National Avian Influenza Surveillance Plan

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Executive Summary

Highly pathogenic avian influenza (HPAI) subtype H5N1 has infected domestic poultry and wild birds in Asia, Europe, and Africa, causing more than 185 human deaths (WHO 2007). This emergence has elevated the risk of introducing the pathogenic strain to domestic poultry in the United States by certain human activities or by migratory birds traveling intercontinental migratory flyways.

Due to heightened animal and human health concerns, the poultry industry and State and Federal animal health regulatory agencies are working together to increase biosecurity and conduct extensive surveillance to prevent, rapidly detect, and control HPAI as well as H5/H7 low pathogenicity avian influenza (LPAI) in commercial poultry, live-bird markets, and poultry raised in nonconfinement operations. Early detection of HPAI, leading to rapid response and outbreak control, safeguards animal and human health and averts the economic consequences of lost export markets and domestic sales of poultry products.

In addition to achieving these disease detection objectives, AI surveillance provides U.S. policymakers, industry, and State stakeholders with the information needed to determine that current prevention measures and efforts are robust enough to protect the health of U.S. poultry flocks, minimize economic effects of the disease, and greatly reduce the health risks to the U.S. public. Realizing that surveillance planning is a dynamic process that involves a continuum of analysis, enhancement, and re-design after implementation, APHIS uses surveillance information as a tool to further guide efforts that refine and enhance surveillance activities.

The primary purpose of this document is to outline the National Avian Influenza Surveillance Plan, which provides a comprehensive summary of notifiable avian influenza (NAI) surveillance undertaken by the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) in partnership with other Federal and State agencies and the commercial poultry industry. In particular, the plan addresses surveillance for and early detection of HPAI, including Asian HPAI H5N1 viruses, as well as low pathogenicity notifiable avian influenza (LPNAI) viruses that pose risk of mutating into forms that may cause more devastating disease. The United States, as a member of the World Organization for Animal Health (OIE), is obligated to notify the OIE when these strains are detected.

This document describes the components of the National Avian Influenza Surveillance System (NAISS) and how, as separate sources of surveillance information, they collectively provide the information necessary to safeguard the health of U.S. poultry. In addition, this document provides an analysis of the ability of current surveillance components to identify rapidly an outbreak of NAI in domestic poultry in the United States.

Using this analysis, areas within various NAI surveillance components that need more attention in order to increase their effectiveness are identified. Finally, this document provides a foundation for periodically summarizing, analyzing, reporting, and interpreting surveillance data to provide relevant information for decision-makers.

The four primary purposes of the NAISS are:

1. Rapid detection of HPAI, particularly the Asian H5N1 strains, in all domestic poultry populations;
2. Early detection of NAI, particularly Asian H5N1, in wild migratory waterfowl prior to introduction into domestic poultry;

3. Assurance that LPNAI strains are not allowed to enter and persist in poultry populations where they may spread and mutate into HPAI; and
4. Consistency with international surveillance guidelines for trade purposes.

The National AI Surveillance Plan divides the domestic poultry population in the United States into four categories: the large-volume commercial poultry industry, the small-volume but high-value commercial poultry industry, the Live-Bird Marketing System (LBMS), and backyard poultry flocks. These categories are based primarily on risk of disease introduction and the level of management practices, as well as commercial characteristics. Non-poultry populations, such as migratory waterfowl and zoo/exhibition birds, also are included in the discussion.

Four methods of surveillance are conducted in domestic poultry, with oversight provided by official State agencies or the commercial poultry industry: passive surveillance, active observational surveillance, active serologic surveillance, and active antigen surveillance. Each method is specifically designed for detecting different pathotypes of NAI within the various subpopulations.

Analysis of U.S. surveillance indicates that the large-volume commercial poultry industry could be expected to identify an outbreak of HPAI through active observational surveillance within 2 weeks (14 days in the broiler industry and 10 days in breeders, layers, and turkeys) with 95 percent probability and with greater than 99 percent probability for an Asian HPAI H5N1 outbreak. **This estimate represents the time from a flock's first exposure to either HPAI or specifically to Asian HPAI H5N1 until regulatory officials quarantine the premises. Outbreak experience indicates that response times may occur in many instances more rapidly than the model indicated.**

Active laboratory surveillance (serologic and antigen) is likely to detect NAI virus in commercial flocks and LBMS flocks within the window of their sampling frequency, generally 3 or more months. While this time frame most likely would allow for detection of the LPAI virus before a mutation could proceed, laboratory surveillance must be combined with active observational surveillance to ensure rapid detection of HPAI viruses in these sectors. Because HPAI viruses cause high mortality rates, active observational surveillance is most likely to result in detection and regulatory action (i.e., quarantine) well before confirmatory laboratory results become available.

In backyard poultry and small-volume commercial operations, management practices are less structured. Surveillance in these flocks depends more heavily on voluntary reporting of sick or dead birds under a passive surveillance system; thus, the possibility exists that several flocks could be infected before an outbreak is identified. LBMS surveillance is likely to detect low pathogenicity viruses within the sampling interval (3 to 12 months or more frequently, depending on individual State surveillance programs). HPAI detections would most likely result from producers or veterinarians reporting sick and dead birds to State or Federal animal health agencies under a passive surveillance system.

Migratory waterfowl surveillance contributes significantly to other AI surveillance efforts. It helps identify high-risk geographic areas where poultry and waterfowl interface and assists with the early detection of Asian HPAI H5N1as well as other NAI.

In conclusion:

- The detection probability, or sensitivity, of surveillance in U.S. large-volume commercial poultry is robust; this sector is meeting all four purposes of the NAISS described above.

- In the LBMS, active laboratory surveillance has high sensitivity for detecting LPNAI. Due to frequent inspection visits and awareness activities by State or Federal regulatory personnel, LBMS surveillance also has reasonable probability to report mortality events that would trigger investigations for HPAI.

- The small-volume high-value commercial industry, in most cases, has less structured biosecurity management and may be at higher risk for NAI introduction with lower sensitivity for detection. Improved availability of data and information on standard management practices, similar to what is available for the large-commercial industry, would reduce uncertainty in the analysis of the small-volume high-value industry and may improve our ability to estimate the probability of detection (sensitivity analysis) of NAI in this sector. Data from newly implemented National Poultry Improvement Plan (NPIP) cooperative agreements is forthcoming and will allow us to draw better conclusions about risk and propose changes if needed.

- Likewise, backyard poultry flocks are widespread with varying management practices and risk. The latter two industry sectors would therefore benefit from further attention to and improvements in biosecurity and surveillance.

Findings of the analysis and surveillance options are discussed in detail in the body and appendices of this document. In brief, active observational surveillance in the field increases the probability of identifying and sampling high mortality events at the earliest stage of an outbreak. This surveillance includes: observations by extension agents or private veterinarians; observations at exhibitions, competitions, and shows; and contacting flock owners about any sign of disease in their flock.

Campaigns such as USDA's "Biosecurity for the Birds" (please see Appendix G) significantly enhance awareness among flock owners and encourage them to report sick or dead birds. As a result, this campaign and other outreach efforts strengthen the passive surveillance component of the NAISS. Additionally, targeting surveillance activities to high-risk areas where poultry and migratory waterfowl are in proximity allows for efficient use of surveillance resources.

Introduction

The recent emergence of HPAI subtype H5N1 that has infected domestic poultry and wild birds in Asia, Europe and Africa, causing more than 185 human deaths (WHO 2007), has elevated the risk of introducing this pathogenic strain to domestic poultry in the United States by certain human activities or by migratory birds traveling intercontinental migratory flyways.

Due to heightened animal and human health concerns, the poultry industry and State and Federal animal health regulatory agencies are working together to increase biosecurity and conduct extensive surveillance to prevent, rapidly detect, and control HPAI as well as H5/H7 LPAI in commercial poultry, live-bird markets, and poultry raised in nonconfinement operations.

Early detection of HPAI, leading to rapid response and outbreak control, safeguards animal and human health and averts the economic consequences of lost export markets and domestic sales of poultry products.

The primary purpose of this document is to outline the National Avian Influenza Surveillance Plan, which provides a comprehensive summary of notifiable avian influenza (NAI) surveillance undertaken by USDA/APHIS in partnership with other Federal and State agencies and the commercial poultry industry. **In particular, this plan addresses surveillance for and early detection of HPAI strains to include Asian HPAI H5N1, as well as H5/H7 LPAI strains that pose risk of mutating into forms that may cause more devastating diseases.** In addition, this document provides an analysis of the ability of current surveillance components to rapidly identify an outbreak of NAI in domestic poultry in the United States.

The National Avian Influenza Surveillance System (NAISS) is based on the Surveillance and Data Standards for USDA/APHIS/Veterinary Services (VS). These standards are designed to facilitate the collection, collation, validation and analysis of accurate and representative surveillance data for a comprehensive surveillance program. Well-planned surveillance and data management at a national level will help ensure that the necessary data is efficiently collected and made available.

This surveillance plan divides the domestic poultry population in the United States into four categories: the large-volume commercial poultry industry, the small-volume but high-value commercial poultry industry, the Live-Bird Marketing System (LBMS), and backyard poultry flocks. The categories are primarily based on risk of disease introduction and management practices. A summary discussion of NAI surveillance and sampling methods is presented for each component of the NAISS. Surveillance data management for each component also is presented, followed by an analysis of each surveillance stream in the component.

In order for the NAISS to be effective, surveillance data must be collected and reported in a timely manner, with comparable data received from poultry and migratory bird populations nationwide. Most data will be maintained within the USDA Animal Health and Surveillance Management (AHSM) system, specifically within the avian health surveillance (AVHS) database, parts of which are now operational.

While AI surveillance programs in the United States have functioned successfully for many years, the surveillance information generated by each program has not been compiled within the framework of a national animal health surveillance system (National Association of State Departments of Agriculture Research Foundation 2001). The NAISS' centralized AVHS database will do so and, as a result, it will strengthen USDA's efforts to analyze, monitor, and respond to AI events.

The AVHS database is composed of a number of modules that house the different subsets of data, including data provided by the National Poultry Improvement Plan (NPIP), LBMS, and APHIS Wildlife Services. The database provides a centralized location for the data, while maintaining security and management of each program.

Two early detection surveillance systems for Asian HPAI H5N1 are currently in place in the United States. Active surveillance in wild birds has been extensively described in *An Early Detection System for Asian H5N1 Highly Pathogenic Avian Influenza in Wild Migratory Birds*, *U.S. Interagency Strategic Plan,* (Interagency Asian H5N1 Early Detection Working Group 2006) which was deployed in Alaska and the lower 48 contiguous States and U.S territories in early 2006.

The second early detection system is described comprehensively here. The term "active observational surveillance" is used to describe the process of frequent monitoring of flock mortality and production by commercial poultry growers. Active observational surveillance is expected to result in early detection of disease caused by HPAI, particularly Asian HPAI H5N1, in commercial poultry populations. Analysis of active observational surveillance is used here to quantify the probability of detecting HPAI within the first 2 weeks post-exposure, indicating that the United States could, with high confidence, rapidly detect the introduction of this pathogen in commercial poultry populations and quarantine infected premises.

In addition to early detection surveillance systems described above for HPAI and Asian HPAI H5N1, other well-established surveillance programs are in place for the detection of low pathogenicity H5 and H7 subtypes of AI in domestic poultry under NPIP and LBMS regulations and standards. The NPIP is an industry-State-Federal cooperative program that awards AI-clean status to poultry breeders, certifying freedom from all AI viruses regardless of antigen type or pathogenicity. An interim rule published on September 26, 2006, in the Code of Federal Regulations extended NPIP low pathogenicity H5 and H7 surveillance to meat-type chicken, meat-type turkey, and table-egg layer flocks (Title 9, Code of Federal Regulations). The APHIS document, *The Prevention and Control of H5 and H7 Low Pathogenicity Avian Influenza in the Live Bird Marketing System,* establishes minimum national standards designed to enhance and unify State live-bird market surveillance programs. Currently, 31 States with LBMS components participate through cooperative agreements with USDA.

Migratory waterfowl surveillance conducted by APHIS Wildlife Services in collaboration with State partners and the Department of Interior's U.S. Geological Survey (USGS), is discussed relative to an assessment of high-risk areas for domestic poultry (please see Appendix C).

Data are gathered for domestic poultry surveillance by either industry or animal health officials using four methods:

- Passive surveillance;
- Active observational surveillance;
- Active serologic surveillance; and
- Active antigen surveillance.

Passive surveillance involves individual poultry growers and flock service personnel who notice atypical disease signs and report them to extension agents, private veterinarians, or directly to diagnostic laboratories. This reporting ultimately results in sample submission to diagnostic laboratories. Active observational surveillance is the flock monitoring process conducted by contract growers and flock service personnel who actively and frequently observe the birds for clinical disease signs and mortality. Serologic surveillance involves collection of blood samples to check for antibodies that represent recent infections in apparently healthy poultry. However, detectable levels of antibodies can take a week to 10 days to develop after exposure. Antigen detection techniques in apparently healthy poultry are also used, but can only detect the virus while it is shed – usually within the most recent 7 to 14 days (Lu and Castro 2004). Active serologic and active antigen surveillance is conducted through State NPIP programs for large-volume commercial poultry and through the LBMS program for H5/H7 LPAI. Each sampling strategy has different utility in the various domestic poultry populations and for the purposes identified for this surveillance plan.

The epidemiological analysis to determine the likelihood that the NAISS would detect Asian HPAI H5N1, should it be introduced into domestic large-volume commercial poultry populations, is presented with in-depth discussion on the parameters used (please see Appendix B).

The epidemiologic analysis to evaluate the sensitivity of the NAISS to detect H5 and H7 LPAI will use current and future AI surveillance data reported from various components of the domestic poultry industry. As data from active serologic and antigen surveillance become increasingly available from industry and newly instituted Federal/State programs, further analysis may be used to quantitatively demonstrate the sensitivity of the surveillance system to detect the occurrence of H5/H7 LPAI of particular concern at a predetermined level.

A comprehensive, integrated surveillance and diagnostic program is essential to determine the extent of AI virus infections in domestic poultry and migratory and non-migratory wild birds (Swayne and Suarez 2000). The plan presented in this document, when fully developed and implemented, establishes a comprehensive, integrated surveillance program. The NAISS' integration of surveillance data from existing programs, as well as the implementation of new surveillance components, will achieve comprehensive AI surveillance.

Part 1: Surveillance Summary

A. Disease Description

The agent responsible for avian influenza, an orthomyxovirus, has been described extensively (Webster *et al.* 1992). Influenza viruses are classified by examining nuclear and matrix proteins that divide them into three groups: influenza types A, B, and C. All influenza viruses from birds and most from mammals are type A. Type A influenza viruses are further classified into various virus subtypes through testing of two surface proteins, hemagglutinin (HA) and neuraminidase (NA). The influenza A viral particles derive a lipid-bilayer envelope from their host where the HA, NA, and M2 matrix proteins are embedded; these are targeted by many detection assays. Presently, 16 HA and 9 NA subtypes have been identified yielding 144 possible virus surface protein combinations.

AI is spread by direct contact between healthy and infected birds and indirect contact with contaminated equipment and materials. The virus is primarily excreted through the feces of infected birds, as well as secretions from the nose, mouth, and eyes.

AI virus infections in domestic poultry may be clinically inapparent or result in disease that ranges from mild transient syndromes to 100 percent morbidity and/or mortality, depending on virus pathogenicity types (Swayne and Suarez 2000). In addition to pathogenicity, other factors such as genetics, nutrition, and co-infection with other pathogens affect clinical outcome. When seen, clinical signs may be evident as respiratory, enteric, cardiovascular, or reproductive. Low pathogenicity strains typically cause either no disease signs or result in mild cases, but may cause increased mortality, decreased feed consumption, respiratory signs (e.g., nasal discharge, coughing, sneezing), and decreased egg production (Dunn *et al.* 2003). Infection with LPAI virus only sporadically leads to appreciable virus shedding in the gastrointestinal tract. Therefore, subclinical cases may shed low amounts of virus and have inconsistent or incomplete seroconversion (antibody production) on a flock basis, causing a concern for detection and control of this form of AI. In contrast, birds infected with HPAI have a greater level of sickness and could exhibit one or more of the aforementioned clinical signs and any of the following clinical signs: sudden death, lack of energy and appetite, soft-shelled or misshapen eggs, swelling and purple discoloration of the combs or wattles, lack of coordination, and diarrhea (Elbers *et al.* 2005).

HPAI viruses cause higher levels of viral shedding with a matching increase in infectiousness. Although HPAI causes rapid death within 4 to 10 days, the infectious period[1] induced by HPAI virus *is not* reduced, unless birds die acutely, and is actually longer for birds infected with HPAI compared with LPAI virus (van der Goot *et al.* 2003). Transmission of HPAI virus *is* strongly reduced in a population where all animals previously went through an infection with LPAI virus (van der Goot *et al.* 2003).

Waterfowl and shorebirds are considered natural reservoirs of LPAI viruses. Wild waterfowl are generally asymptomatic, may excrete virus in feces for long periods, may be simultaneously infected with multiple subtypes, and often do not develop detectable levels of antibody. Seasonal infection with AI virus occurs in conjunction with hatching, brooding, and fledging of susceptible juveniles (Halvorson D.A. 2002). Influenza A viruses generally remain in evolutionary stasis within wild birds and do not cause mortality (Webster *et al.* 2006).

The OIE updated its chapter on avian influenza and revised its guidelines on AI surveillance for member nations in 2005 (OIE 2005). For disease surveillance purposes related to trade in commercial poultry products, NAI is defined by the OIE as an infection of poultry caused by any influenza A virus of the H5 or H7 subtypes or other subtypes meeting specific requirements for high virulence (i.e., severity of disease defined by pathogenicity index) or amino acid sequence in the hemagglutinin receptor protein[2].

