as genetic hybrid viruses, were isolated in Iceland, even from within a single flock of birds, showing that this region is a hotspot of virus movement and reassortment. These studies also demonstrated the longer term persistence of these viruses within the North Atlantic avian community. Highly pathogenic avian influenza viruses (HPAIV) have been frequently found in wild and domestic European birds, significantly in 2014, and most recently in the fall and winter of 2016/2017. This European epidemic increases the risk of HPAIV being transported from Europe to North America as bird populations migrate through the North Atlantic to breeding sites in Greenland and Canada. One of the significant findings from this research is the identification of gulls and marine birds as an integral component of AIV ecology in the North Atlantic region. Icelandic viruses were also discovered to have genetic relationships with viruses causing seal mortalities in Europe. Although no HPAIV has been identified in the North Atlantic region, viruses with genetic relationships to HPAIV H5N1 viruses have been detected in Iceland. **Contact:** Jeffrey Hall, 608-270-2458, jshall@usgs.gov

Another Emerging Fungal Disease: This Time It's Affecting Snakes

In the last decade, reports of wild snakes from parts of the eastern U.S. with severe and often fatal skin infections have increased. These infections, referred to as snake fungal disease (SFD), are caused by the fungus *Ophidiomyces ophiodiicola*. Clinical signs of SFD are variable and include thickened dying scales, nodules below the skin, skin ulcers, and severe swelling of the head. NWHC recently reviewed cases of infection by *O. ophiodiicola* and reported the pathogen in wild snakes throughout the eastern half of the U.S. Many snake species are susceptible to *O. ophiodiicola* infection, including members from at least four of the five snake families that occur in North America. Snake populations have varying responses to *O. ophiodiicola*. While some populations have experienced severe infections and declines in association with the disease, other populations exhibit predominantly mild infections without obvious detriment. Changing environmental conditions, such as climate change and habitat fragmentation may exacerbate the disease and be responsible for its recent emergence in some areas. In 2017, NWHC will continue collaborations on a project lead by researchers in the United Kingdom to better understand the epidemiology of SFD in different snake populations in Europe. **Contact:** Jeff Lorch, 608-270-2367, jlorch@usgs.gov

Will Zika virus impact poultry or wild birds?

Zika virus emerged as a major threat to human health, causing abnormally high birth defects in infants born to infected mothers in South America, and has infected people in at least 38 countries, including the U.S. While much progress has been made in understanding the human medical implications of this virus, very little is known about the impacts of Zika virus to U.S. agricultural industries or wildlife species. In particular, Zika virus belongs to the flavivirus group, which includes many viruses that are vector borne and infect birds, including West Nile Virus. Zika virus is transmitted through the bite of infected *Aedes* sp. of mosquitos. In 2016, the USGS developed diagnostic capability to detect Zika virus and anti-Zika virus antibodies in exposed wildlife. In collaboration with the USGS Alaska Science

Center, NWHC will test sera from North American birds that overwinter in Central and South America and are sampled either on their overwintering grounds or on their northern migration to North America. Serology testing is on-going for 250 blue winged teal samples collected by the Alaska Science Center and the University of Georgia. NWHC also tested the ability of Zika virus to infect embryonated chicken eggs, young chickens, and passerines. This will experimentally determine whether poultry or wild birds may serve as reservoirs for the virus. Results from these exposure studies will likely be published in 2017. Additionally, NWHC is collaborating with the USGS Upper Midwest Environmental Sciences Center to develop a rapid field deployable assay to detect Zika virus in samples obtained from mosquitoes, wildlife, and the environment. This assay will be a significant asset in monitoring the geographic spread of Zika virus and the potential for wildlife to serve as reservoirs for the virus. These activities will enable field technicians to rapidly detect Zika virus or, through testing serum, animals previously exposed to the virus. **Contact:** Erik Hofmeister, 608-270-2476, ehofmeister@usgs.gov

