West Nile Virus, Highly Pathogenic Avian Influenza H5N1, and other zoonotic diseases: what ornithologists and bird banders should know

Introduction

Highly pathogenic avian influenza H5N1 ("HPAI H5N1") first made news in 2004 and seemed to dominate headlines for several years. The alarmism belies the fact that the impact to human health has been slight. Though human outbreaks have been occurring since 1997 (WHO 2005), only 500 human cases, including 294 deaths, have been reported to the World Health Organization from 2003 through July 2010 (WHO 2010). Though there have been several confirmed cases of human-to-human transmission resulting from close, prolonged contact between family members or from an infected individual to a health care worker, nearly all other human cases – which have occurred primarily in healthy adults and children - are attributed to direct handling of infected poultry, consumption of undercooked poultry products, or contact with virus-contaminated surfaces or materials used in handling poultry (Writing Committee 2006). To date, only seven human cases of H5N1 HPAI infection appear to be related to contact with wild birds, and these resulted from the plucking of feathers from dead swans in Azerbaijan. It is not clear that all seven cases resulted from contact with the dead birds, or if one or more cases resulted from contact with those who handled the dead birds (Tsiodras et al. 2008; WHO 2006).

At least in the United States, HPAI H5N1 has faded from the news, but it wasn't the first avian wildlife disease to cause substantial concern and it won't be the last. Only a few years earlier, West Nile Virus (WNV) commanded the public's attention when it first appeared in the United States. First isolated in 1937 in Uganda, WNV has caused outbreaks in Israel (1951-1954), France (1962, 2000), and South Africa (1974). It reached the United States in 1999, where researchers – and their universities, government research agencies, and other research organizations – became concerned about the risk to field biologists, students, and others. Perhaps out of an abundance of caution and spurred by constant media attention, one university cancelled field research and field biology classes that involved handling birds. It was soon determined that:

- most people who are infected with WNV do not develop any type of illness;
- it is estimated that 20% of the people who become infected will develop West Nile fever and will experience mild symptoms, including fever, headache, and body aches, occasionally with a skin rash on the trunk of the body and swollen lymph glands;
- about 1 of each 150 infected persons becomes seriously ill with central nervous system infection (encephalitis and/or meningitis) (CDC 2010).

For young/healthy researchers who are not immunocompromised, West Nile Virus is unlikely to cause much more than a mild illness – typically "flu-like symptoms."

The Ornithological Council – a consortium of 11 scientific ornithological societies in the Western Hemisphere – consulted with a number of experts to compile fact sheets about the risks of HPAI H5N1 and WNV to ornithologists and bird banders and to provide the most up-to-date occupational safety and animal welfare recommendations for those handling live birds, carcasses, or tissues that are potentially infected with WNV or HPAI H5N1.

Ornithologists handling wild birds may also be exposed to other zoonotic pathogens including *Salmonella spp.* and *Chlamydia psittaci (also known as ornithosis or psittacosis)*. Because ornithologists and bird banders handle live birds, prepare specimens, and handle blood and other tissues of avian origin, they need to understand the means of transmission of zoonotic pathogens and know effective means to protect themselves and the birds they study.

The measures that should be taken to avoid contracting a zoonotic disease and to avoid transmitting it to others should be commensurate with the extent of the risk and of the consequence of contracting the disease. Preventive measures can be burdensome and interfere with research techniques, especially under field conditions. However, if encountering a pathogen that has the potential to cause serious disease, more extensive measures are warranted even if burdensome, uncomfortable, or costly.

Check frequently for updates of this fact sheet as new zoonotic diseases emerge or as conditions or degree of risk may change. Updates will be posted on BIRDNET, the website of the Ornithological Council <http://www.nmnh.si.edu/BIRDNET>.

Avian Influenza – the basics

Various avian influenza viruses are found in wild birds in virtually every country, including the United States. The subtypes are named for the 16 hemagglutinin (H) and 9 neuraminidase (N) proteins on the viral surface. The avian influenza virus of recent concern is designated as Highly Pathogenic Avian Influenza (HPAI) subtype H5N1 genotype Z, which first appeared in Asia in 2002. Other avian influenza viruses are designated "LPAI" for low pathogenicity. The degree of pathogenicity is established through testing methods developed by the World Health Organization and the International Office of Epizootics <http://www.oie.int>. The pathogenicity designation pertains only to the behavior of the virus in domestic poultry; a virus may not behave the same way in wild birds.