Diagnosis for official control purposes is established on the basis of pathogenicity according to in vivo tests or to molecular determinants (i.e., the presence of multiple basic amino acids at the cleavage site of the hemagglutinin precursor protein, HA0) and hemagglutinin typing. *Any* avian influenza viruses with an intravenous pathogenicity index (IVPI) greater than 1.2 in 6-week-old chicks, or alternatively at least 75 percent mortality in 4- to 8-week-old chicks infected intravenously, are identified as highly pathogenic notifiable avian influenza viruses under OIE guidelines.

Except for two H10 isolates that would have fulfilled the OIE definition for highly pathogenic notifiable avian influenza (HPNAI), historically, all HPNAI viruses in the world have been H5 or H7 subtypes. All H5 or H7 subtypes that are not highly virulent for chickens and do not have an HA0 cleavage site amino acid sequence similar to any that have been observed in HPAI viruses are identified as low pathogenicity notifiable avian influenza. H5/H7 LPAI subtypes that circulate within poultry over a period of time may mutate into highly pathogenic forms and cause significant losses to the commercial poultry industry (OIE 2005).

[1] Length of virus shedding measured from time of first detection until virus is no longer detected.
[2] A full reading of the OIE definition of avian influenza can be found in Chapter 2.7.12 of the 2006 OIE Terrestrial Animal Health Code.

It is important to note that notifiable avian influenza as defined by the OIE refers to a specific subset of virus subtypes that fall under regulatory control by veterinary officials.[3] The OIE defines “low pathogenicity avian influenza” as all low pathogenic virus subtypes other than H5 or H7. Although LPAI viruses can cause considerable morbidity and sometimes significant mortality in the commercial poultry industry, LPAI viruses of subtypes other than H5 and H7 are not considered notifiable for regulatory purposes (OIE 2005).

The origins of the HPAI H5N1 virus responsible for the current epizootic in Asia, Europe, and Africa can be traced to an outbreak in domestic geese in southern China in 1996 (Sims *et al.* 2005). Expansion of the host range from geese to ducks was probably a key event in the genesis of the epizootic in 2004. Epidemiologic studies suggest that domestic ducks played a key role in the spread of these viruses to terrestrial poultry through widespread seeding of the virus on farms and rice paddies.

The impact of these viruses has been particularly devastating, causing widespread disease in poultry and a wide range of wild bird species and mammals, and fatal cases of human infection. In terms of the number of infected flocks and the geographical spread of the disease, this was, and still is, the most serious epidemic of HPAI ever experienced (Sims *et al.* 2005). From an epidemiological perspective, viral characteristics of Asian HPAI H5NI are similar to other HPAI viruses. Studies of a Hong Kong-origin H5N1 virus circulating in live-bird markets in 1997 determined 75-100 percent mortality within 10 days in 7 different avian species within the order *galliforms* (Perkins and Swayne 2001). The earliest onset and most rapid disease progression and shortest mean death time of 1.5 days (range 1.5-2.0) post inoculation occurred in chickens, suggesting species adaptation and maximal pathogenicity for this species.

Novel sites of viral infection include the feather follicle epithelium, which could be important in terms of epidemiology with the possibility of transmission by contact with dander and shed feathers (Perkins and Swayne 2001).

Prior to the ongoing epizootic, avian influenza caused significant mortality in wild birds only once (Capua and Alexander 2006, Songserm *et al.* 2006). Presently, it is unclear whether Asian HPAI H5N1 is endemic in the Eurasian wild bird population representing a long-term reservoir or is limited to spillover events from domestic birds. Multiple genotypes of the Asian HPAI H5N1 continue to evolve (Capua and Alexander 2006).

B. Purpose of the National Avian Influenza Surveillance System

The potential zoonotic consequences of Asian HPAI H5N1, in addition to its high mortality in domestic poultry, make it extremely important to prevent its incursion into the United States or to detect the disease as rapidly as possible if it enters. However, surveillance in all populations of susceptible poultry should be designed with sufficient sensitivity to serve as an early warning system in order to identify the emergence of all HPAI strains, in addition to other strains of NAI. Early detection is critical to controlling and containing outbreaks in early stages when few flocks are infected in a limited geographic area. An

[3] The *OIE Terrestrial Animal Health Code*, in Article 1.1.2.3 of Chapter 1.1.2 Notification of Diseases and Epidemiological Information, indicates that the Veterinary Administrations shall send to the OIE Central Bureau a report every 6 months on the absence or presence, and evolution of diseases listed by the OIE, including LPNAI, and information of epidemiological significance to other countries.

uncontrolled outbreak may spread rapidly through densely populated poultry production areas, with associated human health hazards and costs to government and industry proportional to the rate of spread.

The four primary purposes of the NAISS are:

1. Rapid detection of HPAI, particularly the Asian H5N1 strain, in all domestic poultry populations;
2. Early detection of NAI, particularly Asian H5N1, in wild migratory waterfowl prior to introduction into domestic poultry;
3. Assurance that H5/H7 LPAI strains are not allowed to enter and persist in poultry populations where they may spread and mutate into HPAI; and
4. Consistency with international surveillance guidelines for trade purposes.

C. Rationale for Surveillance Purposes

Rationale for Purposes 1 and 2: Public Health

Asian HPAI H5N1 has demonstrated the potential to cause serious disease in humans as demonstrated by cases in Southeast Asia in the late 1990s (Cox and Subbarao 2000) and again in the current outbreak, where direct exposure to infected poultry has been the primary route of infection in human cases. However, broad concerns continue regarding public health and the potential for AI viruses to mutate or change into a subtype that could spread from person to person in pandemic proportions. Highly pathogenic subtypes of NAI, particularly Asian HPAI H5N1, present substantial risk to the health and well-being of the public. Other AI viruses have been demonstrated to infect humans, but with less serious clinical signs (Kaye and Pringle 2005). AI has the potential to spread extremely fast in poultry and generate correspondingly large amounts of virus. As a result, prevention, rapid detection and control of an outbreak in poultry are essential to minimize the potential public health hazards and subsequent economic consequences.

Rationale for Purposes 1 through 4: Economic Costs of Disease Control and Trade Restrictions

An outbreak of HPAI may be locally severe for flocks and producers, yet a rapid response by State and Federal animal health agencies and industry generally reduces total production and economic losses by limiting the spread of the disease. Although notifiable LPAI outbreaks do not result in the same magnitude of death loss, economic effects from trade losses are high and rapid identification and response reduces the impact in a similar manner. Further, preventing the LPAI viruses from circulating within the flocks over time greatly reduces the probability of them mutating into a HPAI virus.

The broiler industry is the largest and most valuable of the three major U.S. poultry industry groups. Farm cash receipts for broiler production in 2005 were $20.9 billion. Farm cash receipts for egg production (broilers and table eggs) were valued at $5.3 billion; turkey production, $3.2 billion; and other chicken production, $64.5 million. The domestic retail value of the U.S. broiler industry in 2004 was $43 billion, and exports were valued at $1.7 billion. Exports of turkey meat in 2004 were $252 million, and egg exports were $249 million (National Agricultural Statistics Service 2006b, World Agricultural Outlook Board 2006, USDA/Economic Research Service 2006a, U.S. Poultry and Egg Association 2006).

If Asian HPAI H5N1 were to occur in the United States, the impact on the poultry industry would be similar to that of any other strain of HPAI. However, because Asian HPAI H5N1 has the potential to infect humans and could mutate into a virus readily transmitted directly from person to person, the benefits of surveillance for this strain of AI in poultry are related to the impact of preventing a related influenza pandemic in people.

The majority of U.S. poultry is located in biosecure, integrated production systems; however, the popularity of backyard poultry flocks, including pet, fancy, hunting and hobby production, could result in direct contact between potentially infected birds and a diverse subset of the U.S. human population. Comprehensive NAI surveillance of the poultry population has the potential to protect the health of the U.S. human population by excluding Asian HPAI H5N1, reducing the potential contact with Asian HPAI H5N1 should it occur in the United States, and avoiding the costs of a human health pandemic that could arise from contact between the U.S. human population and poultry. The Congressional Budget Office (CBO) estimated the annual impact of pandemic influenza on the U.S. economy would range between $187 billion for a less severe scenario and $623 billion for a severe outbreak. The CBO believes that even a large HPAI outbreak in the poultry population would be relatively less expensive to fight than a human pandemic originating from an Asian HPAI H5N1 outbreak in poultry (Congressional Budget Office, 2006).

Another important consideration in the surveillance of poultry and the potential impacts of Asian HPAI H5N1 is that the less structured biosecurity practices of small-volume high-value and non-commercial poultry producers present a high risk to the total value of the U.S. poultry industry. If HPAI is identified in the small-volume high-value or non-commercial poultry segment, commercial poultry producers would likely be impacted by reduced poultry meat purchases (possibly 20 percent or more in the short run) and a loss of access to export markets. Non-commercial or low-volume producers would not be impacted at the same rate, since the value in those industries is not all related to poultry product sales.

Despite prompt industry and government action, loss of export markets may result from any NAI outbreak; this lost export value can have a large negative impact on the entire poultry industry. In the past, nationwide or statewide trade restrictions have been enacted by trading partners for HPAI or NAI outbreaks, despite generally localized (farm, market or county) disease outbreaks. Recent changes to the OIE AI guidelines have more clearly defined the appropriate actions countries can take to protect domestic poultry production for all types of NAI. Compartmentalization and regionalization can be used to reduce the economic impacts from trade export losses to the poultry industry. There is little protection from consumer demand reductions, though historically U.S. consumers have not reacted as adversely to animal disease scares as consumers in European countries. Therefore, when the economic impacts of HPAI or notifiable LPAI are considered, surveillance that detects the disease rapidly and helps establish confidence by U.S. trading partners in the disease status in both the commercial and non-commercial poultry sectors is important to the value of the U.S. poultry industry.

Rationale for Purposes 1 and 3: Surveillance in Backyard, LBMS, and Other Small Poultry Operations

The sectors of the U.S. poultry population outside the intensely managed large-volume commercial operations present a higher level of risk for introduction of AI due to the generally lower emphasis on biosecurity practices. Live-bird markets have been implicated as potential reservoirs for AI viruses and may serve as an amplifier and reservoir of infection (Bulaga *et al.* 2003a, Bulaga *et al.* 2003b, Mullaney 2003, Nguyen *et al.* 2005, Trock *et al.* 2003, Webster and Hulse 2005). These markets house birds from many different sources and species, including waterfowl; they continuously maintain live birds on the premises and, in some cases, may practice suboptimal sanitation. Since 1996, five outbreaks of low pathogenicity H7N2 in commercial poultry have been linked to the LBMS in the northeastern United States (Senne *et al.* 2003). Of four LPAI outbreaks in Pennsylvania since 1983, two were traced to connections with live-bird markets (Dunn *et al.* 2003).

Backyard flocks present a risk to the commercial poultry industry due to varying biosecurity practices by flock owners and their proximity to commercial poultry operations (National Animal Health Monitoring System 2004). Hence, it is not surprising that index cases of AI have been identified in backyard flocks prior to the onset of AI outbreaks in commercial flocks (Kinde *et al.* 2003). Gamebirds raised under semi-wild conditions for eventual release on shooting preserves have become infected with strains of LPAI found previously in wild waterfowl (Groocock 1994).

In addition to the risk from these populations to the commercial poultry industry, human contact is minimally restricted in the live-bird markets and backyards. Viruses in these birds with the potential to infect people pose increased public health risks and therefore provide further rationale for surveillance of these poultry populations.

If allowed to persist, H5/H7 subtypes of LPAI virus may change into more deadly agents for poultry. The length of time that LPAI virus has circulated in poultry before becoming highly pathogenic has varied from 11 days to more than 2 years (Senne *et al.* 2006). Due to increased international concerns over the possibility of mutation, trading partners have used this concern to impose restrictions on U.S. poultry exports after detection of H5 or H7 LPAI in U.S. LBMS or backyard flocks (Hall 2004).

Rationale for Purpose 2: Early Detection in Wild Birds

The ecology and location of infected wild birds near poultry establishments support the option of enhanced risk-based poultry surveillance in the vicinity. Migrating wild birds have been postulated to introduce and serve as a reservoir of AI viruses (Chen *et al.* 2006). For example, the timing of some outbreaks of LPAI H6N2 in chickens in California from 2000 to 2002 coincided with normal waterfowl migration periods (Woolcock *et al.* 2003). Similarly, exposure of range turkeys to wild birds and subsequent direct or indirect contact with confinement turkeys have resulted in seasonal outbreaks of LPAI in Minnesota (Halvorson D.A. *et al.* 1997), where between 1978 and 2002, there were 108 introductions of AI affecting 1,100 flocks (Halvorson D.A. 2002). Twenty of these introductions were H5 or H7 subtypes. During the 1980s and early 1990s, while only 2 percent of the turkeys grown in Minnesota were reared on range, these semi-confined flocks provided a pathway for introduction of the AI virus into the commercial turkey industry. Producers in Minnesota have since stopped the practice of range-rearing turkeys in favor of confinement rearing. As a result, the risk of AI infection from wild birds and range reared turkeys to commercially raised turkeys in that State is under greater control (Senne *et al.* 2006).

D. Surveillance Objectives

Surveillance objectives define the tasks that, when completed, achieve the purposes for surveillance described above. This list describes accomplishments that will allow for rapid detection of HPAI and other NAI viruses, the assessment and evaluation of surveillance for HPAI in poultry, as well as migratory waterfowl, and prevention of persistent H5/H7 LPAI viruses in domestic poultry populations. In the case of the Asian HPAI H5N1 virus, achieving these objectives will aide in the protection of public health by allowing rapid initiation of control measures early in the outbreak. Fulfilling these objectives is also consistent with international guidelines and assures trading partners that comprehensive prevention and control measures are conducted in the United States and that U.S. poultry and poultry products represent negligible disease risk.

- Conduct effective AI surveillance activities cooperatively with State and industry partners to identify, control, and eliminate NAI in commercial poultry. These efforts will maintain exports for the commercial poultry industry and eliminate/reduce production losses due to infection;

- Collect data through the existing surveillance programs administered cooperatively with other Federal and State agencies, and industry; leverage these data to demonstrate adequate surveillance within commercial industry sectors and the LBMS (i.e., if information gained through this surveillance did not demonstrate adequate surveillance, then it would indicate where augmentation should occur);
- Obtain appropriate numbers of diagnostic samples within sectors to determine confidently the avian influenza status of poultry and in some instances, such as live-bird markets, the environment where poultry is held;
- Conduct surveillance of migratory waterfowl cooperatively with State wildlife and natural resource agencies, the Department of Interior, and APHIS Wildlife Services to facilitate poultry surveillance targeted to areas proximate to the wild waterfowl; and
- Ensure effective surveillance in sectors other than traditional commercial poultry production and create disease awareness in all sectors, particularly backyard flock owners, to increase passive surveillance and reporting. These non-traditional flocks include: "raised-for-release" upland gamebird farms and hunting preserves; fancy fowl and gamefowl exhibited at shows and fairs; backyard menagerie hobby flocks; and small production flocks.

E. Expected Outcomes: Products, Decisions and Actions

- Early detection of NAI, triggering response plans to control and eliminate any NAI in a timely manner;
- A systematic mechanism to gather surveillance data;
- A national report demonstrating the level of surveillance within all sectors at risk for NAI detections (including Asian HPAI H5N1); and
- Enhanced surveillance programs through the analysis and strengthening where necessary of existing U.S. AI surveillance efforts.

F. Stakeholders and Responsible Parties

Appropriately trained field personnel are essential for early disease detection. In the United States, universities and poultry trade organizations sponsor educational seminars and provide publications as training tools for field personnel and flock managers (Lacy 2002). It is in commercial contract growers' interests to work closely with their integrators and company field representatives to reduce morbidity and mortality associated with disease (Dozier *et al.* 2001). Growers are likewise expected to be familiar with their companies' grow-out plans and keep complete records of their operations. Dead birds are removed from each barn and recorded each morning in practically all large-volume commercial flocks and usually in smaller operations (Voris J.C. *et al.* 1998). Responsibilities attributed to the grower, heightened situational awareness, and financial incentives (premiums) increase the likelihood that disease will be reported (Doherr and Audige 2001). Company field representatives normally visit large-volume commercial farms weekly to assist with management, but they may do so more often if necessary (Cunningham 2005). Decisions related to medications for disease problems or vaccination programs for disease prevention are company responsibilities made only as recommended by company representatives and prescribed or administered by licensed veterinarians. Company-employed veterinarians may visit the flock and collect appropriate diagnostic specimens from a sample of sick and healthy-appearing birds, perform field necropsies, and submit diagnostic specimens to the laboratory. In most States, veterinarians are legally obligated to report any disease listed as reportable if the disease is even suspected in an affected animal (Clark 2002). If a company does not employ a veterinarian, the field representative may submit samples directly to a lab. Federal and State veterinary medical officers trained as foreign animal disease diagnosticians (FADDs) are consulted when an outbreak is suspected, and direct the follow-up action, such as foreign animal disease investigations (USDA Animal and Plant Health Inspection Service 2006).

Hobby flock owners may educate themselves on diseases important to domestic poultry using widely available resources including the Internet, the agriculture extension service, private veterinary practitioners, and feed sales representatives. These owners are advised to submit dead birds from hobby flocks to State diagnostic labs for necropsy and testing, often at a subsidized fee (Sander J.E. and Lacy 1999, National Animal Health Monitoring System 2004).

Wildlife biologists employed by Federal and State agencies conduct active surveillance in high-risk populations of migratory waterfowl by sampling live and hunter-killed birds, investigating wild bird mortality events, collecting composite fecal samples, or sampling water sources contaminated by feces (Interagency Asian H5N1 Early Detection Working Group 2006). Some zoological parks with captive outdoor waterfowl populations will conduct active surveillance by regularly sampling these populations. In addition, some zoological parks and exhibitors will collect appropriate samples from sick or dead exhibit birds, as well as wild birds found on the premises that are suspect for AI.