Chronic Wasting Disease in Deer, Elk, and Moose: An Epidemic in Slow Motion

Since its initial identification in Colorado in captive mule deer in the late 1960s and free-ranging elk in the 1980s, chronic wasting disease (CWD) has affected captive and free-ranging cervids (members of the deer family) in about half the states in the U.S., as well as Canada, South Korea, and Norway, and continues to spread across North America through new and recurring outbreaks. The only prion disease known to affect free-ranging wildlife, CWD is increasing in prevalence in areas where the disease is already established; in heavily affected areas of Wyoming and Colorado, more than 40 percent of free-ranging cervids are infected and wildlife managers and researchers have documented CWD-associated population declines in white-tailed deer, mule deer, and elk.

Currently, effective treatment for CWD does not exist, and management practices to prevent disease transmission in cervids are limited. Scientists at the NWHC work collaboratively with various federal and state natural resources agencies, academic institutions, nongovernmental organizations and even industry partners to: 1) understand the biology, ecology, and epidemiology of CWD; 2) assess and predict the spread and persistence of CWD in wildlife and the environment; and 3) develop tools for early detection, diagnosis, surveillance, and control of CWD. NWHC research has been instrumental in developing surveillance strategies for early detection of CWD in Montana (Montana Fish, Wildlife and Parks Department) and Shenandoah National Park (National Park Service), identifying potential disease risks posed by CWD to noncervid species such as bighorn sheep, and identifying environmental factors, like soil and plants, that may facilitate CWD transmission on the landscape.

The benefits of USGS research on CWD extend beyond wildlife management; for example, USGS scientists identified a novel enzyme from lichens with the ability to break down infectious prion protein that is being studied for its use in decontaminating human hospital environments in collaboration with an industry partner. Current and future efforts will focus on improving diagnostic testing platforms in collaboration with the U.S. Food and Drug Administration; providing surveillance and modeling technical assistance to a long-term CWD study carried out the Wisconsin Department of Natural Resources; developing modeling techniques for predicting CWD growth within free-ranging cervid populations and forecasting disease spread in regions of interest; and continued identification and development of novel anti-prion compounds and processes to disrupt disease transmission cycles.

Contact: Bryan Richards, 608-270-2485, brichards@usgs.gov, or Christina Carlson, 608-270-2442, cmcarlson@usgs.gov.

AVIAN HEALTH EVENTS IN THE PACIFIC, CENTRAL, MISSISSIPPI, AND ATLANTIC FLYWAYS

2016 Avian Disease Update for the Pacific Flyway Council

During the period January and December 2016, 44 avian mortality events involving more than 20,820 migratory birds were reported to the NWHC from within the Pacific Flyway (NWHC investigated 28 of these events). The 5-year annual average number of reports NWHC has received from the Pacific Flyway has historically been around 52. The total estimated numbers have ranged from 18,500 during 36 events in 2010 to 46,361 during 56 events in 2013.

Thirteen different etiologies were identified or suspected in causing these mortality events. The top 3 etiologies accounting for 13,459 individual mortalities during 18 of the events were avian botulism (6,634 individuals, 6 events), emaciation/starvation (3,318 individuals, 5 events), and avian cholera (3,307 individuals, 7 events). Almost 50 percent of the sick or dead birds reported in the Pacific Flyway were in the order *Anseriformes*, with another 25+ percent in the order *Podicipediformes*.

During 2016, seven wildlife mortality events involving an estimated 3,307 were confirmed or suspect avian cholera cases. This is significantly lower than 2015, in which eighteen wildlife mortality events involving an estimated 14,208 individuals were confirmed or suspect avian cholera cases. All seven 2016 avian cholera events were reported in California. The largest of the 2016 events occurred at the Yolo Basin Wildlife Area affecting over 1,000 birds, primarily American coot and ruddy duck.

