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

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The following information is of a topical nature for wildlife management agencies and entities; many partners and collaborators are involved in gathering and researching the information herein.

Field Investigation Team Summaries: September 2008 to June 2009

Avian cholera in waterfowl in California and Nationwide (CA)
Tule Lake and Lower Klamath National Wildlife Refuges experienced a substantial mortality event from avian cholera this spring. U.S. Fish and Wildlife Service refuge managers reported nearly 2,000 dead birds were collected as part of their disease control operations. Snow geese and Ross' geese comprised 90% of the birds collected. The mortality event began in early March and subsided in mid- to late April. Avian cholera induced events occur nearly every year at the refuges. The total number of affected birds in 2009 was less than in 2008, when the outbreak lasted two and a half months with the total number of dead birds estimated at 4,500. Cold weather conditions contribute to avian cholera outbreaks by concentrating birds in certain migration stopover locations. Prompt collection and disposal of carcasses removes the causative bacteria, *Pastuerella multocida*, from the environment.

Avian salmonellosis mortality confirmed in numerous states (AL, GA, ID, MD, ME, MI, MN, NY, NC, TN, VA, VT, WA, WI, WV)
Recent outbreaks of avian salmonellosis (*Salmonella typhimurium)* have been confirmed in wild birds across several states since January 2009. Suspected salmonellosis cases were also reported from CA, UT, ME, and PA. Concerned citizens across the country have reported finding dead or distressed wild birds near their homes and bird feeders. Public concern most likely is heightened due to the recent Salmonella cases in humans and numerous product recalls. No evidence exists that the strains found in dead wild birds this year are the same strains of Salmonella that prompted the recalls in peanuts, pistachios, or wild bird seed. Large-scale mortalities of passerines using feeding stations are common across the United States and often occur during times of increased supplemental feeding, such as winter and spring. NWHC distributed a Wildlife Health Bulletin on avian salmonellosis in wild birds in April available online at: http://www.nwhc.usgs.gov/publications/wildlife_health_bulletins/WHB_09_01_salmonella.pdf

Unusual mortality event in California brown pelicans (CA)
In mid-December 2008, a higher than normal number of California brown pelicans were submitted to rehabilitation facilities. Sick and disorientated pelicans were found along the coast from San Francisco down to Los Angeles. The International Bird Rescue and Rehabilitation Center estimated that 300–400 pelicans, both adults and juveniles, were affected. Carcass testing by multiple state and federal labs revealed a variety of findings, including infarcts on the feet (suggestive of frostbite), anemia, and emaciation. Many sick pelicans responded to supportive care in rehabilitation. Field information from Oregon indicated that substantial numbers of brown pelicans (~5,000) were present on East Sand Island at the Columbia River in Oregon in December when typical migration is mid-November. Extremely cold weather during the week of December 10 occurred around the same time that the pelicans started to move

south. California brown pelicans have recently been proposed for delisting so understanding the effects of mortality events is critical for continued overall population health.

Emaciated seabirds wash up on Bay Area Beaches (CA)
In mid-April 2009, California state and Federal natural resource agencies and local wildlife rehabilitation centers began receiving numerous reports of dead and dying Brandt's cormorants and other seabirds along the coast from Marin County, north of San Francisco, south to Monterey. All were significantly emaciated when found. Preliminary results of tests for domoic acid, a natural toxin produced by marine algae that proves fatal to birds, were negative, as were tests for Newcastle Disease, Avian influenza and West Nile Virus. No signs of environmental contamination have been found. Trawl data from the National Marine Fisheries Service showed a decrease in the number of Northern anchovies in 2008, a popular food source for Brandt's cormorants that feed near shore. This food shortage, coupled with a strong wind event in mid-April, may have generated a strong upwelling that displaced available prey offshore and out of reach. Brandt's cormorants appeared to be the primary species affected, and the mortality rate is estimated to be in the thousands.