Diagnostic laboratories receive specimens and evaluate them using standardized laboratory protocols. The NPIP, National Animal Health Laboratory Network (NAHLN), and USGS National Wildlife Health Center (NWHC) perform agar gel immunodiffusion (AGID) assay, enzyme-linked immunosorbent assay (ELISA), and real-time reverse transcriptase polymerase chain reaction (RRT-PCR) to screen field-collected specimens. The USDA National Wildlife Research Center (NWRC) laboratory evaluates fecal and water samples from environments contaminated by waterfowl. Confirmatory virus isolation, sub-typing, and pathogenicity testing are accomplished at the USDA National Veterinary Services Laboratories (NVSL), the Nation's animal disease reference lab and only OIE AI reference laboratory in the United States.

Electronic data entry forms have been designed by the Center for Animal Disease Information and Analysis (CADIA) to capture field data and link cases with samples submitted to diagnostic laboratories (National Surveillance Unit 2005). Surveillance data captured through existing APHIS Veterinary Services programs are provided for analysis and reporting through the Animal Health and Surveillance Management (AHSM) system application. Animal health technicians in the field equipped with laptop computers conduct surveillance in backyard flocks and the LBMS and enter data into digitalized surveillance forms, which are transmitted over the Internet. Data are shared between laboratories using HL-7 messaging. Geospatial analysis of migratory waterfowl surveillance is provided by the HPAI Early Detection Data System (HEDDS) available through the National Biological Information Infrastructure Wildlife Disease Information Node (WDIN), developed by the Department of Interior's U.S. Geological Survey.

The APHIS Veterinary Services' National Surveillance Unit (NSU) and the National Animal Health Programs (NAHP) poultry staff analyze domestic poultry surveillance data. In addition to surveillance reports, surveillance data are posted to the National Animal Health Surveillance System (NAHSS) Web site (http://www.aphis.usda.gov/vs/nahss/poultry/index.htm). Stakeholders use the surveillance information to formulate policy, negotiate trade, and, if necessary, take additional security measures. Stakeholders and responsible parties are further summarized in Table 1.

Table 1. Stakeholders and parties responsible for designing, implementing, collecting, managing and disseminating information on surveillance.

Responsible Parties		Stakeholders and Information user	
Field	• Industry field representatives and veterinarians • Hobby flock owners/exhibitors • Federal and State veterinary medical officers • Wildlife biologists • Zoological parks • Animal facilities under USDA APHIS Animal Care jurisdiction	Industry	• Industry producer groups • Fancy (show) bird groups • 4-H groups • Individual owners
Laboratory	• Approved NPIP laboratories • Approved NAHLN laboratories • USDA APHIS National Wildlife Research Center • DOI National Wildlife Health Center • USDA APHIS National Veterinary Services Laboratories	Trade	• USDA APHIS National Center for Import and Export • USDA APHIS International Services • Foreign Agricultural Service • U.S. Poultry and Egg Association • USA Poultry & Egg Export Council • Trading partners
Data Storage	• USDA APHIS Center for Animal Disease Information and Analysis • DOI National Wildlife Health Center • Official State Agencies	Policy	• USDA APHIS National Animal Health Programs • USDA APHIS Emergency Management and Diagnostics • USDA APHIS Smuggling, Interdiction and Trade Compliance
Analysis	• USDA APHIS National Surveillance Unit • DOI National Wildlife Health Center • USDA APHIS Center for Emerging Issues	Budget	• USDA-APHIS Policy and Program Development-Budget and Program Analysis

G. Population Description, Characteristics, and Management Practices

The domestic poultry population in the National AI Surveillance Plan is divided into four categories: the large-volume commercial poultry industry, the small-volume but high-value commercial poultry industry, the Live-Bird Marketing System, and backyard poultry flocks. The categories are primarily based on risk of disease introduction and management practices. Most surveillance in domestic commercial poultry populations occurs through the NPIP, a cooperative industry-State-Federal program administered through APHIS Veterinary Services and official State agencies in cooperation with USDA.

Surveillance of the wild bird populations primarily falls within the jurisdiction of the Department of Interior's U.S. Fish and Wildlife Service and APHIS Wildlife Services in cooperation with State wildlife agencies. In addition, some zoos and other exotic animal facilities under APHIS Animal Care jurisdiction will regularly collect samples from apparently healthy outdoor waterfowl populations on their grounds, and will test sick, moribund or dead exhibit or wild birds suspected to be affected by AI.

Pet bird populations are not included in this plan. Imported pet birds brought into the United States from countries other than Canada are tested at one of three animal importation quarantine stations or undergo monitored home quarantine. Currently, the Centers for Disease Control and the USDA restrict birds from countries where HPAI H5N1 is present in poultry, in order to prevent the introduction of avian influenza.

Domestic pet birds are housed indoors; they would generally not be exposed to waterfowl or their habitat and are considered to be at negligible risk for AI, especially Asian HPAI H5N1.

Population Group I: Large-Volume Commercial Poultry

Large-volume commercial poultry production is the largest segment of the U.S. poultry industry and includes broiler, layer, and turkey production. Almost 90 percent of all U.S. poultry is produced under contract (USDA/Economic Research Service 2006b). Contracts are made between growers and the integrator, usually for a specified amount of production to be delivered at a specific time. The integrator—the company that owns the contract—provides services and support to the growers, although the grower usually owns the house where the poultry are raised. These poultry producers characteristically follow standard production practices, with a focus on consistent, high-quality supply tied to specific requirements of their production contract. While the product, location and integrator vary, this industry segment has the most standardized production practices of all U.S. livestock industries. High levels of biosecurity, daily monitoring, and restricted access to the poultry are important characteristics of the segment.

Broiler, Layer, and Turkey Production

The commercial poultry industry includes three main components: broiler production, table-egg production, and turkey production. All three industries are similarly structured and are largely vertically integrated. Vertical integration refers to the control of two or more successive stages of production and marketing with respect to quantity, quality, and timing of production flows (Martinez 2002). Poultry farms are either individually owned and contracted with integrated companies, or are company owned, with independent producers accounting for a minimal proportion of production.

Indoor housing is the norm for commercial broiler, layer, and turkey operations, especially breeders, reducing the risk presented by wildlife and migratory wild birds. The level of biosecurity, monitoring, and management practices is very high. In an outbreak of LPAI H7N2 in commercial farms in Virginia, however, raccoons possibly acting as mechanical vectors were found to be associated with the outbreak (McQuiston *et al.* 2005). Risk factors for introduction of virus to flocks include service personnel, catching crews, vaccination crews, employees (especially if they own birds), rendering facilities, feed trucks, egg pickup and processing (racks and crates going to different farms), shared equipment, and bird placements (spiking males, flock additions). Top States for broiler, turkey and egg production are listed in Table 2 (National Agricultural Statistics Service 2006b, National Agricultural Statistics Service 2006c).

Table 2.

Top 10 Broiler Production States

State	Percentage of U.S. Production
Georgia	14.9
Arkansas	14.2
Alabama	12.0
Mississippi	9.5
North Carolina	8.2
Texas	7.1
Maryland	3.3
Kentucky	3.3
Virginia	3.0
Delaware	2.8

Top 6 Turkey Production States

State	Percentage of U.S. Production
Minnesota	17.4
North Carolina	14.0
Arkansas	11.3
Virginia	8.2
Missouri	8.0
California	5.8

Top 10 Table-Egg Layer States

State	Percentage of U.S. Production
Iowa	15.2
Ohio	10.0
Indiana	8.2
Pennsylvania	8.1
California	7.1
Texas	4.9
Nebraska	4.1
Georgia	4.0
Florida	4.0
Minnesota	3.6

Primary breeder flocks for the large-volume commercial industry have the highest levels of biosecurity measures, including daily monitoring, showers and designated clothing for employees, visitor restrictions, vehicle sprays, and parking located away from bird housing. Birds are housed indoors and rarely have contact with wild birds.

Commercial Production Flocks

Meat-type chickens include all domesticated chickens grown primarily for producing meat, including but not limited to broilers, roasters, fryers and Cornish game hens. A total of 8.87 billion broilers were produced in the United States in 2005 (NASS Poultry Production and Value, 2005 Summary, April 2006).

The grower house environment, including temperature, ventilation, and light, is frequently computer-controlled, and birds are housed in total confinement. Although mechanical catching is becoming more common, broilers are mostly caught and loaded into coops or cages by hand. The typical operation experiences five to six turns per year depending on economic conditions.

Meat-type turkeys are domesticated turkeys grown primarily for producing meat. In 2005, a total of 256 million turkeys were raised in the United States (NASS Turkeys Raised, August 2006). Housing in the turkey industry has moved mostly indoors. Multi-age farms are being phased out of production. Poults (young turkeys) are now brooded to 6 to 8 weeks in one operation and then moved to one or more grow-out operations. Turkeys are separate-sex reared and a typical operation experiences three to four turns per year.

Table-egg layers are domesticated chickens grown primarily to produce eggs for human consumption. On average in 2005, there were 285 million table-egg layers on hand (NASS Chickens and Eggs 2005 Summary, February 2006).

According to a 1999 NAHMS study of the layer industry, AI risk factors include the opportunity for disease transmission between flocks from racks and flats via the processor. Biosecurity practices employed by U.S. egg producers include: prohibiting non-business visitors (68.1 percent), prohibiting employees from owning poultry (75.7 percent), fencing (26.7 percent), and employee footbaths (24.5 percent). Only 3.9 percent of U.S. egg producers provide workplace shower facilities for employees and/or visitors. While there are many independent small farms, they account for a small percentage of production; the majority of egg production occurs through vertically integrated commercial operations. For operations with 30,000 or more layers, the average number of layers per farm is 163,000; 56 percent of farm sites have 70,000 or more layers, and 36.5 percent of farm sites have 100,000 or more layers. Two-thirds (63.9 percent) of farm sites have one flock, and one-third have two or more concurrent flocks; the average flock size is 63,000 birds (National Animal Health Monitoring System 1999).

Population Group II: Small Commercial and Other Industries

The remaining 10 percent of the production value for poultry and eggs occurs in what the NAISS describes as small-volume and high-value production. Production characteristics for many of these producers are undocumented, and production practices are diverse, including outdoor and free-range flocks. Contracting is unlikely. This industry segment produces poultry and eggs for commercial sales, although not through the same channels as described for large-volume commercial operations.

Upland Gamebirds and Raised-for-Release Waterfowl

Upland gamebirds include domesticated fowl such as pheasants, partridge, quail, grouse, and guineas, but not doves and pigeons. A total of 3,826 waterfowl, exhibition poultry, and upland gamebird breeder flocks participate in NPIP. These flocks account for 1.47 million birds. Raised-for-release waterfowl and upland gamebirds are raised for game preserves and are not considered breeding stock.

A total of 8 million pounds (live weight) of poultry other than chickens, turkeys or ducks were slaughtered in Food Safety and Inspection Service (FSIS) inspected plants, accounting for about 0.01 percent of total poultry slaughtered (NASS 2006a), though the proportion that is gamebirds is unknown. The proportion of upland gamebirds and waterfowl slaughtered on farm or sold for custom slaughter in smaller facilities, and not at federally inspected plants, also is unknown. Gamebird production is detailed in Table 3 (2002 Census of Agriculture).

Table 3. Gamebird Production (excludes raised-for-release).

Species	**Number farms**	**Number birds**	**Top States** (by # birds)
Pheasants	4,977	2,267,136	Wisconsin, Pennsylvania, California, New Jersey, Ohio, Minnesota, Kansas, Michigan
Pigeons or Squab	4,405	449,255	California, South Carolina, Texas, Washington, Kansas, Pennsylvania
Quail	3,742	4,888,196	Georgia, South Carolina, Alabama, Texas, North Carolina, Mississippi, California, Florida, Pennsylvania, Illinois

Although much of the upland gamebird industry focus appears to be on stocking hunting preserves and wildlife restocking, some producers sell meat and eggs of upland gamebirds, mainly in specialized gourmet markets. Some upland gamebirds are also raised for exhibition, and some farms sell day-old chicks (Iowa State University Agricultural Marketing Resource Center). Inherently, this industry has less strict biosecurity measures, because these birds are released into environments for contact with wild birds. Primary AI risk factors include movement of birds off property and exposure to wild birds.

Gamefowl Breeders

Gamefowl are breeds of chickens intended primarily for exhibition/competition and bred for visual characteristics, strength, health, vitality, and longevity. Nearly 9,000 gamefowl breeders in 34 States belong to the United Gamefowl Breeders Association (UGBA) or a State association not affiliated with

UGBA. Texas has the greatest number of UGBA members with 5,000; Georgia, Louisiana, and Alabama each have about 700 members.

Gamefowl breeding is a diverse industry where a wide array of practices occurs. In general, birds used for experimental purposes or to develop blood lines are penned with one rooster and one or two hens. Pullets, young hens intended for egg laying, are raised free-range until ready for production. Hens are allowed to forage on a free range in the winter when they are not producing. Spent hens—mature hens that have reached the end of their productive lives—are often sold at live-bird markets; younger hens that are no longer needed may be sold to another producer as brood hens (Mathews 2006).

Primary risk factors for exposure to AI viruses include: outdoor housing, exposure to wild birds, and movement of birds, particularly to shows, competitions, and exhibitions where other birds are present. According to a national survey of UGBA members conducted in 2004 (NAHMS Poultry ’04), nearly two-thirds of gamefowl flocks have 100 or more birds. Only 6.8 percent of premises are located within 1 mile of a commercial poultry operation. Over 90 percent of flocks are housed inside a barn or coop, although about half also have birds that were able to leave the property, and 82 percent of gamefowl breeder flocks have contact with wild birds. Ponds were present on 16 percent of premises, and wild bird feeders on 15.3 percent of premises. Movement of birds is common. New bird introductions to the gamefowl premises are primarily adult birds. Most frequently, introduced birds come from within the same State; 38 percent of flocks with new additions introduce birds from another State. Only 1.2 percent of gamefowl premises introduce birds from outside the United States.

Commercial Waterfowl

Commercial waterfowl are defined as domesticated ducks or geese grown under confinement primarily for producing meat for human consumption. Waterfowl production numbers are described in Table 4 (2002 Census of Agriculture).

Table 4. Waterfowl Production.

Species	Number of farms	Number of birds	Top States (# birds)
Ducks	26,140	3,823,629	Indiana, California, New York, Wisconsin, Pennsylvania, Texas
Geese	17,110	173,000	Texas, Indiana, Wisconsin, California, Iowa, Michigan, Minnesota, New York

The U.S. duck industry is widely dispersed throughout the country (Dean 1986) with production occurring in all 50 States (NASS), but FSIS slaughter data reports indicate that most commercial ducks are raised in Wisconsin and Indiana.

According to the Cornell University Duck Research Lab, (Cornell University 2006) commercial duck housing is either total or semi-confinement. Properly designed confinement housing will restrict contact with wild birds. Under a semi-confinement housing plan, ducks more than 2 to 3 weeks old are allowed outside during the day, and ducks over 4 weeks spend most of their time outdoors. Ponds are not required for commercial waterfowl production as long as the birds are provided ample clean, fresh drinking water and access to shade, if kept outdoors.

In 2005, 28 million ducks (188 million pounds live weight) were slaughtered in FSIS-inspected plants. This accounts for approximately 0.3 percent of all poultry slaughtered. Additional ducks may be slaughtered in non-federally inspected facilities and are not included in this total (United Egg Industry 2006).

Geese in commercial production are raised under cover until approximately 6 weeks of age. Brooding is done in a temperature-controlled environment. After this period, geese are kept on range, where they graze and are fed some supplemental grain for another 14 to 20 weeks, until slaughter.

Eight million pounds of other poultry (live weight) were slaughtered in federally inspected plants in 2005, although the number of geese included in that total is unknown (National Agricultural Statistics Service 2006a).

Risk factors for exposure to AI viruses are the same as for other poultry with similar management practices. An additional consideration for this poultry sector is that many AI viruses pathogenic to other poultry show few, if any, clinical signs in ducks and geese (Swayne and Suarez 2000). However, the exceptionally virulent Asian HPAI H5N1 virus generally causes clinical signs in these species (Webster *et al.* 2006).

Pastured, Free-Range, and Organic Poultry

The total number of farms that raise poultry as pastured, organic and free-range is unknown. A survey by NASS, which will target sites with 1,000 to 50,000 chickens, is planned for summer 2007. One goal of this survey is to estimate the population of chicken farms with outside access, particularly the numbers of pastured, organic and free-range farms.

Pastured poultry is a production system that involves raising chickens directly on pasture using moveable shelters. Birds receive up to 20 percent of their feed intake from pasture forage and are moved regularly to fresh pasture. Processing is often done on the farm, although larger producers transport birds to slaughter facilities. The American Pastured Poultry Producers Association (APPPA) identified 12 U.S. producers who raise 4,000 or more birds per year. The APPPA lists many smaller producers in most States.

In order to receive USDA “Free-Range” certification, producers must demonstrate to USDA that chickens raised for meat have daily access to the outdoors, although there are no industry guidelines for how long birds must remain outdoors (FSIS Fact Sheet, 2007).

"Certified organic" production means that the production methods meet the national standards established by USDA’s Agricultural Marketing Service, as certified by accredited State, private, or foreign organizations, or other approved certifying agents. The national standard requires that animals for slaughter must be raised under organic management from the last third of gestation, or no later than the second day of life for poultry. Producers are required to feed livestock agricultural feed products that are 100 percent organic, but may also provide allowed vitamin and mineral supplements. Organically raised animals may not be given hormones to promote growth, or antibiotics for any reason. Preventive management practices, including the use of vaccines, will be used to keep animals healthy. Producers are prohibited from withholding treatment from a sick or injured animal; however, animals treated with a prohibited medication may not be sold as organic. All organically raised animals must have access to the outdoors, including access to pasture for ruminants. They may be temporarily confined only for reasons of health, safety, the animal's stage of production, or to protect soil or water quality. In 2001, a total of 1.6 million laying hens, 3.29 million broilers, and 98,653 turkeys were certified organic (USDA/Economic Research Service 2001). Also, the 2002 Agriculture Census identified 1.6 million birds on 13,790 farms that do not fall into one of the other poultry categories discussed above.