Many avian influenza viruses normally circulate as gastrointestinal infections in wild birds, causing little or no illness or mortality (Webster et al. 1992). The H5N1 strain of HPAI has affected 152 species in 14 orders of wild birds and has caused mortality in 115 of those species (USGS 2010). Bird species in many families appear to be susceptible to infection, but because cool, wet conditions favor the persistence of the virus, and because the virus is shed in feces that contaminates their aquatic habitats, it appears that waterbirds, especially ducks and geese, are the most-commonly infected wild birds (Causey and Edwards 2008).

Studies have been conducted to determine if wild birds can be healthy carriers of HPAI H5N1 virus, the role of healthy carriers in the spread of the disease, and to gather information on the routes and periods of migration of the infected wild birds. It has proved difficult to find healthy, infected birds. In 2006, none of the 39,143 wild birds of 150 species sampled in Europe were found to be infected (Pittman et al. 2007). In a study that sampled 13,000+ live migratory birds in China, HPAI N5N1 was detected only six times (Chen et al. 2006). Of 862 live birds tested across the Western Mongolian flyway, including 430 live birds (of 55 species) found on Erhel Lake in Mongolia where a mass mortality event killed 100 birds, none tested positive for the virus (WCS 2005).

Where the highly pathogenic form of H5N1 avian influenza is found

The World Animal Health Information Database, compiled by the World Organization for Animal Health (OIE), provides the official disease status for each country < http://www.oie.int/wahis/public.php?page=home>. The website of the USDA Animal Plant and Health Inspection Service, National Center for Import and Export <http://www.aphis.usda.gov/import_export/animals/animal_disease_status.shtml> lists countries that the agency has recognized as free of certain diseases. Early reports, often prior to official confirmation, can be found on ProMed <http://www.promedmail.org>.

Precautions to take to protect yourself when working in the field

Infected birds shed flu virus in their saliva, nasal and tracheal secretions, and feces. The virus has also been detected on the feathers of wild birds (Delogu et al. 2010). Although "high pathogenicity" is generally associated with the rapid onset of severe illness and high mortality, it has been confirmed in laboratory tests and through sampling of wild birds that some infected birds can be appear healthy (Chen et al. 2006; Kou et al.2005).

It is not yet known if some species are more likely to be healthy carriers or are more efficient at transmitting the virus than are other species. Most dead, wild birds found to have been infected with H5N1 are waterfowl species, but this may reflect the fact that the carcasses of large birds are more readily noticed than are the carcasses of small bird species, which will likely decompose or be scavenged before they are found. Surveillance of live wild birds has focused on waterfowl; in the European Union, 62% of the birds tested were waterfowl. Despite the acknowledged research bias and the lack of published data, however, experts think it likely that anseriformes are more susceptible to HPAI H5N1 infection than are other taxa, although in experimentally inoculated birds, mortality was higher in gallinaceous birds, finches, geese, emus, and budgerigars (Perkins and Swayne 2003). Cool, wet conditions favor persistence of the virus (Causey and Edwards 2008), and the virus may be concentrated in the habitat used by species that congregate in large numbers, as do waterfowl.

When working in countries or regions where H5N1 has been confirmed, or along pathways used by birds migrating to, from, or through regions where H5N1 has been confirmed, assume that the birds you handle may have been or may be shedding virus. Whatever the risk of encountering the virus and contracting the disease, the disease is difficult to treat and the mortality rate is fairly high. Therefore, to protect yourself:

- Avoid unprotected contact with feces, secretions, blood, and fluids. Wear protective clothing including shoe covers or rubber boots, eye protection, and gloves. If you cannot do so, decontaminate and clean yourself immediately after exposure, using a detergent-based cleanser. Disinfect or dispose of protective clothing after use.
- Learn to remove gloves and protective clothing in a manner that avoids skin contact; consult your safety officer or safety manual.
- Wash hands immediately with soap and water. Use a respirator or mask to avoid inhalation of aerosolized droplets; otherwise, work upwind of birds to avoid inhaling aerosolized fecal material, feathers, and dander. After handling birds, use detergent-based

cleansers to wash hands, equipment, and clothing. Alcohol (70%) or alcohol-based cleansers or diluted household bleach (10% strength) will also kill the virus.