Avian botulism type C was the laboratory-confirmed or suspected diagnosis associated with 6 wildlife mortality events and involved an estimated 6,634 individuals during 2016. The number of individuals is 32 percent of the overall mortality for 2016. Events occurred in California (210 individuals in 2 events) and Utah (6,424 individuals in one event). The largest of the 2016 events occurred at the Willard Spur of the Great Salt Lake, Utah, during November with multiple species of mallard, northern pintail and northern shoveler being the primary species affected.

Contact: Barb Bodenstern, 608-270-2447, bbodenstern@usgs.gov

2016 Avian Disease Update for the Central Flyway Council

During the period between January and December 2016, 12 avian mortality events, involving an estimated 4,092 wild birds were reported within the Central Flyway region. NWHC directly investigated all of these events and five different significant etiologies were identified: avian botulism type C, pigeon paramyxovirus, West Nile virus, schistosomiasis, and salmonellosis. The largest avian mortality event occurred on Lake Sakakawea in North Dakota and involved more than 1,600 birds, mostly ring-billed gulls and American white pelicans. Three major causes of mortality were identified from this single event: botulism type C, West Nile virus, and salmonellosis. Botulism type C was also identified as the primary cause of death in five other avian mortality events in the Central Flyway during 2016, including three events that affected >200 birds in ND, SD, and MT and two events that affected <50 birds each in TX. As in 2015, Lake Bowdoin, MT was again the site of a botulism mortality event with an estimated 500 birds being affected. West Nile virus was also recorded during this event. In contrast to the lack of pigeon paramyxovirus detections in 2015 in the Central Flyway, four mortality events involving this disease agent were reported in 2016. The largest event was estimated to be approximately 1,000 birds (all Eurasian collared doves) and was recorded in TX in January through March. The three additional

pigeon paramyxovirus outbreaks were also reported from TX in 2016, all involving Eurasian collared doves, and estimated to have affected <60 birds in each event.

NWHC is participating in an ongoing research project assessing the exposure of selected raptors to anticoagulants, lead, and mercury in the Central Flyway. Since 2014, and in collaboration with USFWS Region 6 and the USGS Forest and Rangeland Ecosystem Science Center, the NWHC has been examining bald and golden eagles and ferruginous hawks found dead. The NWHC examined 80 raptor carcasses in 2016, 89 in 2015, and 26 in 2014; including 101 bald eagles, 79 golden eagles, and 15 ferruginous hawks. Trauma (42%), electrocution (26%), and poisoning (23%) were the three leading causes of death for all years combined among those birds where a cause of death was determined. Analysis is ongoing for anticoagulants and other contaminants.

Contact: Bob Dusek, 608-270-2403, rdusek@usgs.gov

2016 Avian Disease Update for the Mississippi Flyway Council

During the period January to December 2016, 47 wildlife mortality events involving approximately 18,350 migratory birds were reported to the NWHC from within the Mississippi Flyway. NWHC was directly involved in the investigation of 36 of these events. The number of events was similar to the average annual avian mortality events (52 events \pm 14 sd) and total estimated number affected (19,800 birds \pm 13,100 sd) reported during the previous five years for the flyway. Over the past five years, wild bird mortality in the Mississippi Flyway has consistently exceeded that reported in either the Atlantic and Central Flyways and accounts for 13%-53% (average: 30% \pm 16% sd) of all wild bird mortalities reported nationwide.

Of the 47 avian mortality events, 18 different etiologies were identified. Four etiologies in particular accounted for over 90% of all mortalities in the Mississippi Flyway; these included trematodiasis (9506 birds affected), avian botulism type E (3,540), a single event with multiple diagnoses (3,197), and Newcastle disease (855). Trematodiasis due to *Sphaeridiotrema* spp., *Cyathocoytle bushinensis*, and/or *Leygonimus polyoon* primarily in American coot (67%) and lesser scaup (33%) reoccurred again in 2016 within the Upper Mississippi River NWR (Pools 5, 5A, 7, and 8). Blue-winged teal and ring-necked ducks were among the other species affected (<1%). Spring and fall die-offs have occurred annually on the Mississippi river since 2002 and total estimated waterbird mortality is more than 136,000 individuals since its discovery. The next largest contributor to avian mortality in the Mississippi Flyway during 2016 was avian botulism type E reported from multiple counties in upper Lake Michigan. Mortalities began in July and continued through mid-December. In all, 20 species were involved with long-tailed ducks, common loons, and white-winged scoters accounting for nearly 75% of the total estimated dead. There were also six die-off events attributed to botulism type C in MI and IL during 2016 affecting mostly mallards (total est. dead ~ 260; range 15-85 dead per event).