Population Group III: Live-Bird Marketing System

Live-bird markets are part of a complex marketing system that provides a source of fresh poultry meat often preferred by ethnic populations (Senne *et al.* 2003). Customers select live birds that they wish to purchase and the birds are then individually slaughtered and prepared according to the customer's specifications. The NAHMS Poultry '04 LBMS study showed 87 markets in New York, 44 markets in Southern California (mostly custom exempt slaughter), 33 markets in New Jersey, 31 in Florida, (mostly botanicas[4]), 11 in Pennsylvania/New England, and 9 in Texas. As of 2004, those States accounted for the majority of live-bird markets in the United States.

The LBMS includes the live-bird markets and their production and distribution systems. Birds entering the LBMS come from a variety of sources, including farms that raise birds specifically for live-bird markets, backyard flocks, and spent hens from smaller layer farms. While some markets receive birds directly from farm deliveries, most receive birds from distributors or wholesalers who collect birds at the farm and deliver them either to distribution centers, where the shipments are mixed to fill orders, or directly to markets.

Population Group IV: Backyard Flocks

For the NAISS, a backyard flock is defined as a premises having fewer than 1,000 birds, other than pet birds (NAHMS Poultry '04). Exact estimates for the number of backyard flocks are unavailable.

According to a 2004 NAHMS study, the average backyard flock size is 35 birds, with more than half of flocks numbering fewer than 20 birds. Some common types of birds are table-egg laying chickens, gamefowl, ducks, meat-type chickens, guinea fowl and gamebirds. Approximately 20 percent of backyard poultry flocks include ducks. A total of 8.7 percent of backyard flocks report having waterfowl other than ducks. While nearly one in four backyard flocks have gamefowl, they account for only 10 percent of backyard birds, indicating that gamefowl flocks tend to be smaller than the average flock.

Backyard flock owners rarely use the services of a veterinarian (2.9 percent). Primary risk factors include: exposure to wild birds, birds leaving the property, ponds that attract wild waterfowl, and minimal biosecurity practices.

The NAHMS Poultry 2004 study determined that on average there are 1.9 backyard flocks located within a 1-mile radius of commercial poultry operations. In 47.1 percent of the flocks, birds are housed in a manner that allows them to leave their property. Two-thirds of flocks have contact with wild birds. Footwear precautions are rarely used (11.4 percent). For sites with backyard flocks, 38.4 percent have ponds on the property (most common in Midwest) and 40 percent have wild-bird feeders. Although biosecurity practices are minimal, bird movement and interaction are also uncommon. Only one-third of flocks reported new flock additions in the year, most commonly from a private individual and generally from the same county. Only 17.8 percent of flocks sell or give away live birds. Movement to fairs, shows, and other events where other birds were present is extremely rare (3.6 percent of flocks), and these events are mostly within the same county or within the State (NAHMS Poultry '04).

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[4] Botanicas are markets that sell birds primarily for ritual slaughter.

Population Group V: Migratory Waterfowl and Shorebirds

Waterfowl originating in Asia and Europe that travel to North America through migratory pathways have the potential to introduce Asian HPAI H5N1 into migratory and resident North American wild bird populations. Thus, North American migratory waterfowl that spend part of their life cycle in Asia or Europe have become a primary target of sampling efforts designed to detect the presence of Asian HPAI H5N1 should it be introduced into North America. Additionally, although Asian HPAI H5N1 has not been observed in the western hemisphere, concern about species that migrate between the America's has also been structured the current sampling effort. Because dabbling duck and goose populations have life history characteristics that lend themselves to maintenance and spread of avian influenza sampling has focused primarily, though not exclusively, on these groups. Further, experimental infection in mallards (Sturm-Ramirez et al. 2005) has shown variability in the pathogenicity of Asian strain H5N1 isolates, with some virus isolates that were nonpathogenic in ducks being replicated and transmitted efficiently to immunologically naïve contacts. This suggests that highly pathogenic H5N1 viruses causing minimal signs of disease in ducks could spread to domestic poultry and human populations. To address concerns over introduction of Asian HPAI H5N1 into the United States, USDA/APHIS Wildlife Services and to a lesser extent the Department of Interior, have implemented surveillance in numerous species of wild birds in all 50 States.

Population Group VI: Zoos and Exhibited Animals

The Association of Zoos and Aquariums (AZA) Web site (www.aza.org) reports that as of 2005, a total of 57,115 individual birds were housed in the 210 facilities accredited by the AZA. Bird populations at zoos and exhibitions vary widely in kind. Additionally, housing and enclosures for birds vary as well.

H. Case Definition

A comprehensive case definition for notifiable avian influenza surveillance in the United States includes clinical and laboratory diagnostic criteria for both active and passive surveillance (National Surveillance Unit). Recognition of clinical sign combinations and gross lesions is an essential component of passive and active observational surveillance. Recognition triggers the reporting of suspicious cases for further investigation and enables appropriate control measures to be taken rapidly and efficiently (Kradel *et al.* 1986, Weaver *et al.* 2006). Laboratory confirmation is necessary for index cases.

Clinical Description

Clinical signs noted earlier in this document (Part A: Disease Description) provide the trigger for sampling and laboratory testing to determine if the illness or mortality is one of the more virulent strains of the AI virus. In the case of Asian HPAI H5N1, high mortality with overt clinical signs has been the predominant clinical presentation of the disease. The clinical manifestations and mortality from other NAI H5/H7 infections can vary considerably depending on species, age, sex, concurrent infections, virus strain, and environmental conditions. The digestive, respiratory, nervous, reproductive, or circulatory systems may be affected. Infection with few or no clinical signs may also occur with H5/H7 LPAI. Such infections can only be detected by planned surveillance programs. The clinical definition below describes several of the clinical manifestations of NAI viruses that may characterize an outbreak, although some strains of HPAI and many strains of LPAI may not show overt disease manifestations that would be detected by direct observation of clinical signs. Due to this characteristic, passive and active surveillance are supplemented by active serologic surveillance.

Clinical Definition

The clinical definition in addition to the laboratory criteria will help correctly diagnose NAI H5/H7 in the United States in commercial poultry, the LBMS, or in non-traditional poultry production systems, such as backyard flocks, which are distinct populations. Meeting the clinical definition is generally the first screening tool that triggers testing when clinical signs are present. Domestic poultry meeting the clinical case definition for NAI H5/H7 are those with one or a combination of the following clinical signs and gross lesions: reduction in normal vocalization; listlessness; conjunctivitis; drops in egg production sometimes with pale, misshapen or thin-shelled eggs; respiratory signs such as rales, snicking, and dyspnea; neurological signs such as incoordination or torticollis; a drop in feed and/or water consumption; swollen or necrotic combs and wattles; swollen head and legs; subcutaneous hemorrhage of legs; lungs filled with fluid and blood; tracheitis and airsacculitis; petechial hemorrhages on internal organs (Easterday *et al.* 1997); ***or,*** flocks that experience mortality as listed for each population group as follows (Weaver *et al.* 2006):

- Commercial broilers: mortality exceeding 4 birds/1,000 per day for 2 consecutive days;
- Commercial layers: 4 times normal daily mortality for 2 consecutive days (0.5 per 1,000 per day for layers from 2 to 50 weeks and 0.75 per 1,000 per day for layers over 50 weeks) or 5 percent drop in egg production over 3 days;
- Commercial turkeys: mortality in excess of 2 birds/1,000 per day; and
- Backyard flocks: any sudden and significant mortality event or sudden drop in egg production should be investigated.

Depending on the pathogenicity of the virus, birds raised on litter may experience rapidly spreading mortality. Mortality in birds reared in cages (e.g., layers, quail) may progress more slowly over a 10- to 15-day period (Swayne 2006).

Epidemiological Criteria and Restrictions

In a case definition, criteria are provided which clearly define the population (s) of interest under surveillance. Surveillance is therefore restricted to certain herds, flocks, or premises that possess specific epidemiological characteristics. Surveillance within the commercial, LBMS, and backyard population groups is accomplished through industry, State, and Federal programs.

- Commercial poultry breeder surveillance (including many gamebird breeders) is conducted through the NPIP.
- Commercial meat-type chicken and meat-type turkey surveillance is an industry initiative of the National Chicken Council and National Turkey Federation that meets or exceeds the proposed NPIP commercial surveillance program.
- LBMS surveillance occurs through cooperative agreements between APHIS and participating State animal health officials. The federally administered program is designed to enhance and unify State programs and to assist States in meeting their goals for prevention and control of H5/H7 LPAI in the LBMS. State programs often exceed APHIS minimum standards.
- Surveillance of the non-traditional backyard flocks occurs through individual State surveillance programs in cooperation with USDA/APHIS.

Laboratory Criteria for Diagnosis

Sub-clinical infections identified through active laboratory surveillance or clinical cases with compatible clinical signs and pathologic lesions in a susceptible species are evaluated using laboratory criteria for HPAI and LPAI defined by one or more of the following diagnostic assays:

- Isolation of virus from sample material inoculated into embryonated fowl eggs[5] and confirmation of the presence of influenza A virus by hemagglutination activity; AND
- Determination of H5/H7 subtype by hemagglutinin and neuraminidase inhibition testing; AND
- Classification of the isolate as HPAI by having an intravenous pathogenicity index greater than 1.2 or by causing at least 75 percent mortality within 10 days in 4- to 8-week-old chickens infected intravenously; OR, if no mortality occurs,
- Determination of the base sequence of the hemagglutinin precursor protein (HA0) cleavage site to identify viruses that have the capacity to become highly pathogenic.
- If H5 or H7 subtypes do not meet the criteria for HPAI, they are classified as H5/H7 LPAI.

Assumptions

- Influenza virus may be detected 48 hours post infection (HPAI by 24 hours post infection) by RRT-PCR (Spackman 2006) and 1-5 days post infection by antigen capture enzyme immunoassay (AC-EIA) (Gelb and Ladman 2006).
- RRT-PCR tests on samples containing fecal material (i.e. cloacal swabs) lack sensitivity compared with the high sensitivity and specificity relative to virus isolation for tracheal samples.

Case Classification for NAI

Suspect Case: A tentative diagnosis of NAI based on the clinical case definition in consultation with State animal health officials and APHIS' area veterinarian in charge; ***or*** positive laboratory samples taken during routine surveillance with or without the presence of clinical criteria.

Presumptive Case: Meets the suspect criteria and one of the following criteria:

- Detection of antibodies[6] to influenza A in sera as determined by the AGID serological test that cannot be explained by vaccination; and subsequent subtyping by hemagglutination inhibition and identification as H5 or H7; or
- Detection of influenza A antigen using a commercially available influenza A antigen detection kit approved by the NPIP administrator and determination is H5/H7 (USDA); or,
- Identification of influenza A RNA by RRT-PCR[7] and determination of subtype as H5/H7.

Confirmed Index Case: Isolation of an influenza A virus and identification as an H5 or H7 subtype (NAI) and subsequent determination of pathogenicity (HPAI or H5/H7 LPAI) by USDA's National Veterinary Services Laboratories.

Required Reporting

NAI H5/H7 infections in commercial poultry should be reported in accordance with APHIS Veterinary Services Memorandum No. 580.4, "Procedures for Investigating a Suspected Foreign Animal Disease/Emerging Disease Incident (FAD/EDI)" and Veterinary Services Memorandum No. 565.14, "Reporting Detections of Low Pathogenic Notifiable Avian Influenza (H5 and H7 Subtypes) to the World Organization for Animal Health (OIE) and to Trading Partners." In addition, on concurrence of State animal health officials and APHIS' area veterinarian in charge, State animal health officials should report the presence or absence of NAI in commercial poultry to USDA through the National Animal Health Reporting System (NAHRS), following NAHRS and OIE guidelines.

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[5] Tracheal or cloacal swabs (or feces) from live birds; or feces and pooled organ samples from dead birds: trachea, lungs, air sacs, intestine, spleen, kidney, brain, liver, and heart inoculated in embryonated fowl eggs (OIE 2005).
[6] Antibodies may be detected as early as day 7-10 post infection in birds raised on litter. An acute serum sample should be taken as soon as clinical signs are evident, and a convalescent sample should follow 7 to 28 days later.
[7] Cloacal or tracheal swab or environmental samples (Live Bird Marketing System).

I. Sampling Methods

Active laboratory surveillance for NAI involves periodic sampling of flocks and/or their environment (premises) to detect the presence of antibodies or antigen. Active laboratory surveillance is used to detect circulating LPAI H5/H7 virus in poultry or waterfowl in the absence of high mortality and would also detect any virus of the H5 or H7 subtype. Tests that detect antibodies (serology) are sensitive during the period that antibodies are circulating in the birds. The antibody titer rises to detectable levels in 7–10 days after infection and declines after several months. These assays are valuable because they can detect evidence of disease for a period spanning several months; however, if there are indications of several infections, they cannot determine the most recent infection, nor can they indicate if virus remains in the flock. Tests for antigen (virus protein) are sensitive as long as circulating virus is present. Since AI virus is generally only shed for about 10 days in infected poultry, its utility is high for current infections but declines as virus circulation decreases in the flock. The utility of active laboratory surveillance for the detection of the HPAI is also limited because these viruses typically cause overt and severe clinical signs that are easily detected by observation of affected poultry.

Active observational surveillance is the active effort to detect evidence of disease through observation rather than laboratory sampling. Growers whose commercial interests are directly tied to disease prevention and biosecurity practices actively observe production flocks on a scheduled basis in order to detect and report certain disease syndromes to flock service personnel or industry veterinarians. Active observational surveillance is similar to active laboratory surveillance in that it is ongoing and follows a pre-planned schedule; however, the screening test is the observation of clinical signs. It has the advantage over laboratory types of surveillance in that the “test” is the observation looking for clinical signs and is done very frequently—generally once or twice daily in large-volume commercial poultry operations. Its utility is highest for diseases that show overt clinical signs such as HPAI, and is used as a trigger for further investigation and laboratory sampling. Virtually all large-volume commercial operations use active observational surveillance to detect a multitude of diseases, including diseases that have signs compatible with AI viruses. Many of the other industry sectors, such as small-volume high-value flocks and backyard flocks, also use active observational surveillance, but there is no industry standard, and documentation of management practices is not readily available.

Passive surveillance is used by all industry sectors and involves concerned individuals reporting suspicious mortality or clinical signs. It differs from active observational surveillance in that it is not an ongoing, frequently scheduled practice. The likelihood of voluntary reporting varies with flock owners, disease awareness, laboratory cost, and rate of mortality within the flock.

Surveillance methods vary depending on the bird populations described in the NAISS components. Active laboratory surveillance (i.e., serologic or antigen detection surveillance) is conducted in commercial poultry flocks, the LBMS, and in high-risk migratory bird populations using different types of diagnostic tests, depending on surveillance objectives.

The objective of active laboratory surveillance in commercial poultry is to detect circulating H5/H7 LPAI and to prevent its persistence within poultry flocks, thereby eliminating opportunities for mutation of these viruses into HPAI. Serology is the most common test method used to identify evidence of infection in long-lived commercial flocks.

Active laboratory surveillance of migratory birds in migratory flyways is aimed at detecting the introduction of Asian HPAI H5N1 virus into the United States. Migratory bird surveillance uses antigen detection testing.

In the LBMS, production flocks are evaluated using serology; short-lived flocks of birds for sale in markets are tested for the presence of viral antigen; and environmental swabs of market premises are tested for persistent viable virus. For all active laboratory surveillance efforts using antigen testing, follow-up methods are used to identify presence of Asian HPAI H5N1 virus.

Detection of HPAI in commercial poultry relies largely on the reporting of high morbidity or mortality disease events followed by subsequent investigation to identify cause. Laboratory testing is carried out in such cases, not for early detection purposes, but to confirm HPAI and virus sub-type.

Because of HPAI's high mortality rate and ability to rapidly infect birds, active laboratory surveillance—as a surveillance method—is not effective as an early detection tool for HPAI. With the exception of migratory bird surveillance/testing for HPAI, USDA's active laboratory surveillance in the United States is largely focused upon detecting H5/H7 LPAI.

Under the new voluntary NPIP H5/H7 LPAI prevention and control program, participants are responsible for submitting laboratory samples to federally approved diagnostic laboratories from any cases of unexplained avian respiratory disease, egg production drops, and mortality suspicious for AI. Diagnostic surveillance programs developed under the NPIP's new prevention and control program require H5/H7 LPAI to be a disease reportable to the State veterinarian.

Serum samples are initially screened using an ELISA antibody detection assay or the AGID assay; samples found positive by the ELISA assay are confirmed by the AGID assay. Samples found positive by either antibody assay lead to follow-up investigations, which may include sampling from the originating flock for virus isolation and sample submission to USDA's National Veterinary Services Laboratories for sub-type and pathogenicity determination. AI antigen RRT-PCR assay to detect H5 and H7 subtypes are conducted in federally approved diagnostic laboratories. All H5 or H7 subtypes identified are further analyzed to determine pathogenicity associated with high mortality HPAI strains, such as the Asian HPAI H5N1 subtype.

Sampling for active laboratory surveillance is performed primarily through cooperation among commercial producers and Federal and State government. The following factors complicate the description of the sampling methods:

- Differences exist in the level of participation. For example, because not all States have live-bird markets, not all States maintain LBMS programs. In addition, although NPIP programs are established in all 48 States with significant commercial poultry flocks, not all producers participate in NPIP programs.

- The sampling methods employed in each subpopulation of U.S. domestic poultry are based on a set of minimum standards (CFR Title 9, Parts 145, 146 & 147). Each State program agrees to meet the minimum requirements, but may elect to collect additional data. The descriptions and analysis here describe only the minimum standards.