- Avoid eating or drinking while handling birds or bird parts.
- Consider having antiviral medications on hand. Ask your physician if you should take these medications on a prophylactic basis before you begin working in a country or region where H5N1 has been confirmed or along pathways used by birds migrating to, from, or through countries or regions where H5N1 occurs. Any influenza strain can become resistant to one or more drugs; genetically distinct H5N1 subtypes have already been found in Asia and some antivirals may be more effective for some subtypes than for others. Be sure to check current health information from a credible source, such as the Centers for Disease Control for both country disease status and antiviral recommendations and seek a prescription for the appropriate medication from your physician.
- Consider vaccines, if they are available. The National Institutes of Health began testing a vaccine in clinical trials in April 2005. The current CDC recommendations to travelers to and residents of HPAI H5N1 countries do not include vaccination, but it is recommended to avoid contact with domestic and wild birds. As ornithologists and banders will of course handle wild birds, a consultation with your physician or infectious disease specialist about the use of an appropriate vaccine is recommended.

The university or research institution may attempt to restrict field research. Know the disease status of the countries where you intend to work and be prepared to explain to the risk management office (or, in the United States, the Institutional Animal Care and Use Committee, which, in many universities, performs risk management functions) and the precautions you plan to take. It is the researcher's responsibility to know the recommended precautions and to make arrangements to obtain and use the appropriate materials, such as disinfectants, gloves, and eye protection.

Ornithologists should know that the USDA restricts imports of birds and bird products (defined by the USDA as "anything that was once a bird or a part of a bird") from countries where the HPAI H5N1 subtype of avian influenza is known to exist. Permits for such imports are conditioned upon the importer promising, in the permit application, to treat the specimens and tissues with a USDA-approved method to inactivate the virus and importers must supply a certification, upon arrival in the United States, that the imported materials have, in fact, been treated in accordance with the methods delineated in the permit. The Ornithological Council has published detailed guides to the import of birds and bird products <http://www.nmnh.si.edu/BIRDNET/PERMITS.html>. If your institution has a permit that does not include imports from the countries where HPAI H5N1 is found, or if you do not provide a copy of the permit and the certification of treatment upon arrival in the United States, the specimens or samples will be refused entry and will probably be confiscated and destroyed.

Some universities and museums recommend or require a period of quarantine for biologists returning from fieldwork in countries or regions where the current HPAI H5N1 strain is present. In addition to the fact that very few cases of human-to-human transmission have been confirmed, and these few cases have occurred only after close, prolonged contact, recent research suggests

that this precaution may be scientifically unwarranted. Research shows that person-to-person transmission is unlikely because the virus preferentially attaches to cell types that are found in the lower respiratory tract. If the virus cannot replicate in the upper respiratory tract, it is difficult to transmit through coughing and sneezing, which is the most common means of viral transmission among humans (Shinya et al. 2006; van Riel et al. 2006). There has been concern that the virus will mutate or will reassort with other viruses that circulate among humans, and will acquire characteristics that make it easier to transmit between humans. However, deliberate manipulation of the H5N1 genome that produced mutations and reassortments with other avian influenza viruses that humans contract failed to produce characteristics that increased transmissibility (Maines et al. 2006). Before you return, any clothes worn in the field should be laundered with detergent and should not be worn again until they have been laundered. Field equipment should be disinfected after use, as described above.

Precautions to take to protect yourself when working in the laboratory

Ornithologists preparing specimens or working with blood or tissue from fresh birds should be aware that the virus will remain viable in dead birds for several days, particularly in cool or wet climates. Freezing does not kill viruses; those working with thawed tissue from birds originating in countries or regions where HPAI H5N1 occurs should take appropriate precautions. The USDA-approved treatment methods (as described in the OC Permit Guide to Import of Bird Specimens) will inactivate the virus. If you have imported birds from HPAI H5N1 countries, you will have been required to use one of these methods prior to import, and will have inactivated the virus. Nonetheless, it is recommended by the World Health Organization that work be conducted in a laboratory that meets Biosafety Level 2 (BSL2) conditions. These standards are found in the Biosafety in Microbiological and Biomedical Laboratories Manual (BMBL).