White-Nose Syndrome

Research progress on white-nose syndrome of bats (MA, NY, VT, NH, CT, NJ, PA, WV, VA)
Scientists continue to investigate the causes of bat white-nose syndrome (WNS), an emerging disease associated with the loss of an estimated half million insectivorous bats of 5 species in the eastern United States. Little brown bats and eastern pipistrelles have been particularly hard hit with as many as 90-100% of the local population wiped out at some winter hibernacula. Partnerships among state, Federal, academic, and non-profit organizations have formed to investigate the disease, its effects on bat populations, and management options. Infection and transmission trials investigating the fungus, *Geomyces destructans*, as the cause of skin lesions on bats associated with WNS have been carried out at the NWHC. Other studies in which NWHC scientists are involved include soil sample surveys from caves to determine the distribution of *G. destructans* relative to affected hibernacula, summer bat surveys for evidence of latent infections, and evaluation of possible treatment or control options. Concern about possible human activity spreading WNS caused the USFWS to issue cave closure recommendations this spring to the public to reduce the risk and speed of disease spread to cave sites in the central United States where much larger winter hibernacula exist.

A paper published in *Mycotaxon* on June 12 defines the taxonomy and provides a species name for the fungus causative of the skin infection that is the hallmark of white-nose syndrome in bats. NWHC microbiologist David Blehert is the corresponding author. The new name, *Geomyces destructans*, reflects the devastating effects of this fungus on hibernating bats. Since 2007, white-nose syndrome has spread rapidly from Northeastern to Atlantic states of the U.S.

Sylvatic Plague

Oral vaccination of prairie dogs against plague via ingestion of vaccine-laden baits
Prevention of plague in wild rodents by immunization could reduce outbreaks of the disease. However, efficient large-scale immunization of free-ranging wildlife populations can only be achieved through voluntary consumption of vaccine. Poxviruses are ideal vectors for oral vaccines because they have a predilection for mucosal tissue. In collaboration with scientists at the University of Wisconsin, Madison, the NWHC developed and tested plague vaccines using raccoonpox as a vector for two plague antigens. The vaccines were incorporated into palatable baits and offered several times over the course of several months to a group of 16 black-tailed prairie dogs (*Cynomys ludovicianus*) for voluntary consumption. Upon challenge with 70,000 cfu of virulent *Y. pestis*, the survival rate of the orally immunized group (94%) was significantly higher than the control group (7%). Our findings demonstrate that oral immunization of prairie dogs with RCN-vectored vaccines can provide near full protection against

challenge at dosages that simulate simultaneous delivery of the plague bacterium by numerous (3-10) flea bites.

H5N1 Highly Pathogenic Avian Influenza

The Federal, State and Tribal partnership formed to develop and implement the National Interagency Early Detection System for Highly Pathogenic H5N1 Avian Influenza in Wild Migratory Birds has continued into the fourth year of surveillance. Birds have been tested from all 50 states and 6 freely-associated states and territories. While the surveillance focused on waterfowl, shorebirds, gulls and terns, a total of 284 species were sampled. During the 2008 sampling year (April 1, 2008 – March 31, 2009) cooperating agencies collected and analyzed over 78,600 wild bird samples and the highly pathogenic avian influenza H5N1 virus was **not** detected. Since April 1, 2009, a total of 3,555 birds have been tested for avian influenza at the NWHC. Of these, 16 have tested positive for low-path avian influenza based on molecular screening; none of these were H5 positive.

Up-to-date information on the U.S. wild bird surveillance program is available at: http://wildlifedisease.nbii.gov/ai/. Current information on results of the sampling and testing efforts in Canada can be found at the website of the Canadian Cooperative Wildlife Health Center: http://wildlife1usask.ca/en/aiv/index.php

Modeling the Dynamics of Avian Influenza in Wild Birds and Potential Transmission with Domestic Fowl

The objective of this project is to develop a simplified epidemiological model of AI transmission among wild birds and wetland ecosystems and to consider potential routes of transmission between wild and domestic birds. Currently little is known about the many factors that likely influence the dynamics of AI in wild birds. This project will focus on simple models that incorporate rates of virus shedding, infection, and recovery for wild bird populations; input and turnover of virus in wetland systems; and alternative routes of transmission between wild and domestic birds (e.g., common wetlands, use of contaminated water, and exposure via field contamination). Model development, complexity, and initial parameter estimation will be based on information or data obtained from published and unpublished reports and on knowledge provided by wildlife disease experts.