- Although only certain testing assays are approved for use in these surveillance programs, not every participating laboratory is approved to perform all of the assays. Therefore, testing schemes are not uniform across the nation National surveillance is dependent on varying individual State plans, which consider accessibility to the laboratories approved for particular assays

- Although their use in State programs for H5/H7 LPAI surveillance has been approved, no minimum standards have been established for the sampling scheme for programs planning to use the antigen detection assays (RRT-PCR and ELISA antigen detection assay) in commercial meat-type chickens. Some companies are choosing to use antigen tests pre-slaughter to meet FSIS requirements in order to avoid testing finished product. These companies follow the sampling scheme for antigen screening that is described in 9 CFR Part 146, LPAI H5/H7 Voluntary Control Program, which was developed for antibody screening. Meat-type chicken flocks are tested within 10 days of slaughter.

The role of slaughter surveillance has not been discussed in this document, because it is difficult to assess the efficacy of this surveillance. However, the vast majority of all meat-type poultry grown by the large- and small-volume producers is inspected at slaughter by FSIS or State inspection agencies. Birds that exhibit signs of respiratory infection such as airsaculitis are either salvaged or condemned, depending on disease severity and producers are made aware of the percentage of condemnations in each consignment. Unusually high percentages of lesions or condemnations lead to investigation of the source of infection by industry veterinarians or flock service personnel.

Part 2: Surveillance Programs, Data Management and Analysis

Under the NAISS, AI surveillance is conducted through many different channels, targeting multiple populations of susceptible species. This section of the document describes the populations under surveillance and the types of surveillance conducted in each. It is organized by the following four areas of concentrated surveillance under the NAISS' components:

- National Poultry Improvement Plan;
- Prevention and control of H5 and H7 LPAI in the LBMS;
- Backyard Poultry; and
- Migratory Waterfowl and Shorebirds.

APHIS relies on a variety of voluntary State and commercial programs to monitor and test domestic poultry, and efforts to obtain more information about State surveillance programs through alliances and partnerships with multiple government agencies and private entities are underway. All of these activities generate useful surveillance data, whether they result from structured population-based surveys or from non-random data sources.

A. National Poultry Improvement Plan

Egg-Type Chicken, Meat-Type Chicken, and Turkey Breeder Flocks

Active laboratory surveillance for AI in participating breeder flocks is presently conducted through the NPIP disease control provisions for breeding poultry as described in 9 CFR Part 145. The plan provides for a "U.S. Avian Influenza Clean" classification for table-egg layer breeding flocks in § 145.23(h) and for meat-type chicken breeding flocks in § 145.33(l). For turkey breeding flocks in § 145.43(g), the status of "U.S. H5/H7 Avian Influenza Clean" is awarded for participating flocks. These active surveillance programs are used to certify baby chicks, poults, and hatching eggs for interstate commerce or export from the United States. The plan identifies States, flocks, hatcheries, and dealers that meet certain disease control standards specified in the plan's various programs. As a result, customers can buy poultry that have tested clean of certain diseases or were produced under appropriate disease-prevention conditions. Participation numbers for NPIP are published annually by the NPIP staff and presented to the United States Animal Health Association.

For primary flocks, 30 birds per flock are tested at 4 months of age and then at 90-day intervals. For multiplier flocks, 30 birds per flock are tested at 4 months of age and then at 180-day intervals. Upon meeting program criteria, Avian Influenza Clean or H5/H7 Avian Influenza Clean status is awarded. Testing 30 birds per flock provides 95 percent confidence that AI is not present at a prevalence of 10 percent or greater (Cannon and Roe 1982). This assumes a test with perfect sensitivity, and either that birds are selected at random or the disease is randomly distributed throughout the flock. Testing policy and oversight are described in **Data Sources** section below.

Waterfowl, Exhibition Poultry, and Gamebird Breeder Flocks

Surveillance for LPAI in breeding flocks for raised-for-release waterfowl, birds for exhibition and gamebirds is covered under 9 CFR Part 145.53, with participating flocks awarded “H5/H7 Avian Influenza Clean” classification. In waterfowl, exhibition, and gamebird primary breeder flocks, 30 birds per flock are tested at 4 months of age and then at 90-day intervals. Upon meeting program criteria, H5/H7 Avian Influenza Clean status is awarded. Testing 30 birds per flock provides 95 percent confidence that AI is not present at a prevalence of 10 percent or greater (Cannon and Roe 1982). This assumes a test with perfect sensitivity and the random selection of birds from the flock.

Pending the rulemaking process and public comments that are received, NPIP may be adding provisions covering AI testing in the raised-for-release and commercial waterfowl and gamebird industries. The proposed change was approved at the 38th Biennial Conference of the NPIP in September 2006. The proposed sectors to be covered are defined as:

- Raised-for-Release Upland Gamebirds: Pheasants, quail, and partridge that are raised under confinement for release in game preserves and are not breeding stock.

- Raised-for-Release Waterfowl: Waterfowl that are raised under confinement for release in game preserves and are not breeding stock.

- Commercial Waterfowl or Commercial Upland Gamebirds: Domesticated ducks or geese or pheasants, quail, and partridge grown under confinement for the primary purpose of producing meat for human consumption

The program proposes to add “H5/H7 Avian Influenza Monitored” status for raised-for-release upland gamebirds, raised-for-release waterfowl, commercial waterfowl, and commercial upland gamebirds. Once finalized, the regulations and surveillance program will appear in 9 CFR Part 146.53. For the raised-for-release industries, 30 birds from the participating premises must be tested for the H5/H7 subtypes of AI every 90 days. For commercial waterfowl and upland gamebirds, participating slaughter plants will test 11 birds per shift for H5/H7 subtypes of AI; alternatively, they can test 11 samples within 21 days prior to slaughter or have an ongoing active and passive surveillance program approved by the Official State Agency and APHIS.

Before publication of these provisions, APHIS entered into cooperative agreements with some States in FY 2006 to initiate testing in raised-for-release upland gamebirds (NPIP CA) and raised-for-release waterfowl (LBMS CA). In order to contact and gain access to these types of flocks and operations, the State agricultural agency cooperates fully with appropriate State wildlife agencies that license hunting preserves and gamebird farms and the North American Gamebird Association. This testing is reported to regional offices on a quarterly basis to each State with a cooperative agreement.

Commercial Meat and Egg Production Flocks: Interim Rule Published September 26, 2006

NPIP has amended the regulations to establish a voluntary program for the control of the H5/H7 subtypes of LPAI in commercial poultry, adding a new Part 146 in 9 CFR. Participation in the new NPIP LPAI H5/H7 control program for the commercial industry will continue to be voluntary. The control program consists of three aspects: active surveillance, passive surveillance and initial State response and containment plans for H5/H7 LPAI.

The active surveillance portion of the program (9 CFR Part 146, LPAI H5/H7 Voluntary Control Program) includes testing in commercial table-egg layer, meat-type chicken (broiler) flocks, and meat-type turkeys. For commercial table-egg layer flocks, 11 birds or eggs per flock are tested once every 12 months or at 30 days prior to disposal for commercial table-egg premises with more than 75,000 birds. For commercial broiler flocks, 11 birds per shift are tested at slaughter, or 11 samples no more than 21 days prior to slaughter for meat-type chickens associated with a plant that slaughters at least 200,000 birds per week. For commercial turkey flocks, 60 birds with respiratory signs from flocks over 10 weeks of age are tested monthly at federally inspected plants that slaughter more than 2 million birds annually. Upon meeting program criteria, H5/H7 Avian Influenza Monitored status is awarded. An 11-bird sample provides 95 percent confidence that AI is not present in the population at a prevalence of 25 percent or greater (Cannon and Roe 1982). This assumes a test with perfect sensitivity, and either that birds are selected at random or that the disease is randomly distributed throughout the flock. Testing policy and oversight are described in **Data Sources** section below.

Prior to recent publication of the NPIP regulations noted above, the National Chicken Council initiated a voluntary broiler program. Currently, 37 companies are sampling and testing all of their meat-type chicken flocks within 2 weeks prior to slaughter. This represents approximately 98 percent of U.S. broiler production. With the publication of the NPIP H5/H7 LPAI program, the companies will participate under NPIP to leverage the international reputation of NPIP. We expect that at least 90 percent of commercial poultry operations that meet the size standards will participate. This is similar to the participation level in the current programs for breeding flocks, in which we have a nearly 100 percent participation level from chicken and turkey companies. With the proposed surveillance levels, a 90 percent participation rate would accomplish the program's goals.

Data Sources

NPIP programs are established in 48 States. Because Alaska and Hawaii do not maintain significant commercial poultry operations, they do not have NPIP programs. Individual States maintain testing data for the programs and participation in the NPIP program is voluntary. All NPIP testing is conducted in NPIP authorized laboratories, which can be State-affiliated or private/industry laboratories. All NPIP-authorized laboratories are required to report testing data to the official State agency by which they are authorized. USDA's National Veterinary Services Laboratories diagnosticians promptly report positive laboratory findings for NAI to State and Federal regulatory officials.

States receiving NPIP cooperative funding for LPAI submit quarterly reports to APHIS' Veterinary Services regional offices. These reports provide summarized flock testing data for certain NPIP programs (i.e., number of participating table-egg layer flocks; meat-type chicken and turkey slaughter plants; egg- and meat-type chicken breeding flocks; turkey breeding flocks; waterfowl, exhibition poultry, and gamebird breeding flocks; number of samples collected and tested; and number of inspections.) Official State agencies report flock testing data annually to the NPIP national office, where an APHIS data collection system is maintained. Currently, the official State agencies overseeing the program maintain surveillance data for poultry tested through the NPIP program. APHIS' Centers for Epidemiology and Animal Health (CEAH) personnel are developing new modules to facilitate integration of NPIP AI surveillance data (please see Appendix F).

Currently, accurate population numbers for all of the industry segments covered in the NPIP program are not available. Therefore, it is difficult to assess the proportion of the Nation's poultry populations that is participating, making it also difficult to determine representativeness of the data to the entire domestic poultry population. In addition, reporting to the national NPIP office is only done annually and requires NPIP staff to manually re-enter much of the data into a local NPIP database. Due to limitations of available resources and delays in reporting from States to the national program office, timely evaluation of surveillance data gathered through this collection system is difficult. The development of the new NPIP data collection system modules described above will modernize the NPIP reporting system by improving the reliability and timeliness of data collection and providing online tools for authorized program participants, State agencies and APHIS staff. Because of the sensitivity of some data that will be maintained in the NPIP system, select summary data in this system will also be housed within the AVHS. Data from the NPIP reporting system will only be forwarded into the AVHS after evaluation and approval by an authorized State official.

Data generated through testing in NPIP-approved laboratories will be provided to the Avian Health Surveillance (AVHS) database as summary data, whereas data generated through testing in NAHLN-approved laboratories will be provided at the individual animal level. The specific data available to authorized participants will vary and depends on their defined role in the NAISS.

All follow-up investigations to presumptive positives for H5 or H7 will be entered into the APHIS Emergency Management Response System (EMRS). Any illness seen in poultry that is "highly likely" to be HPAI due to clinical signs will be entered into the EMRS and not the AVHS.

Data Analysis and Interpretation

The NPIP surveillance strategy is effective within the limitations of the tests and assumptions on which the sample size estimates are based. However, test protocols that detect antigen only provide information for the time that the birds are shedding virus (generally about 7-14 days after exposure), while serologic tests for antibodies provide information for the past several weeks to months, but not for the most recent 7-14 days while the immune response is developing. The limitations of the test protocols are partly mitigated by the likelihood that an infected flock would probably have virus circulating for quite some time, so that seropositive or antigen positive birds would more likely be detected.

Laboratory surveillance sampling methods obviously have low utility for rapid detection of HPAI because the interval of testing covers several months and any virus capable of causing high mortality and morbidity would be detected primarily by observation. For low pathogenicity NAI viruses, clinical signs may not be evident and must be detected by laboratory based testing. LPNAI results in less immediate risk to the poultry industry and public health, so the surveillance strategy focuses instead on detecting circulating strains to reduce the opportunity for mutation to HPAI.

For H5/H7 LPAI or HPAI viruses that cause few clinical signs, these surveillance methods are the only effective means of detection. Active laboratory surveillance provides a high degree of confidence in detection if the prevalence of detectable disease is high (25 percent within flock), but the window of detection may be as long as the sampling interval. That is, samples taken once every 180 days cannot be expected to consistently detect disease in less than 180 days.

Because most of the small-volume high-value commercial sector is not currently under NPIP sampling protocols, little information is available for surveillance based on laboratory test results. The primary surveillance methods include passive surveillance (delivering dead birds to diagnostic laboratories or veterinarians) and in most cases, active observational surveillance. We believe that most, but not all, of the small-volume high-value industry producers monitor flocks daily for disease. Because of their value, it is likely that the owners would seek help and that the detection window for HPAI would be similar to that for large-volume commercial flocks. However, standard management practices for biosecurity and AI prevention are not as clearly documented as in large-volume commercial industry NPIP participants or State equivalent plans; many of the flocks in this category represent birds raised outdoors and, in some cases, with exposure to bodies of water where migrating waterfowl may be found. Although surveillance in this component of national AI surveillance is driven by the economic value of flocks, reporting and sample collection is voluntary in nature. Diagnostic labs that test positive samples for NAI H5 or H7 are required to forward samples to the NVSL for confirmatory testing.

Part of this small-volume high-value poultry sector is composed of domestic waterfowl (e.g., ducks, geese) that generally do not show clinical signs of AI or, in the case of Asian HPAI H5N1, demonstrate lower mortality than other poultry (Hulse-Post *et al.* 2005; Sturm-Ramirez *et al.* 2005). These factors increase the risk of infection and, in the case of ducks and geese, decrease the efficacy of passive surveillance or active observational surveillance systems. Active laboratory surveillance methods must be used in domestic ducks to detect the presence of Asian HPAI H5N1 (Tumpey, *et al*. 2002).

We believe that current surveillance in the small-volume high-value commercial poultry sector would identify an outbreak of HPAI H5N1, but in the worst case, the outbreak could be ongoing for several weeks and could spread to multiple flocks before detection. Therefore, enhanced surveillance in the small-volume commercial sector would likely result in earlier detection and thus reduce the consequences of an outbreak. APHIS' Veterinary Services is currently using methods similar to those used to locate poultry dense production areas described in Appendix C to locate areas with high densities of small-volume high-value production flocks. Once located, flocks could be sampled by active observational or active laboratory surveillance. Such enhancements to surveillance in the small-volume high-value poultry population sector are covered in more detail in the summary section on pages 45 through 47. Surveillance may already be in place through diagnostic laboratories that service specific industry sectors or other State surveillance programs.

B. Prevention and Control of H5 and H7 LPAI in the LBMS

Surveillance occurs in each of the three components of the LBMS: the production flocks, the distribution system, and the live-bird markets. AGID or RRT-PCR methodology is used to test samples from production flocks. RRT-PCR or virus isolation (VI) is used to evaluate specimens collected from birds in the distribution and marketing components of the system. VI is used for environmental samples (Table 5).

Table 5. Sampling methods for the Live-Bird Marketing System.

Population	Subgroup	Sampling methods (# tested)	Frequency and interval
Live-Bird Marketing System Production Flocks	AI monitored flock	30 birds	Monthly for 3 consecutive months; if all test negative then at least quarterly testing thereafter
	Established flock	30 birds	Within 10 days prior to movement
	Commingled flock	30 birds	Birds must be held for 21 days after the addition of untested birds to the flock and then tested for AI
	Non-monitored flock	30 birds	Within 10 days prior to movement
Live-Bird Marketing Distribution System	Haulers Wholesalers Distributors	Birds Environment Conveyances such as crates and vehicles	At least quarterly
Live-Bird Markets	Custom slaughter Botanicas Live-bird retail markets	Live birds or the LBM environment Swabs or tissues from sick or dead birds	At least quarterly; if positive, monthly for 3 consecutive months; if all test negative then at least quarterly testing thereafter

Environmental samples usually consist of swabs taken from floors, drains, kill areas, and any areas where birds may be housed on the floor. States establish sampling protocols based on APHIS' Veterinary Services program standards. Currently a total of 31 States participate in the LPAI-LBMS surveillance programs through cooperative agreements.

Data Sources

The voluntary H5/H7 LPAI LBMS programs currently are established in 31 States, with expansion expected in FY 2007. Similar to the voluntary H5/H7 LPAI NPIP program, data is collected and test results are maintained in individual States, with summary reports provided to the USDA APHIS regional offices on a quarterly basis. These reports are subsequently input into a master system that maintains regional data, to be forwarded into the AVHS. USDA regional offices maintain data for LBMS programs. The efficiency of the reporting has varied, with some reports submitted on paper and others electronically. Recently, an electronic surveillance reporting tool was developed and implemented for each State to use in reporting to the regional offices.

Data Analysis and Interpretation

Since 1987, extensive surveillance has been conducted in the LBMS to identify circulating viruses. Surveillance activities were reviewed in 2003 (Senne *et al.* 2003). Each year since 1994, between 1,457 and 8,120 tracheal and cloacal swab pools were collected from live-bird markets in the northeastern United States and tested for the presence of AI virus by virus isolation. During the period from 1994 to 2003, between 30 and 808 isolations of AI virus H7N2 were made each year from live-bird markets in the northeastern United States (Senne *et al.* 2003). A separate study of two States in 2001 found AI in chickens in 49 of 81 (60 percent) of the New York and 12 of 28 (43 percent) of the New Jersey markets (Henzler *et al.* 2003).