A university or research institution's risk management office may attempt to impose restrictions on work involving materials imported from countries where HPAI H5N1 occurs because the BMBL states that BSL3 is appropriate when "work is done with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection." Should this occur, the researcher can explain to the university that the import permit required pre-import inactivation of the virus, using a USDA-approved method, so the materials do not contain infectious agents. In the event that H5N1 is confirmed in wild or domestic birds in the United States, these pre-import treatment methods would of course not be required. It would then be possible to bring tissue containing H5N1 virus into the laboratory. Only then would BSL3 conditions be required, and then only if you choose not to treat the material so as to inactivate the virus and if the manner of manipulation of the tissue would be likely to result in aerosolization.

West Nile Virus - the basics

West Nile is an insect-borne flavivirus commonly found in Africa, western Asia and the Middle East, and, since 1999, in the Western Hemisphere. In North America, it has been detected in at least 48 species of mosquitoes and over 250 species of birds (USGS 2010). It is now found in every state except Alaska and Hawaii.

Precautions to take to protect yourself when working in the field

Although there are no documented cases of ornithologists or bird banders contracting WNV from handling living or dead birds, it is also the case that there has been no surveillance of ornithologists or bird banders to determine the presence/absence or prevalence of the disease. Even if such surveillance were to be implemented, it would be difficult to know if the disease had been contracted through contact with bird feces or saliva or if it had been contracted from an insect bite – at the research site or elsewhere.

It has been confirmed that WNV may be shed from the cloacal and oral cavities (Komar et al. 2002). Therefore, contact with droppings, dropping-contaminated feathers, or the cloaca may result in exposure to WNV.

- Be sure to have antiseptic (not antibacterial or antimicrobial) wipes or gels available for handwashing and first aid for cuts or punctures sustained while handling birds. Using wipes after handling each bird will protect both the researcher and the birds subsequently handled by the researcher.

- Avoid contact with bird feces.

- If bitten by a bird, wash hands (when possible) or use antiseptic (not antibacterial or antimicrobial) wipes or even a small amount of fresh bleach.

- Extra care should be taken to avoid needle sticks when taking blood samples. Public health officials consider gloves to be an appropriate precaution but ornithologists rarely wear gloves when handling birds, particularly in the field. If gloves are worn, they should be changed or decontaminated with 70% ethanol or other appropriate substance after handling each bird to avoid transmission from one bird to another. Be familiar with proper glove removal, which entails avoiding contact with the skin, and disposal. Other barrier protections such as goggles and masks are standard precautions against inadvertent exposure to droplets and fluids. However, goggles and masks are probably disproportionate to the nature and extent of the risk posed by this particular pathogen.

- Take same reasonable precautions to minimize risks – of various diseases - posed by mosquito bites. Reasonable measures include protective clothing (long sleeves, long pants, socks), and the use of DEET or other insect repellants – with repeated applications over time. For detailed information about the proper use of DEET and summary of a recent assessment of the efficacy and safety of DEET, see the appendix).

Precautions to take to protect yourself when working in the lab

As of February 2003, there have been only two documented cases of researchers contracting West Nile Virus in the course of conducting research. Both cases involved microbiologists. One was infected from an accidental needle puncture in the finger while working with live virus while the other was infected through an accidental scalpel cut while performing a necropsy on a dead Blue Jay (*Cyanocitta cristata*)(CDC 2002).

It is best to assume that any specimen or tissue sample that has not been treated with a method known to kill the virus could be infectious and to take proper precautions at all times. Neither refrigeration nor freezing will kill the virus. Assume that thawed tissue or specimens from birds could contain live virus. The virus can remain viable in dead birds for several days.

- Take care to avoid scalpel cuts and punctures. If they occur, cleanse the area promptly and thoroughly, apply antiseptic and report the incident to a supervisor. If signs of illness occur within two weeks of exposure, seek prompt medical evaluation and consult with public health authorities.