Experimental Infection of American Kestrels with H5N1 Highly Pathogenic Avian Influenza

Several raptor species in Europe and Asia have died from H5N1 HPAI during periods of die-offs in other wild birds, but their relative susceptibility and potential role in the epizootiology of this disease are essentially unknown. Using American kestrels as a model raptor species, researchers at the NWHC determined the effect of HPAI H5N1 infection on raptor survival, including dose-response, antibody production, virus shedding, pathology and potential risks. All inoculated birds succumbed to viral infection regardless of dose within seven days of inoculation.

Within 24 hours of inoculation with HPAI, all birds were shedding large amounts of virus orally. There was no difference in the amounts of oral viral shedding between doses. Cloacal shedding had a different profile, typically lagging a day or more behind the oral shedding before becoming detectable.

Experimental Infection of Dunlin with H5N1 Highly Pathogenic Avian Influenza

Dunlin are one of the target species for HPAI surveillance and knowledge regarding transmission, viral shedding, ability to cause death, and infectious dose are critical components of meaningful risk assessments of the introduction of HPAI into North America. In this study, dunlins captured in Alaska were experimentally infected with various doses of H5N1 HPAI at NWHC to determine morbidity, dose-response, infectious dose, lethal dose, and antibody production. Results are pending analyses.

USGS Study on Avian Influenza Genetics Published in *Molecular Ecology*
In an article published in the November 2008 issue of *Molecular Ecology*, USGS scientists observed that nearly half of the low pathogenic avian influenza viruses found in wild northern pintail ducks in Alaska contained at least one of eight gene segments that were more closely related to Asian than to North American strains of avian influenza.

Chronic Wasting Disease (CWD) Research

Developing new animal models for CWD
Deer and elk are expensive and cumbersome experimental subjects, which has seriously hampered the rate of scientific discovery regarding CWD. Traditional lab mice are not good models for CWD, and genetically engineered mice can be problematic. We have discovered that meadow voles (*Microtus pennsylvanicus*) are extremely susceptible to CWD (100% penetrance via the intracerebral route) and are very promising wild-type models for CWD. We are currently using meadow voles in a series of CWD infectivity and bioassay studies. Additionally, we have determined that red-backed voles (*Myodes gapperi*), deer mice (*Peromyscus maniculatus*) and white-footed mice (*P. leucopus*) are all susceptible to CWD via intracerebral inoculation, but with longer incubation times than meadow voles.

Quantitative epidemiology
To design effective CWD management strategies for free-ranging herds, we need to understand the basic dynamics of CWD epidemics. Most of the data available on free-ranging herds comes from spatially referenced hunter-harvested samples that are tested for CWD. We have developed and applied sophisticated statistical epidemiological techniques to model and estimate the spatial-temporal dynamics of CWD. These analyses have helped explain the processes that drive the pattern of CWD prevalence typically seen on the landscape, and have suggested how management strategies might exploit these processes. An extensive manuscript detailing this new methodology has been submitted as an Ecological Monograph and is currently under review.

Environmental Persistence
Deer have been shown to acquire CWD following habitation in environments previously contaminated with disease agent. Our research is focused on understanding the persistence of CWD in the environment, identifying reservoirs of infectivity and understanding routes by which deer acquire disease from the environment. More specifically, we are interested in how soil contributes to CWD transmission and how associated vegetation and microbes influence CWD infectivity on the landscape with respect to dissemination or degradation of agent.

Remediation
Anecdotal, epidemiological and controlled field experiments have all indicated that prions are stable in the environment and in soil. A goal of our research program is to identify and characterize biotic and abiotic means of degrading prions in the environment. Toward that end, we have found that certain lichens, common fungi-algae symbiotic organisms, contain a potent anti-prion activity that could influence CWD persistence on the landscape. Additionally, we have found that the common oxidative soil mineral birnessite (MnO2) is capable of degrading prions in *in vitro* experiments. We are pursuing each of these lines of study to try to achieve practical means of remediating CWD-contaminated sites.

THANK YOU

The NWHC thanks all the state, federal and tribal agencies who worked with us the past year. We are at your service to provide technical support, field investigation assistance and diagnostic capabilities as your needs dictate.

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