A NAHMS 2004 study[8] on biosecurity practices in the LBMS found that the North region performed market surveillance more frequently; 98.4 percent of markets were tested at least once, and 86.4 percent of markets were tested four or more times between March 2004 and March 2005 (NAHMS 04). In the South region, 83.1 percent of markets were tested at least once, and 18 percent were tested four or more times during the year. H5/H7 subtypes of AI were not found in any markets that had only one testing occasion during the year. Markets in the North region tested positive for H5 or H7 LPAI at 14.6 percent of the testing visits and no markets in the South region tested positive for H5/H7 at any time during the year.

Live-bird market surveillance has demonstrated that it is capable of detecting H5/H7 viruses, but not how likely it is to detect every outbreak. The data suggest that markets tested only once per year rarely reveal infection, while those tested multiple times frequently detect viruses. Large differences in the frequency of detection as a function of the number of rounds of testing indicate that the system sensitivity is near 0.5 (Cannon 2002). This suggests that market tests should be conducted two or more times per year. The uniform standards developed for the program have addressed frequency of sampling in the LBMS to promote early detection of H5/H7 LPAI. Participating States are required to test distributors and retail markets at a minimum of every 3 months (or more frequently) and flocks from producers who supply birds to markets should be tested monthly.

Testing in Other Components of the LBMS

Under newly implemented cooperative agreements, States are asked to report quarterly surveillance data on all parts of the market system to USDA. The number of production units, distribution units, and market units inspected and tested will be reported by test type as well as population census estimates for facilities tested. We assume, given the sampling strategy, that this testing will detect most AI virus events but have not had the opportunity to evaluate data due to the recent implementation of the surveillance. Positive laboratory findings for NAI are promptly reported to State and Federal regulatory officials by NVSL. USDA then notifies the OIE.

C. Backyard Poultry

Backyard flocks are those flocks not included in the populations of high-volume or small-volume commercial poultry (backyard poultry flocks with small-volume commercial characteristics are monitored under the NPIP), flocks marketed through the LBMS, or migratory birds and waterfowl. Backyard poultry flocks are presumed to be at greater risk of acquiring NAI because husbandry practices associated with such flocks may increase the likelihood of environmental exposure to NAI. Furthermore, backyard poultry flocks may be more likely to transmit NAI to other flocks via movement of birds from these premises (Table 6).

[8] In the study, the North region included: New York, New Jersey, New England, and Pennsylvania. New England included: Massachusetts, Maine, Vermont, New Hampshire, Connecticut, and Rhode Island. The South region included: California, Florida and Texas.

Table 6. Risk factors thought to influence NAI disease risk for backyard poultry.

Environmental Exposure	Movement
Premises located near (within 2 to 5 miles) natural wetland areas where waterfowl congregate (i.e. U.S. Fish and Wildlife Service waterfowl management areas) OR premises located in counties immediately surrounding wetland areas identified as described in the U.S Interagency Strategic Plan by one of the 4 U.S. Flyway Councils where priority waterfowl species congregate	Premises with on and off movement of fancy fowl and other non-commercial poultry (to shows, fairs, swap meets, trade, or exhibition) and return them to the premises 5 times per year or more or the flock owner has taken at least one or more international trip per year with exposure to poultry.
Premises are located in areas with high densities of backyard or other non-commercial flocks.	Premises where visitors who have poultry exposure are allowed direct access (contact with birds) to poultry.
Premises where poultry are allowed to free range (i.e. not always kept within a fenced enclosure) and are free to leave the premises.	
Premises where wild waterfowl are frequently observed on the property or there is a farm pond on the property.	
Premises where waterfowl are raised for release.	

We have identified geospatial and temporal factors related to the occurrence of avian influenza in waterfowl reservoirs thought to influence disease risk in backyard flocks (Table 7).

Table 7. Timing and location of disease risk for NAI of backyard sentinel flocks in relation to the migratory behavior of reservoir waterfowl species.

Geospatial Considerations	Temporal Considerations
• Location in flyway o Waterfowl management areas o Fairs, exhibits, swap meets • Prioritized species of interest o Birds that originate in Southeast Asia and migrate to breed in northeastern Asia and Alaska o Birds exposed to Asian migrants and relocate along migratory flyways	• Seasonal nature of migration o Northern breeding areas o Southern wintering areas o Fall and spring migration routes • Host susceptibility o Highest viral loads in juvenile dabbling ducks, particularly mallards, that muster in August through November

Spatial considerations include location relative to waterfowl concentrations with potential for exposure to migratory waterfowl or their habitat. Temporal considerations include breeding season at a given location and the presence of immunologically naive juvenile dabbling ducks and other functional groups that congregate for fall migration from August through November. An increase in disease incidence in backyard flocks would be expected to occur during seasonal periods when avian influenza is most abundant in waterfowl reservoirs and when waterfowl are most abundant in a particular geographic area.

Identifying Backyard Poultry in High-Risk Areas (Sentinels)

Backyard poultry could serve as an early warning system for the introduction of Asian HPAI H5N1 into the U.S. commercial poultry industry. Movement practices and husbandry practices resulting in exposure to migratory waterfowl increase the probability of disease emergence in backyard poultry flocks, if the disease is in wild birds in the United States.

To allocate sampling efforts and prioritize locations with the highest probability for introduction of Asian HPAI H5N1, it is necessary to identify waterfowl habitat near commercial poultry populations at risk. A risk-based spatial analysis of U.S. counties was conducted to define commercial and backyard poultry populations at higher risk for exposure to migrating waterfowl and of greatest importance for surveillance (please see Appendix C).

Areas of critical overlap between commercial poultry production and concentrations of migratory waterfowl were identified by merging bird banding spatial data and commercial poultry spatial data (NASS). Bird banding data, distributed by the U.S. Geological Survey Patuxent Wildlife Research Center Bird Banding Laboratory, was analyzed to characterize continental movements of avian functional groups likely to be responsible for large-scale movements of Asian HPAI H5N1, if introduced onto the North American continent from Asia.

Preliminary analysis summarized the data by county for functional groups (dabbling ducks, dark geese, light geese, and swans) with a higher risk for transmitting Asian HPAI H5N1, because they interact with Asian migrants in the northeastern Asian and Alaskan breeding grounds.

County-level summaries for both bird banding (as a proportion of total migrants) and commercial poultry data (density of poultry farms) were stratified into four categories at the national level using percentiles (25^{th}, 50^{th}, 75^{th}) identifying counties of critical importance for both migrating waterfowl and commercial poultry.

The overlap of these critical areas identified areas of importance for backyard poultry surveillance. The left side of Table 8 presents the top 10 States for band-recovered birds originating in Alaska, Asia, or Canada. The right side of Table 8 excludes data for Canada and ranks the top 10 States for band-recovered birds originating in Alaska and Asia.

Table 8. Top 10 States for number of migrant band recovered birds (1991-2006).

Alaska, Asia and Canada Recoveries			**Alaska and Asia Recoveries**		
State	**Recoveries**		**State**	**Recoveries**	
	Total	Alaska / Asia		Total	Alaska / Asia
Arkansas [- +]	69,237	345	California [+ ^]	34,962	8,649
Louisiana	52,741	738	Oregon	17,987	7,304
Texas [- ^]	42,683	2,279	Washington	25,974	5,144
California [+ ^]	34,962	8,649	Texas [- ^]	42,683	2,279
Illinois	32,010	66	Louisiana	52,741	738
Missouri [+]	31,097	95	Arkansas [- +]	69,237	345
Washington	25,974	5,144	Kansas	11,965	226
Mississippi [-]	20,686	64	Utah	2,637	217
North Dakota	20,199	73	Idaho	17,667	141
Nebraska [^]	19,945	121	Nebraska [^]	19,945	121

[-] Top 10 broiler production state.
[+] Top 10 turkey production state.
[^] Top 10 table-egg layer production State.

The analysis identified 483 counties (15 percent of total) with both high numbers of waterfowl migrants and poultry farms that ranked in the very high, high, and medium high priority strata for backyard flock surveillance, when analysis was restricted to migrants originating from Alaska and northeastern Asia. These 483 counties are primarily located along the Pacific flyway and critical over-wintering areas along the Gulf Coast of Texas and Louisiana. Counties with critical migration stopover points in Utah, New Mexico, Kansas, and other Midwestern States also rank high. These 483 counties account for 29 percent of poultry farms and 26 percent of the domestic poultry population (NASS 2002). Table 9 presents the number of counties in each risk category along with the number of commercial poultry farms represented by those counties. Figure A presents the geographic risk-based rank for counties in the lower 48 States.

Table 9. Counties with Alaska and northeastern Asia migrant waterfowl by risk-based rank.

Risk Rank	Number of Counties	%	Number of Farms	%	Estimated Poultry Population	%
Very High	73	2	10,745	7	53,761,836	3
High	74	2	6,410	4	60,179,262	4
Medium High	336	11	24,729	17	308,497,272	19
Medium Low	1,377	44	86,227	59	1,124,351,378	68
Low	1,281	41	18,016	12	95,681,294	6
TOTAL	3,141		146,127		1,642,471,042	

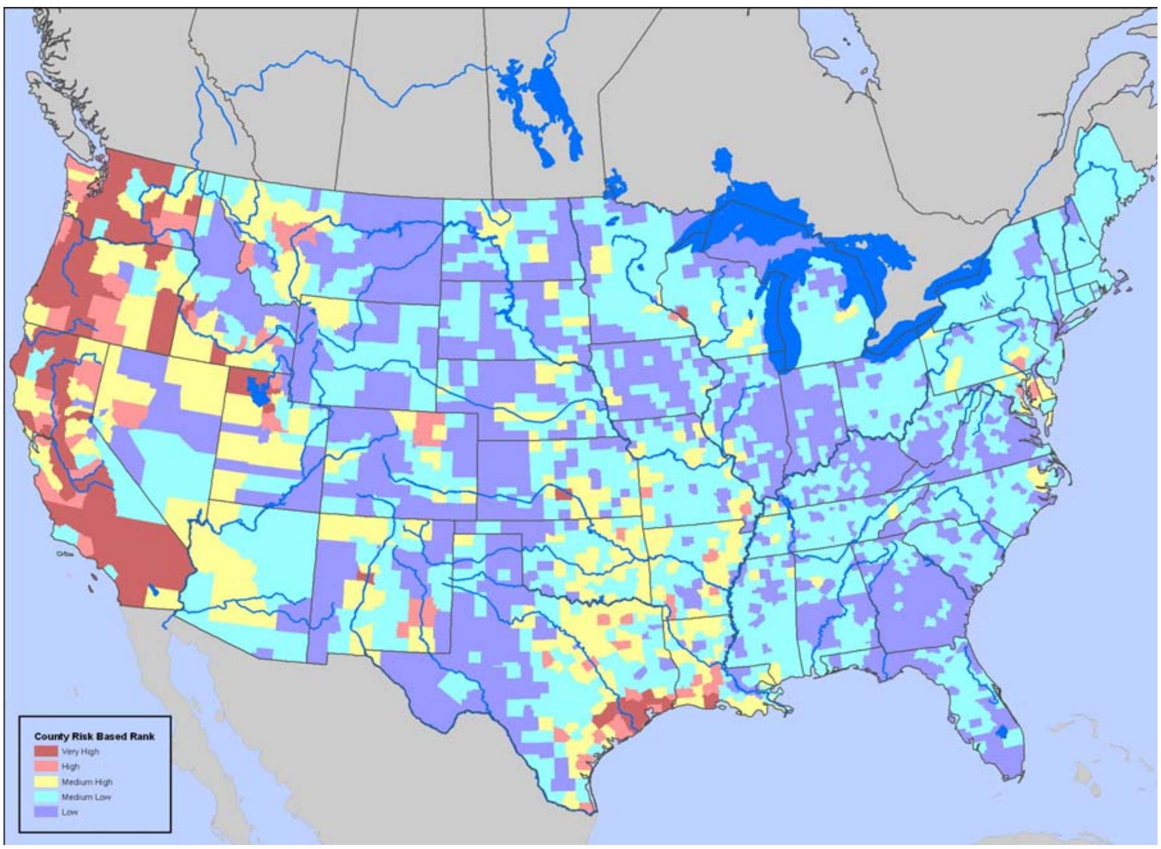

Figure A. County risk-based rank using Alaska and northeastern Asia migrant bird band recoveries.

It is possible to further refine this coarse level approach to identify areas within high-risk counties where interaction between backyard poultry and aggregations of waterfowl are more likely to occur. Geospatial data such as the 10-minute block band recoveries[9], national wetland inventory, and other waterfowl habitat related information can be used to further refine the areas at risk for interactions between waterfowl and backyard poultry. In addition, surrogate data can help identify concentrations of backyard poultry

[9] Defined in Appendix C, page 62-63.

operations and locations of poultry suppliers and poultry feed stores, zoning code violations, and noise violations related to excess or crowing poultry.

The temporal aspects of migratory bird movement are also critical, because maintenance of AI viruses in a population is both density-dependent and associated with the presence of immunologically naive (i.e., susceptible) hosts. It is possible to define the temporal period most important for surveillance of Asian HPAI H5N1 based on the typical migration and over-wintering period of waterfowl. This period—and therefore the optimum time interval for collecting samples—will differ between southern and northern States.

Sampling backyard poultry in high-risk areas (sentinels)

For many years, USDA's foreign animal disease investigations have benefited from the active observational surveillance of backyard flocks by flock owners and the subsequent laboratory testing of flocks that experience unusual mortality. Currently in 2007, several States are using supplemental HPAI funding for sampling backyard flocks in high risk areas following guidelines published in cooperative agreement templates (please see Part 3 Summary and Conclusion).

The following describes further refinement of the existing guidelines for early detection of Asian HPAI H5N1 near commercial poultry operations in high-risk areas. For example, approximately 30 backyard flocks are randomly selected from a census of backyard flocks in high-risk counties and visited each month by a veterinary official. The flocks may be re-visited each month (i.e., using these flocks as sentinel sites) throughout the high-risk transmission season. The veterinary official interviews the flock owners about the frequency of owner observation and the occurrence of mortality, or alternatively, the owners submit a standardized data collection form with the same information at predetermined intervals. For flocks that have experienced excess mortality in the past 21 days (flock incubation period), a foreign animal disease investigation is initiated and laboratory samples are taken. Sample sizes taken resulting from an FAD investigation would likely range from seven to 11 samples per flock, depending on flock size, and would include mortality if available.

Visiting 30 backyard flocks (or the total population of backyard flocks if there are fewer than 30 such flocks in the geographic area) should initially provide nearly 95 percent confidence of detecting a 10 percent or greater flock prevalence of HPAI. Within-flock sampling of flocks that experience mortality of 7 to 11 birds per flock provides 95 percent confidence of detecting HPAI infection at a prevalence of 25 percent or greater within the flock. This level of confidence requires the assumption of a perfect test and randomly selected samples (Cannon and Roe 1982). Nevertheless, a combination of imperfect test sensitivity with higher within-flock prevalence levels may still provide sufficient confidence in detecting an affected flock. Probability for truthful reporting of mortality by backyard poultry producers at the time of interview is expected to be at least 50 percent if their flock experiences at least 25 percent mortality. Although the probability of reporting is assumed to be suboptimal and minimally specific for cause, subsequent biological sampling and testing of flocks that experience mortality will confirm the presence or absence of AI. Observation of the flock by the veterinarian would further increase sensitivity. The same interview process is used to identify flocks that have experienced mortality through convenience sampling at shows, fairs, and exhibits and augments surveillance methods for HPAI for birds that move frequently.

This active observational surveillance described above of non-commercial backyard poultry has begun as limited backyard surveillance in some States through HPAI Supplemental Funding cooperative agreements.

Other Backyard Poultry

A USDA educational initiative called “Biosecurity for the Birds” is directed toward backyard flock and hobby flock owners nationwide. It provides telephone hotlines and educational programs that explain principles of biosecurity and the importance of reporting unusual mortality to animal health officials (please see “Provisions for Enhancement of AI Surveillance in the United States,” page 43, and Appendix G). This educational initiative augments the passive surveillance component for HPAI and H5/H7 LPAI strains that cause overt clinical disease in backyard poultry. Additionally, some backyard flock owners voluntarily participate in the NPIP program and follow regulatory testing requirements.

Data Sources

Initial and future plans for reporting backyard poultry data are similar to those in place for the voluntary NPIP H5/H7 LPAI program. Data are collected continually as the birds are sampled and test results maintained in individual States, with summary reports provided to USDA/APHIS regional offices on a quarterly basis. These reports will subsequently be included in a database that maintains regional data, to be forwarded into the AVHS. USDA regional offices will maintain data for backyard bird surveillance. The efficiency of the reporting may vary, with some reports submitted on paper and others electronically. Recently, an electronic surveillance tool for the LBMS was developed for each State to use in reporting to the regional offices; the tool can be modified to include backyard field surveillance data. Implementation of this data management tool may become part of cooperative agreements for AI surveillance with State Department’s of Agriculture.

Data Analysis and Interpretation

The backyard poultry sector represents poultry operations that generally conduct the fewest biosecurity practices. Surveillance has traditionally been based on voluntary reporting of dead birds by owners, private veterinarians, or diagnostic lab officials as part of a passive surveillance system. While some owners would undoubtedly seek help if they experience a high mortality event, others may dispose of the chickens and take no further action due to the small investment loss, thus allowing an outbreak of high mortality AI to be present for several weeks in the flock before appropriate samples are collected and tested. The Asian HPAI H5N1 virus would present additional concerns for human health during control of an outbreak. For these reasons, we believe that the backyard sector is at higher risk with lower sensitivity of surveillance (probability of timely detection) than most other poultry sectors in the United States. However, strategies such as: active targeted surveillance in high-risk areas through observational surveillance or laboratory sampling; active observational based surveillance at shows and other events; and increased public awareness will augment existing surveillance (please see Page 43, Provisions for Enhancement of Avian Influenza Surveillance in the United States). Figure B describes the likely sensitivity for each of these surveillance systems.