- Standard measures to minimize exposure to fluids or tissues during handling of potentially infected tissue include barrier protections such as gloves, masks, and eyewear; proper use and disposal of needles, scalpels, and other sharp instruments; and minimizing the generation of aerosols (such as vigorous spraying of water on carcasses or work surfaces). At least when preparing specimens, ornithologists rarely wear gloves. Taking care to avoid scalpel cuts and punctures, washing promptly if a cut or puncture wound occurs, followed by the use of an antiseptic or 70% alcohol is probably an appropriate alternative given the nature of the risk. However, gloves should be worn if the skin is broken. Aerosolization rarely occurs when preparing specimens, but procedures that could possibly produce aerosols or splashing can be conducted under a biosafety hood.

- Avoid touching anything but the materials involved in the procedure. Touching equipment, phones, wastebaskets or other surfaces may cause contamination. Decontaminate any surfaces that were touched. Be aware of touching the face, hair, and clothing as well.

Other zoonotic pathogens

Wild birds may carry other diseases to which ornithologists and banders are susceptible and an ornithologist or a bander may easily transfer some avian pathogens from one bird to another. According to the USGS Field Manual of Wildlife Disease**,** "As a group, bacterial diseases pose greater human health risks than viral diseases of wild birds. Of the diseases addressed in this section, chlamydiosis, or ornithosis, poses the greatest risk to humans. Avian tuberculosis can be a significant risk for humans who are immunocompromised. Salmonellosis is a common, but seldom fatal, human infection that can be acquired from infected wild birds." However, other avian diseases rarely cause illness, much less serious illness in humans, and rarely, if ever, result in death.

According to the CDC, chlamydiosis (also known as ornithosis or psittacosis) is characterized by fever, chills, headache, myalgia, and a dry cough with pneumonia often evident on chest x-ray. Severe pneumonia requiring intensive-care support, endocarditis, hepatitis, and neurologic complications occasionally occur. Most people recover from salmonellosis in a week or less without medication though the severe dehydration that can occur can be dangerous and may require hospitalization. Human fatalities from bacterial diseases are rare due to the availability of antibiotics. There have been several severe cases among wildlife biologists (Wobeser and Brand 1982).

The level of precaution should be commensurate with the level of risk to the individual handling the bird and to other birds. In most situations, then, hand washing and disinfecting of equipment and holding devices should be adequate.

It is always helpful to recognize the signs of illness in a bird, but because birds can harbor pathogens without showing overt signs of illness, do not assume that the absence of signs indicates the absence of a pathogen. A researcher who becomes ill after handling wild birds should inform the physician of the possible exposure to a zoonotic pathogen.

Precautions against transmission to birds and other wildlife

To prevent transmission *of any pathogen* as a result of handling by researchers:

- Do not re-use contaminated bags, boxes or other holding/carrying devices and other devices used to restrain birds during processing. The North American Banding Council manual states, "Launder bird bags frequently, as they must be kept clean," and "If a diseased bird is caught, it is extremely important to put that bag aside until it has been washed and disinfected." However, as it is not possible to determine if a bird is shedding virus, the better practice would be to carry an ample supply of bags or other holding/carrying devices so that no bag or other holding device is used more than once before laundering. Viruses can survive at cool temperatures for days, weeks, or even longer. Wash bags with hot water, detergent, and/or household bleach before reuse.
- When preparing specimens in the field, place waste material in a biosafety bag, seal it, and burn it, or carry it out with you and burn it later. Never re-use needles, scalpel blades, calipers, rulers, banding pliers or other equipment that touches any part of a bird unless the equipment decontaminated with a freshly prepared 10% bleach or 70% alcohol solution or alcohol wipes after use on each individual. The National Veterinary Standards Laboratory of the U.S. Department of Agriculture, which approves pre-import treatment methods for materials of avian origin, confirmed that 70% alcohol will kill the virus.
- Disinfect your hands after handling each bird. Disinfectant hand wipes can be used if washing with soap and water is not possible.
- For field surgeries, aseptic technique is discussed at length in *Guidelines to the Use Of Wild Birds in Research* (Fair et al. 2010).