A large mortality event occurred at Marsh Lake (Big Stone County, MN) between July and September in which several causes of death were identified among the various species involved. Septicemia was detected in ring-billed gulls which accounted for 47% of total dead, West Nile virus and septicemia in American white pelicans (41% of dead), Newcastle disease and salmonellosis were detected in double-crested cormorants (12% of dead), and botulism type C in a Canada goose (<1% of dead). Die-offs at this location from multiple etiologies have occurred in past years. Also in 2016, there were 7 mortality events involving double-crested cormorants attributed to Newcastle disease; all of which occurred in the Mississippi Flyway (MN, WI, IN). Mortality for each event ranged from 15 to 281 birds (avg. 159). Concurrent mortality in other species including ring-billed gulls, herring gulls, American white pelican and American bittern were reported at some of these events but the virus was only detected in

cormorants. The last Newcastle disease outbreaks in Mississippi Flyway occurred in 2012. Finally, a potential emerging avian disease worth mentioning is *Bisgaard* Taxon 40, a *Pasteurella*-like bacterium, which was identified as the primary cause of death in gulls, terns and auklets from the Atlantic, Mississippi, and Pacific Flyways for the first time in 2016. Various lesions were observed among the species affected and the significance of its occurrence is currently under investigation by NWHC.

Contact: Anne Ballmann, 608-270-2445, aballmann@usgs.gov

2016 Avian Disease Update for the Atlantic Flyway Council

During January–December 2016, 38 avian mortality events were reported to NWHC from the Atlantic Flyway (NWHC directly investigated 17 of these events). This exceeded the average (\pm SD) annual number of avian mortality events reported to the NWHC during the previous 5 years (28 events \pm 5.2) for the Atlantic Flyway. The total estimated morbidity and mortality from these events was 1,956 and lower than the average of the previous 5 years (3,169 \pm 2,005).

Ten different etiologies were identified. Trauma, toxicosis (various non-infectious sources), and type C botulism were the most common etiologies. The most common infectious etiologies associated with mortalities were *Bisgaard* (3 events; more below), salmonellosis (2 events), and duck virus enteritis (a.k.a. duck plague; 2 events).

A notable mortality and morbidity event caused by acute lead poisoning occurred on the Alligator River National Wildlife Refuge in North Carolina from February–March 2016. Refuge staff estimated 100–200 tundra swans died and several hundred more were observed with clinical signs consistent with acute lead poisoning. The clinical signs included lethargic behavior, green staining around the vent, and mouths held agape.

In 2016, the NWHC received a number of cases in which a *Pasteurella*-like bacterium called *Bisgaard* taxon 40 was associated with mortality. This pathogen is taxonomically related to the causative agent of avian cholera (*P. multocida*), but causes a distinct disease. There were 3 mortality events in the Atlantic flyway where bacterial septicemia (infection in the blood) caused by *Bisgaard* taxon 40 contributed to mortality. These included mortality of herring and black-backed gulls in southeastern Maine, laughing gulls near Baltimore, MD, and herring gulls on Poplar Island in Chesapeake Bay. *Bisgaard* infections have frequently been concurrent with other opportunistic pathogens, such as aspergillosis (fungus) and salmonellosis (bacteria). NWHC also identified *Bisgaard* -associated mortality in gulls and seabirds on the west coast in 2016. A preliminary review of historical cases indicated the mortalities in 2016 were unusual in number and geographic extent. NWHC is collaborating with USDA-APHIS Wildlife Services to further investigate the importance of this pathogen with the goals of determining if *Bisgaard* is an emerging pathogen or its role in avian mortality are emerging because of other stressors.