If States accept cooperative agreement funding and the initial and future plans for backyard surveillance described here are implemented, three sources of information may become available for backyard surveillance to address the risk factors described above. First, using flocks targeted by locations based on risk factors as sentinels increases the probability of early detection of an AI incursion. Likewise, targeting shows, exhibitions, swap meets, and other events where birds are moved and mixed will increase the odds of early detection. Finally, ongoing passive reporting in an environment where most people are highly aware of the disease provides substantial probability of detecting the disease early in the onset of an outbreak (See Figure B).

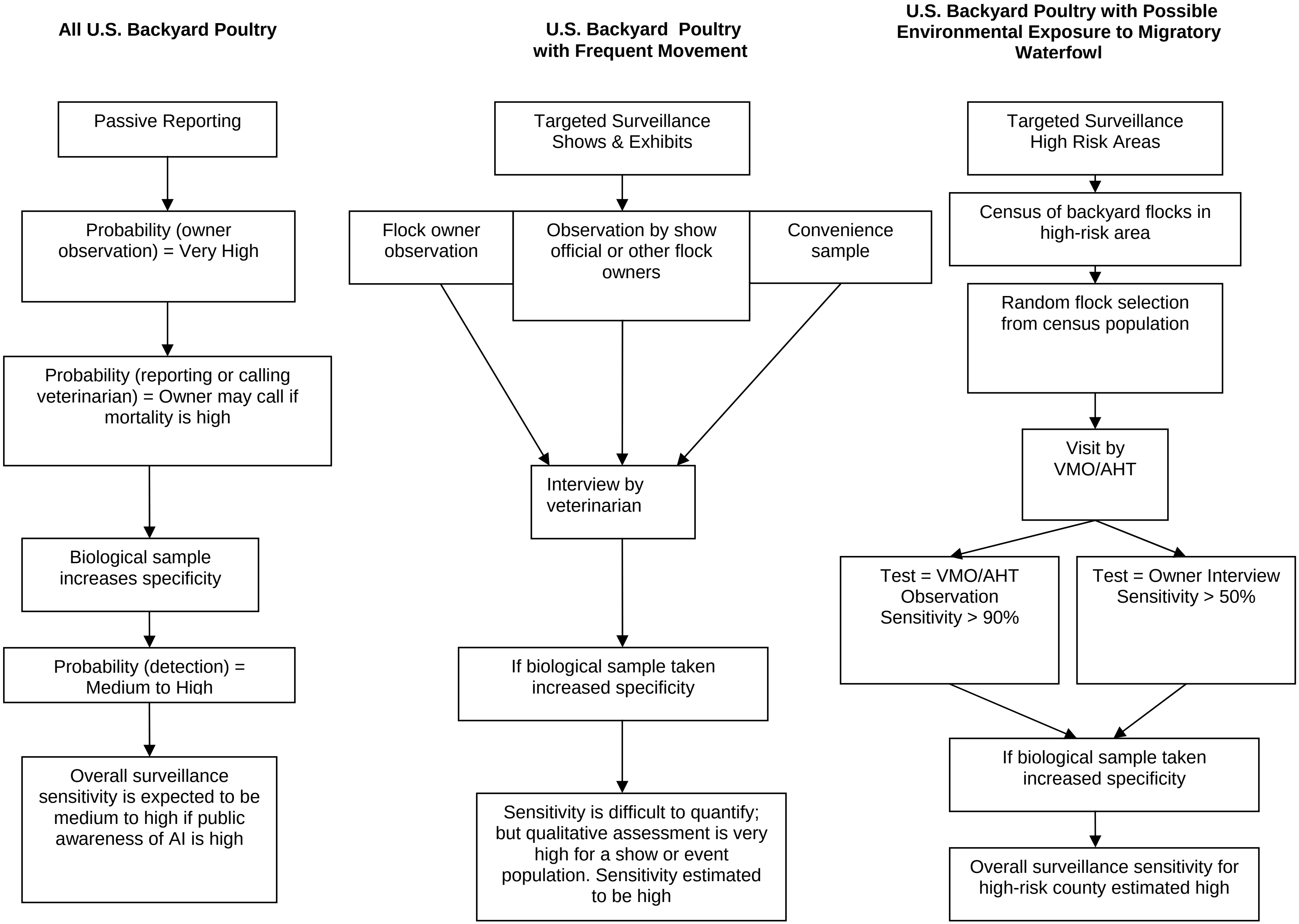

Figure B. Active targeting and observational surveillance and passive surveillance methods of backyard poultry in the United States. Estimated sensitivity (i.e., probability of detection) is given for each surveillance method and corresponding part of the population.

D. Migratory Waterfowl and Shorebirds

The document, *An Early Detection System for Asian H5N1 Highly Pathogenic Avian Influenza in Wild Migratory Birds, U.S. Interagency Strategic Plan,* written by APHIS-Wildlife Services and other agencies, describes sampling strategies for the detection of Asian HPAI H5N1 in migratory waterfowl and shorebirds presently being implemented by USDA and others, including DOI. The document is available at http://www.usda.gov/documents/wildbirdstrategicplanpdf.pdf. Methods used include the investigation of morbidity/mortality events, surveillance in live wild birds, surveillance in hunter-killed birds, the use of sentinel species, and the collection of environmental samples.

The sampling approach and laboratory methodology for the collection of environmental water and fecal samples have undergone further development since publication of the U.S Interagency Strategic Plan and are described here in more detail. Fecal sampling has proven to be an effective means for detecting viral RNA. Specifically, preliminary analyses suggest that fecal and cloacal sampling of wild birds in 2006 resulted in comparable proportions of infected samples being detected at a national scale. Thus, environmental samples are presumed to be as effective as cloacal sampling for determining if Asian HPAI H5N1 has infected birds in a given location.

Locating and Collecting Environmental Samples

In May 2006, officials with APHIS Wildlife Services National Wildlife Research Center (NWRC) convened a panel of sampling experts to recommend a unified approach to prioritizing sampling efforts nationwide with respect to the collection of fecal and water samples. Using information about the biology and ecology of migratory waterfowl and type-A influenzas, and considering the complications of data collection on a national scale, five premises were established to guide the sampling design. Recommendations for sampling locations and frequency are based on band recovery data and epidemiological principles. Sampling is focused on migratory species because of their spatial and temporal proximity to breeding birds originating in countries outside the United States that have reported, or have the potential to be infected with, Asian HPAI H5N1. In addition, migratory species have a life history that includes seasonally driven, large-scale movements across North America which may allow them to be long distance dispersers of Asian HPAI H5N1 if they are mildly affected by the disease., Although shorebirds have been found to harbor avian influenzas, practical sampling constraints limit use of this group in a nationwide sampling effort.

Design Premises and Deductions

Because migratory waterfowl may become infected and transmit HPAI without exhibiting morbidity or mortality, the potential for widespread dispersal of HPAI is possible. Experimental infection in mallards (Sturm-Ramirez *et al.* 2005) has shown variability in the pathogenicity of Asian H5N1 isolates, with some virus isolates that were nonpathogenic in ducks being replicated and transmitted efficiently to immunologically naïve contacts, suggesting that highly pathogenic H5N1 viruses causing minimal signs of disease in ducks can spread to domestic poultry populations. Because of this, the sampling design targeted data collection from wild migratory waterfowl and geese. Further, avian influenzas are often transmitted by an oral-fecal mode, with virus concentrated in fecal matter that is subsequently excreted in water where it can infect a susceptible bird. Thus, sampling of feces and water containing fecal material is presumed to be an effective means for determining if Asian HPAI H5N1 has infected birds in a given location. Primary interest is focused on sampling migratory waterfowl populations that spend either a portion of their lives outside the United States or that spend time within the United States in regions where they commingle with migratory bird populations originating outside the United States. For example, one area of concern is, Alaska where species that migrate from Southeast Asia—where Asian HPAI H5N1 may infect wild bird populations—mix on breeding grounds with birds that migrate to the lower 48 contiguous States in the late-summer and fall. Waterfowl and goose feces are easily identifiable and relatively easy to collect since there is no need to directly handle animals. The NWRC has developed a reliable assay for detecting viral RNA in feces using RRT-PCR and is currently working to optimize and validate a water-sampling assay.

Because of the short implementation period, the focus on the first detection of Asian HPAI H5N1, and an unknown level of infection of HPAI in North American migratory waterfowl, formal sampling theory was not helpful in determining sample design with respect to detection probabilities. Thus, sampling protocol emphasized the detection of the disease as early as possible following first introduction based on *a priori* risk factors, in this case the number of waterfowl and geese of Alaskan, Canadian, European or Central and South American origin harvested from a given location and the sampling that occurred in 2006. Because the most likely route of entry for Asian HPAI H5N1 into the United States through a migratory bird population is currently unknown, sampling in Alaska and the lower 48 states should focus on locations having the highest concentrations of accessible waterfowl that have migrated from areas outside the United States or from areas where migrants from outside the United States overlap with populations of birds that spend their lives within the United States (e.g., Alaskan breeding grounds).
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Target and Sampled Population

The target population includes all waterfowl that occur within the lower 48 contiguous States that have an opportunity to commingle with bird populations that spend a portion of their lives outside the United States. The sampled population includes all areas in the lower 48 contiguous States having a high concentration of birds that spend, or commingle with birds that spend, a portion of their lives outside the lower 48 states. Within this sampled population, sample locations are ranked in each State by the number of waterfowl and goose bands recovered within the last 15 years from the 10-minute band recovery blocks.

Sampling units are defined by 10-minute band recovery blocks where large numbers of water birds are harvested. Examples of sample units with large concentrations of waterfowl of interest include Federal and State managed lands along with private land where band recoveries occur, such as private hunt clubs. Although species considered when selecting sampling units include more than just dabbling ducks, these bear the main consideration as a functional group due to the assumed primary route of transmission being waterborne, fecal-oral.

Although it is possible to apply the band recovery data at the species level, commingling of many migratory waterfowl species within migratory corridors and on over wintering areas in the United States makes functional groups more important in sampling for early detection of Asian HPAI H5N1. Temporally, sampling should consistently occur when migratory waterfowl numbers and type-A influenza prevalence are at their peak for a location. The timing of data collection can be expected to correspond to fall migration patterns of waterfowl. For resident species, the highest concentrations and infection rates can be expected to occur shortly after the spring birth pulse of immunologically naïve (i.e., susceptible) young. Because these conditions are variable in time and space at the national scale, personnel within each State who are familiar with local patterns and can adapt sampling efforts to changing conditions must determine the exact timing and intensity of sampling.

Band Recovery Data

Much of the existing information on movement patterns of migratory waterfowl originating outside the United States comes from birds banded on breeding grounds and subsequently recovered via hunters, or dead birds that are reported to the USGS Bird Banding Laboratory. This information was used to determine areas to target for sampling. Procedures used to locate priority areas are described more completely in Appendix C.

Environmental Sampling Methods

Because water sampling provides epidemiological information concerning numerous birds—as opposed to a single bird—it could potentially become the primary sampling method for determining the presence or absence of avian influenza for a given sampling unit (water body). Additionally, because water sampling is a relatively non-technical procedure it is easy to implement in the field with minimal training required. Finally, water sampling provides a direct link to determining the AI occupancy status of a location, while feces is an indirect measure of virus presence or absence in individual and potentially highly mobile birds. Currently, NWRC researchers are attempting to determine concentration thresholds for detecting AI in water samples under various environmental conditions, such as variations in temperature, salinity, and pH, using RRT-PCR.

Current State Efforts

In 2006, the USDA, in conjunction with State fish and wildlife agencies, collected approximately 85,000 cloacal samples from live and dead birds and approximately 50,000 fecal samples in all 50 states. Each USDA Wildlife Services State Office collected 1,000 fecal samples from waterfowl concentration areas for 50,000 total samples nationally. In addition, each Wildlife Services office working with State wildlife agency partners, collected between 750 and 1,500 cloacal samples from wild birds. DOI collected approximately 20,000 samples in 2006, with a majority of samples coming from Alaska. In 2007 the USDA intends to collect 50,000 cloacal and 25,000 fecal samples following similar guidelines as in 2006, with additional emphasis being placed on re-sampling locations that tested positive for avian influenza, and H5 and H7 sub-types in particular,

Data Sources

The migratory waterfowl surveillance program and data sources are extensively described in *An Early Detection System for Asian H5N1 Highly Pathogenic Avian Influenza in Wild Migratory Birds, U.S. Interagency Strategic Plan*. The document is available at http://www.usda.gov/documents/wildbirdstrategicplanpdf.pdf. In 2006 samples collected from wild birds were tested either by the DOI's National Wildlife Health Center (NWHC) or by a laboratory approved as one of USDA's National Animal Health Laboratory Network (NAHLN). Data for wild bird and environmental specimens collected by APHIS' Wildlife Services was entered into the Avian Health Surveillance (AVHS) database and also posted, along with DOI collected data, to the publicly accessible (http://wildlifedisease.nbii.gov/ai/) Highly pathogenic avian influenza Early Detection Data System (HEDDS). Mapped general summary data for the entire nation is available for viewing by the public at http://wildlifedisease.nbii.gov/ai/.

In addition to migratory waterfowl surveillance conducted by APHIS, DOI, and State wildlife and natural resource agencies, additional surveillance will be conducted on wild and exhibited species in zoos and other facilities under APHIS jurisdiction. Active and passive surveillance in healthy, moribund and dead birds will be conducted in these facilities. Data will be maintained in USDA's AVHS.

Data Analysis and Interpretation

Wild bird surveillance data is currently assimilated for analysis on the HEDDS Web site, available at http://wildlifedisease.nbii.gov/ai/abouthedds.jsp. APHIS' National Wildlife Research Center, in collaboration with Colorado State University and USDA CEAH-GIS, is currently developing a national scale risk analysis model using domestic poultry and wild bird AI surveillance data combined with information about ecology and movement patterns of targeted wild bird species. The goal of this risk analysis is to develop a nationwide estimate of transmission risk from wild bird populations to domestic poultry populations at relatively local scale (e.g., within 100 mi^2 blocks). Because the project began in late-April 2007, results were not available at the time this document was prepared.

Part 3: Summary and Conclusion

The first step in developing the National Avian Influenza Surveillance Plan was to leverage data from the existing and effective surveillance programs that comprise the NAISS and its components. Surveillance data generated by the NAISS components are focused upon four domestic poultry populations that are defined based on management and biosecurity practices and commercial characteristics. These four populations encompass the majority of poultry at risk for AI in the United States.

The sensitivity of current surveillance efforts for these populations using the NAISS components has been analyzed to measure the probability of detecting the disease in any segment of the U.S. domestic poultry population. This analysis identifies parts of the poultry industry where sampling, whether by taking a biological sample or by making an observation, is inadequate to determine confidently AI status. Information in Table 10 identifies industry sectors that would benefit from augmented surveillance. To further define high-risk areas where targeted surveillance is needed, information from wild migratory waterfowl surveillance was used to evaluate risk to the commercial poultry industry. Wild migratory waterfowl may serve as a first point of detection for entry of AI viruses into the domestic poultry population.

Table 10. Surveillance sensitivity (i.e., probability of detection) of AI in U.S. poultry industry sectors.

	HPAI	**LPAI**
Large-volume commercial	Very high	Very high
Small-volume high-value	Medium	Low
LBMS	High	High
Backyard	Medium	Low

The NAISS' long-standing surveillance component activities include:

- The NPIP administered by Official State Agencies;
- Minimum national standards designed to enhance and unify State live-bird market surveillance programs;
- Foreign animal disease investigations;
- Slaughter inspection;
- Targeted surveillance of backyard poultry at shows, fairs, exhibits, and flocks located in high-risk areas; and
- Wild migratory bird surveillance.

APHIS relies on a variety of voluntary State and commercial programs to monitor and test domestic poultry, and efforts to obtain more information about State surveillance programs through alliances and partnerships with multiple government agencies and private entities are underway. All of these activities generate useful surveillance data for determining the status of AI in the United States and compliance with international standards, whether they result from structured population-based surveys or from non-random data sources.

Analysis of Avian Influenza Surveillance in the United States

Virtually all large-volume commercial poultry operations conduct serological and antigen (swab) testing at differing intervals and intensities consistent with minimum NPIP standards. Breeder flocks meeting program criteria receive Avian Influenza Clean or H5/H7 Avian Influenza Clean status, providing 95 percent confidence that AI is not present at a prevalence of 10 percent or greater within any poultry unit (i.e. house or flock). For commercial table-egg layer, meat-type chicken (broiler), and meat-type turkey flocks, surveillance sampling provides 95 percent confidence that AI is not present at a prevalence of 25 percent or greater at within any poultry unit (i.e., house or flock).

In addition, due to the highly structured nature of commercial operations, active observational surveillance is conducted very frequently (e.g., once or twice daily) with high probability of detecting HPAI virus within the first 1 to 2 weeks after exposure. For the large-volume commercial industry, standard management protocols for active observational surveillance predict that HPAI would be identified with very high probability in a short time, as changes in morbidity and mortality are observed and investigated. Additionally, NPIP testing guidelines provide added assurance of detecting an HPAI virus, but more importantly, they are designed to identify the more subtle clinical appearance of the low pathogenicity H5 and H7 viruses, which present risk of mutation into HPAI. Further, the Asian HPAI H5N1 virus will be detected in this sector very rapidly with high confidence.

The probability of timely detection in other sectors is lower, although adequate in most cases to diminish risks to human health and production agriculture to very low levels, where an unidentified outbreak would be unlikely to persist for longer than a few weeks.

Under cooperative agreements with USDA, State animal health officials conduct surveillance in the LBMS to detect LPNAI by testing production flocks, distributors, and birds sold at markets. For flocks producing birds sold into the system, surveillance sampling provides 95 percent confidence that AI is not present at a prevalence of 25 percent or greater within any poultry unit (i.e., house or flock or market). Most of the markets fall under a State surveillance program, although some small or transient markets may not be included in the program. Sensitivity is relatively high under the LBMS program where the markets and flocks are tested and inspected frequently. Again, small or transient markets may be unidentified in some areas; however, these would be unlikely to remain unnoticed in any significant number or duration of time.