What ornithologists and banders can do in the event of emergent avian disease or disease outbreaks

Ornithologists and banders can and should develop relationships with their state or provincial health and agriculture departments. For a comprehensive list of state agencies in the United States, see < http://www.pandemicflu.gov/state/statecontacts.html >. Should emerging infectious avian diseases arrive in your country, state, or province, or should disease outbreaks occur, you will be prepared to help persuade your state officials to continue monitoring wildlife after occurrence is confirmed, can help to share accurate scientific information about wild birds with these agencies and with the public, and can help address calls from the public or from government officials to cull wild birds. Every international and national agriculture and public health organization, including the World Health Organization and the United Nations Food and Agriculture Organization, has concluded that culling of wild birds or destruction of their habitat – such as the draining of wetlands – is neither practical nor feasible, from logistical, environmental, public health, and biodiversity points of view. In fact, the FAO points out that the attempt to cull or the destruction of habitat could result in the dispersion of birds and if those birds were infected, dispersion would result in spread of the virus to a wider area.

Ornithologists can also serve as experts to provide information to the general public and the media, but should be careful to avoid speculating about how or how quickly the disease might spread; if, when, and how it might arrive in the Western hemisphere or about any other matter about which information is lacking or incomplete. Speculation can lead to calls for inappropriate measures**.**

Ornithologists, banders, and bird observatories can greatly extend biosurveillance capacity. Contact information for organizations already involved in biosurveillance are listed below.

In the United States

Smithsonian Migratory Bird Center
http://www.si.edu/smbc

Landbird Migration Monitoring Network of North America
http://www.klamathbird.org/lammna/

Institute for Bird Populations
http://www.birdpop.org/

Global Avian Influenza Network for Surveillance
http://www.gains.org/

USGS National Wildlife Health Center
http://www.nwhc.usgs.gov/

Submitting samples for analysis

Unpublished research presented by Ron A.M. Fouchier at the Food and Agriculture Organization's International Scientific Conference on Avian Influenza and Wild Birds (Rome, 30-31 May 2006) and the Wildlife Disease Association (Storrs, Connecticut, 2006) suggests that cloacal swabs may not be effective for detecting HPAI H5N1. Dabbling ducks experimentally inoculated with H5N1 did not shed the virus in feces and thus cloacal swabs may not be effective in detecting the virus. However, the virus was found in throat swabs in high quantities. If taking cloacal swabs specifically to test for presence of HPAI H5N1, consult the current literature on this subject. The choice of cloacal swabs versus tracheal swabs may also be determined in part by the species and the impact of this procedure on the birds, as well as the level of training and experience of the field staff.

If you collect cloacal or tracheal swabs during the course of your own research, you may want to have the samples analyzed if you have the funding to do so. The U.S. federal agencies are not currently accepting samples for analysis. However, if the specimens are collecting according to the protocols in the Interagency Avian Strategic Plan, Attachment 9 <http://www.usda.gov/documents/wildbirdstrategicplanpdf.pdf> and if the specimens are analyzed by a National Animal Health Laboratory Network <http://www.nahln.org> laboratory. you are welcome to submit data to the HPAI Early Detection Data System (HEDDS) <http://wildlifedisease.nbii.gov/ai/index.jsp>

Protocols for collecting and shipping avian carcasses for diagnostic evalution are outlined in Attachment 8 of this document: <http://www.usda.gov/documents/wildbirdstrategicplanpdf.pdf>

Do not submit samples directly to the USGS National Wildlife Health Center or the USDA National Veterinary Standards Laboratory. Make arrangements in advance to submit samples to your state. A full list of state agriculture, wildlife, and public health departments can be found here: <http://www.pandemicflu.gov/state/statecontacts.html>.

In Canada

Sampling in Canada must be coordinated through Environment Canada, even if the bander or ornithologist is participating in an organized banding program.

If you find a dead bird, contact the Canadian Cooperative Wildlife Health Center. Submission forms can be found here: http://www.ccwhc.ca/wildlife_submission_forms_regions.php.

In Mexico

Avian Flu Commission
http://www.huitzil.net/nuevo_sitio/PlandetrabajoGripeAviar.pdf

Additional resources

USGS National Wildlife Health Center has made available its course materials on avian zoonotic disease: http://www.nwhc.usgs.gov/outreach/avian_zoonotic_course.jsp

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This fact sheet and the two prior fact sheets, one about West Nile Virus and the other about Highly Pathogenic Avian Influenza, have been peer-reviewed.

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