Contact: Dan Grear, 608-270-2478, dgrear@usgs.gov

ON-LINE PUBLICATIONS, WEBINARS, AND ON-GOING SERVICES TO PARTNERS

Field Manual of Wildlife Diseases, USGS Techniques and Methods Book 15

Since two previous versions of this manual were prepared by the NWHC, new and emerging diseases have impacted wildlife throughout the country. The new field manual will cover field techniques, historical disease issues, and current knowledge of wildlife diseases in the context of conservation and management of free-living populations. This is a collaborative project among the NWHC, the U.S. Fish and Wildlife Service, and the National Park Service. Information presented in the manual is directed primarily toward field biologists and natural resource managers. The first major section, *General Field Concepts and Techniques*, consists of 14 chapters posted online as they are completed

(<https://pubs.usgs.gov/tm/15/>). Topics covered include disease surveillance, mortality investigation, safe work practices, specimen collection and preservation, special considerations for law enforcement cases, and information resources. Two new chapters were added to the field manual in 2016: *Recording and Submitting Specimen History*, and *Information Resources*. Overall, web server statistics list 17,692 visits and downloads for the field manual during 2016. Additional chapters will be developed in 2017 and 2018. *General Field Concepts and Techniques* will be followed by sections on diseases of species groups including birds, mammals, and amphibians and reptiles.

The complete [1999 Field Manual of Wildlife Diseases – General Field Procedures and Diseases of Birds](#) remains available online.

New Fact Sheet about the USGS National Wildlife Health Center

The [USGS National Wildlife Health Center: Advancing Wildlife and Ecosystem Health](#) is the title of this fact sheet that gives readers an overview of the NWHC, including a brief history of its formation, current capabilities, science branches, disease surveillance and science highlights. It is available [online](#) and in paper copies. **Contact:** Gail Moede Rogall, 608-270-2438, gmrogall@usgs.gov

Disease Webinar Series Sponsored by USGS Ecosystems Mission Area and AFWA

USGS and the [Association for Fish and Wildlife Agencies](#) co-host a monthly webinar series on fish and wildlife diseases. The purpose of this series is to keep partners informed about our current disease research and discuss how USGS science can support disease management efforts. Past Webinar topics include CWD, Avian Influenza, *Bsal*, WNS, Plague, Fish Diseases, and Online Tools. USGS Ecosystems Mission Area Web site: <https://www2.usgs.gov/ecosystems/disease/disease.html#webinars>

Disease Investigation Services

To request diagnostic services or report wildlife mortality, please contact the NWHC at 608-270-2480 or by email at NWHC-epi@usgs.gov, and a field epidemiologist will be available to discuss the case. To report wildlife mortality events in Hawaii or Pacific Island territories, please contact the Honolulu Field Station at 808-792-9520 or email Thierry Work at thierry_work@usgs.gov.

A field epidemiologist will be your primary point of contact for questions on disease epidemiology and management. A wildlife pathologist will be your primary point of contact on diagnostic findings and cause of morbidity or mortality. Further information can be found at <http://www.nwhc.usgs.gov/services/>.

The [Wildlife Mortality Reporting and Diagnostic Services Request Worksheet](#) is used by partners to request diagnostic assistance during a wildlife morbidity and event.

To view NWHC Quarterly Wildlife Mortality Reports, please visit: http://www.nwhc.usgs.gov/publications/quarterly_reports/index.jsp

To be added to the NWHC list to receive [Wildlife Health Bulletins](#) and our [newsletter](#), please contact Gail Moede Rogall at gmrogall@usgs.gov

USGS Wildlife Health Information on Twitter

Follow us at twitter.com/USGSWILDLIFE