Surveillance for small-volume high-value commercial flocks is primarily conducted by owners, (either with a structured and frequent active observational surveillance or irregular passive observation and reporting) and in some cases by serological or antigen swab surveillance. However, data are not available for all segments of this industry, and quantitative conclusions about the coverage of surveillance are difficult to make. Since management practices do not necessarily conform to commercial industry standards, the less structured small-volume high-value sector may not be as likely to detect HPAI viruses quickly by active observational surveillance. With the exception of the flocks in this category that participate in NPIP, sensitivity is low for any LPAI viruses that do not show overt clinical disease.

Finally, the backyard poultry segment provides substantial exposure to people and wildlife and is at risk for viruses such as the Asian HPAI H5N1 virus. The size and distribution of the backyard industry is not clearly defined, and management practices by owners vary greatly between flocks. For these reasons, this segment has very low sensitivity (probability of detection) for rapid detection of AI. Backyard poultry flocks present the most uncertainty about the sensitivity or time for detection because of the unstructured nature of the industry and very diverse management practices.

While surveillance of wild birds does little to reduce risk of direct exposure of the Asian HPAI H5N1 virus to people and poultry, it does allow surveillance targeting for domestic fowl at highest risk of contact. Wild migratory bird surveillance data are being used to define high-risk areas for the introduction of NAI, including Asian HPAI H5N1.

Provisions for Enhancement of Avian Influenza Surveillance in the United States

Five cooperative agreements are in place that enhance surveillance in three domestic poultry population sectors (Table 11). Participation varies between States.

Table 11. Number of States Participating in Avian Influenza Cooperative Agreements by Fiscal Year.

Cooperative Agreement	Number of States Participating	
	FY 06	FY 07
LBMS LPAI	30	35
LBMS HPAI	39	*
NPIP LPAI	26	26
NPIP HPAI	45	*
NPIP Upland Gamebird	38	*

* These agreements are supported by supplemental funding and expire spring/summer 2007. Another round of supplemental funding was requested to support renewal of these agreements upon expiration. However, it is unknown at this time if these additional funds will be made available.

LBMS LPAI

This cooperative agreement provides funding for States to work with stakeholders in the LBMS, including: live-bird market owners, auctions, small sales, flea markets, swap meets, farmers markets, wholesalers, dealers, production facilities, and backyard or hobby flock owners to increase biosecurity enforcement, record audits, surveillance, and monitoring for H5/H7 LPAI.

Current AI sampling activities under this program include acquiring—at least quarterly—tracheal or cloacal swabs (dependent on species of bird) for RRT-PCR or virus isolation or serum samples for AGID from live-bird markets, auctions, swap meets, farmer's markets, production units, distributors (dealers, haulers, wholesalers), botanicas, custom exempt poultry facilities, and feed stores. Backyard flocks are tested in conjunction with other programs (fairs, poultry shows, exhibitions, interstate movement). Environmental swabs for virus isolation are also collected at the same venues at the discretion of the State cooperators. Additional surveillance activities under this program include other forms of monitoring, such as regular assessment of the clinical health of birds in the live-bird markets and other premises by State or Federal animal health officials and auditing of records to assess compliance with the LPAI program's uniform standards.

LBMS HPAI

Supplemental funding is being used to expand the LBMS LPAI program by allowing States to increase surveillance and education/outreach programs within the LBMS and/or to add active and passive surveillance of other "non-commercial" poultry, which have been largely unmonitored to date. This includes the backyard poultry population sector. Additional activities under this funding stream were meant to include targeted surveillance of flocks at high risk for contracting NAI, with special emphasis on early detection of HPAI in these flocks.

Surveillance activities under this program include: monitoring and testing of poultry premises located immediately surrounding wetland areas where wild waterfowl congregate; premises located in areas with high densities of backyard flocks; premises containing free-range domestic poultry; premises where wild waterfowl are frequently observed on the property; and premises where backyard flocks are located in close proximity to commercial poultry operations. Additional surveillance activities under this program include the identification or establishment of sentinel flocks in high-risk areas that are to be monitored for clinical signs.

NPIP LPAI

This cooperative agreement allows States to work with commercial table-egg producers, meat-type chicken and turkey producers and processors, and their parent hatching egg production flocks to administer an H5/H7 LPAI monitoring program. This program consists of an active surveillance component, a diagnostic surveillance component, and a federally approved Initial State Response and Containment Plan in accordance with the NPIP chapters of 9 CFR. These participants represent the large-volume high-value commercial poultry population sector.

Current active surveillance activities under this program focus mainly on repetitive regular surveillance sampling of commercial broiler, layer, and turkey breeder flocks and surveillance sampling of broiler, layer, and turkey production flocks as they go out of production. Additionally, there is an active surveillance component included in this program to monitor NPIP Subpart E participants that include exhibition poultry, gamebirds, and domesticated waterfowl (small-volume high-value commercial breeders). Other support for surveillance under this program involves funding for laboratory costs to conduct AI diagnostic testing on all submitted cases of unexplained respiratory disease, egg production drop, and mortality.

NPIP HPAI

This cooperative agreement provides supplemental funding to work with commercial and Subpart E NPIP participants to enhance the current active and passive surveillance components of the NPIP H5/H7 LPAI Monitored Program. Commercial and Subpart E participants are part of the small-volume high-value population sector.

Enhanced surveillance activities under this funding stream are targeted mainly at NPIP Subpart E type flock participants and included selection of Subpart E type flock participants that were at higher risk of AI introduction to undergo increased active surveillance. Risk-based selection of Subpart E participants was carried out by evaluating proximity to commercial poultry operations, proximity to wildlife/waterfowl refuges, location within a major migratory flyway of selected species of waterfowl, and flock population components, such as a mixture of gallinaceous birds with waterfowl and/or upland gamebirds.

NPIP Upland Gamebirds

Supplemental funding is being used to work with the upland gamebird industry (pheasants, quail, chukar partridge, hunted waterfowl) in the development of an H5/H7 LPAI Monitored Program in the raised-for-release portion of the industry. This effort addresses producers who raise the progeny from NPIP participating breeding flocks up to flight age for release in preserves. The upland gamebird industries are part of the small-volume high-value population sector.

Surveillance activities under this program focus on active sampling of both upland gamebird breeding flocks and raised-for-release gamebirds for AI testing. Sampling guidelines for the raised-for-release flocks, for example, call for routine flock testing every 90 days to include a representative sample of each species present on the operation.

Biosecurity for the Birds

APHIS has an ongoing biosecurity information campaign called “Biosecurity for the Birds,” which can be accessed at www.usda.aphis.gov/vs. The campaign has distributed nearly 1 million copies of materials to all 50 States and more than 50 countries, and placed bilingual biosecurity information on more than 1.7 million poultry feed sacks. The campaign has placed radio ads on national and regional agricultural radio networks reaching an estimated 23 million listeners in 29 States, and has advertised in newspapers and magazines reaching nearly 30 million readers. In addition, APHIS held a number of stakeholder briefings on avian influenza, and partnered with FFA and 4-H to distribute materials at county and State fairs. In mid-August 2006, APHIS Veterinary Services issued a $150,000 contract with Paradigm Media to update an interactive CD-ROM training module on poultry biosecurity. The update will include new modules for portions of the poultry industry that were not included on the original version of this training module, such as feed mills, hatcheries, and other production facilities. Completion and distribution of the CD-ROM is expected within 1 year. (Please see Appendix G).

In conclusion, analysis of the NAISS in the United States provides reassurance that the disease would be rapidly identified in most sectors of the poultry population and particularly in the large-volume commercial sector where the risk of virus amplification is greatest. In flocks following the NPIP guidelines and those monitored under the LBMS program, probability of rapid detection of NAI is high and current surveillance efforts are adequate. This includes detection of LPNAI strains that may persist at a subclinical level so that appropriate disease response efforts can be carried out—giving the virus less opportunity to mutate to HPAI. Small-volume high-value and backyard flocks represent greater uncertainty and lower sensitivity for detection of HPAI. Nonetheless, these sectors would have a high likelihood of detecting HPAI during early phases of an outbreak, although at later stages than the large-volume commercial and the LBMS. These sectors would have a low likelihood of detecting LPAI viruses, yet the consequences of an LPAI outbreak would be of lesser impact and more likely to diminish in the smaller flocks.

AI surveillance allows U.S. policymakers, industry and State stakeholders to determine that current prevention measures and efforts are robust enough to protect the health of U.S. poultry flocks, minimize economic effects of the disease, and greatly reduce the health risks to the U.S. public. Realizing that surveillance planning is a dynamic process that involves a continuum of analysis, enhancement, and re-design after implementation, APHIS is currently implementing actions to further increase surveillance sensitivity and believes that this surveillance plan will allow for rapid and efficient detection of future outbreaks of AI.

Appendix A: U.S. Poultry Population Description

Large-Volume Commercial Poultry

Commercial Broiler, Layer and Turkey Production

The three main components of the commercial poultry industry are broiler production, table-egg production, and turkey production. The structures of these three industries are similar; they are all largely vertically integrated. Poultry farms are individually owned and contracted with integrated companies or are company owned, with independent producers accounting for a minimal proportion of production. Contracts with growers vary, but in general, the grower provides the housing, equipment, labor, and utilities, while the companies provide the birds, feed, medication, and veterinary care.

Genetics are produced by elite and pedigree birds. For broilers and turkeys, "primary breeding flocks" are made up of male line and female line great grandparent and grandparent flocks. Grandparent flocks produce "multipliers (parent flocks)." The parent flocks then produce chicks for meat production.

(Pedigree/elite → great grandparent flocks → grandparent flocks → parent flock → commercial production)

The egg layer industry, which requires fewer birds, does not have a great-grandparent step.

(Pedigree/elite → grandparent flocks → parent flock → commercial layer)

Eggs for hatching are incubated at hatcheries, and usually day-old chicks and poults are placed at grower farms for meat production or pullet farms for table-egg layers. Layer pullets are usually placed in layer production houses at 16–18 weeks.

Commercial Breeders

Broiler breeders are placed in breeder houses at 20–22 weeks, with 8–10 males per 100 hens. Hens are provided with nest boxes, as floor eggs are undesirable. Egg production peaks at 30-40 weeks and flocks generally will be in lay until 60–65 weeks. Uncompetitive males are culled, and new young males are introduced into the flock (spiking males). Eggs are removed from the hen house at least daily and stored up to 7 days. Eggs are transported to the hatchery for incubation and hatching.

The majority of egg-type primary breeder stock is controlled by a few companies, who maintain ownership of the multiplier breeder stock, with approximately 20 percent of day-old multiplier breeding stock sold to large integrators to maintain their own multiplier breeding stock. Pullets for breeding are raised by pullet growers on litter floor to 18 weeks, at which time they move to contract layer houses on slats. Production ends at 70 weeks of age and hens are not molted. Males and females are kept together throughout the process; males make up approximately 8–10 percent of breeder inventory. Eggs are sent to company owned hatcheries. Day-old chicks are then sold to commercial producers for table-egg production.

Because turkeys are artificially inseminated, turkey toms and hens are raised separately. Hens and toms are selected at 16 weeks and moved to a dark-out house, where they are gradually exposed to increasing light. At 30 weeks they are moved to laying/stud facilities, and production begins at about 32 weeks. Hens are inseminated every 1–-2 weeks and will have a lay cycle of 25 weeks. Farm personnel at the stud farms collect semen manually, and different personnel at the laying farms do the insemination. The addition of extenders has allowed storage of semen, and thus semen can be delivered to longer distances. Hens lay eggs in nests, and eggs are collected by hand several times per day (University of Minnesota 2006).

Commercial Production Flocks

Meat-type chicks are placed in the grower house at 1 day of age and are raised on the floor on litter until market age (6–8 weeks). Farms are operated in all-in, all-out management systems. The grower house environment, including temperature, ventilation, and light, is frequently computer controlled total confinement. Caked litter is removed between flocks, and litter is replaced every 1-3 years. Feed is withdrawn 8 hours prior to processing. Although mechanical catching is becoming more common, broilers are mostly caught and loaded into coops or cages by hand.

In 2005, 256 million turkeys were raised in the United States. Poults are sexed and beak-trimmed at the hatchery. Turkey toms and hens are grown separately because of large differences in growth rate. Poults are placed in a brooder barn, and then moved to a grow-out barn at 6–8 weeks. Hens are grown out to 15–16 weeks and toms to 17–20 weeks. Single-age flocks are becoming more common, although multi-age flocks still exist. (National Agricultural Statistics Service, 2006)

According to a recent national study, pullets are raised on pullet farms, where approximately three-fourths are cage reared and one-fourth floor-reared. Layers are placed in layer houses at 18–20 weeks. Layers are nearly always housed in cages; non-caged layers accounted for less than 1 percent of layer houses. On the majority of farm sites, eggs were gathered by egg belts. Eggs were gathered by hand on about 30 percent of farm sites, accounting for 10.6 percent of eggs gathered. This practice was most common in the western United States. Eggs were processed on-farm at 19 percent of farm sites, and 81 percent of farms had their eggs processed off-farm. Egg pickup occurred every 1-2 days for 48 percent of farms and every 3-5 days for 45 percent of farms. Eggs were transferred to the processor in crates or flats on racks. (National Animal Health Monitoring System 1999)

The NAHMS study determined that egg production peaked at 27–29 weeks with a peak hen-day egg production of 90 percent. Approximately three-fourths of flocks were molted when production dropped (at approximately 60 weeks) and a second laying cycle occurred. Molting was most common in the Southeast and least common in the Central United States. Molted flocks ended production at an average of 111 weeks and unmolted flocks at 74 weeks. Most (86.1 percent) spent hens went to processing while 2.6 percent of spent hens (from 10.8 percent of farm sites) went to live-bird markets. The average down time between flocks was 17 days.

Live-Bird Marketing System

The Live-Bird Marketing System (LBMS) includes the live-bird markets, their production and distribution systems.

Market characteristics and practices vary according to region. The NAHMS Poultry 2004 study found that markets were larger in the North region [defined in the study as New Jersey, New York, New England (Massachusetts, Maine, Vermont, New Hampshire, Connecticut, and Rhode Island,) and Pennsylvania] compared to the South region (defined in the study as California, Florida, and Texas). In the North region, over two-thirds of markets sold 1,000 or more birds per week. In the South region, over half of markets sold less than 500 birds per week. Nearly all markets in the North region always slaughtered birds on site, whereas birds left the market alive in over half of markets in the South region (mostly Florida botanicas[10]). A higher percentage of markets in the North region sold spent laying hens, turkeys, ducks, and guinea fowl, while geese and pigeons were sold by a higher percentage of markets in the South region (National Animal Health Monitoring System 2004).

Small Commercial and Other Industries

Gamefowl Breeders

In general, birds that are used for experimental purposes or to develop blood lines are penned with one rooster and one or two hens. Hens will lay a clutch of 8–10 eggs. Although some breeders may incubate these eggs, more commonly hens are allowed to sit. Once hatched, the chicks are identified (similar to notching pigs) and put in a brooder for 2 to 2.5 months, then are turned out (free-range). Hens will lay and sit on a second clutch.

Hens that are producing birds for sale are flock-mated with one rooster in a confined yard with 12-40 hens. Three to four identical brother roosters are rotated, with each rooster placed with the hens for 3-4 days at a time. Eggs are gathered daily and stored at 55–58 degrees Fahrenheit for 3–5 days. NPIP participants may send eggs to a hatchery, but more commonly, incubators are on site. Eggs are placed in a brooding incubator and moved to a hatching incubator 3 days before hatching.

Pullets are raised free-range until ready for production. Breedlines originating from Asia begin production at 10–11 months of age and American strains at 6–7 months of age. Hens are turned out free-range in the winter when they are not producing. Spent hens are often sold at live-bird markets, or younger hens that are no longer needed may be sold to another producer as brood hens. Hens are in production an average of 4–5 years and roosters for 5–6 years. This is significantly longer than other breeder segments (Mathews 2006).

According to NAHMS Poultry ’04, overall, 70.9 percent of premises sold or gave away live birds in the previous 12 months, mostly to private individuals and within the same State. International sales occurred on 14.3 percent of premises that sold birds. Two-thirds of premises (69.9 percent) took birds to locations where other birds were present (shows, fairs, etc.) and returned them to the flock in the previous 12 months; 44.4 percent did so five or more times. These trips were frequently to other States. The majority of breeders reported isolating birds upon returning home. A total of 85.4 percent of flocks had transported birds by vehicle, which was nearly always in a wooden with fine screen container or special recyclable

[10] Botanicas are markets that sell birds for slaughter offsite, primarily for ritual slaughter.

container with airflow cardboard, which greatly reduces the amount of feathers or droppings escaping en route. Air transportation was less common (15.1 percent of flocks), although over half of operations with 500 or more birds transported by air (NAHMS Poultry ’04).

Waterfowl, Exhibition Birds and Gamebirds

North Carolina State University (North Carolina State University 1991) recommends that a breeding duck flock use a program of artificial light to maximize egg production, which would necessitate keeping the breeding flock indoors. A flock of breeding ducks is generally in production from 1 to 2 years, and may be recycled.

Most commercial ducks are raised for meat, as the flavor of duck eggs is unappealing to most U.S. consumers. Ducks grow very quickly, reaching a market weight of approximately 7 pounds by 7 to 8 weeks of age. Total confinement housing on modern farms is well insulated and mechanically ventilated, usually via a negative pressure system. Properly designed confinement housing will keep out wild birds. There are no estimates of relative percentages of the various methods of duck management.

In commercial production, geese are raised under cover until approximately 6 weeks of age. Brooding is done in a temperature-controlled environment. After this period, geese are range-raised where they graze and are fed some supplemental grain for another 14 to 20 weeks until slaughter.

The North American Gamebird Association is a non-profit trade organization representing the gamebird industry and has approximately 1,500 members in the United States, Canada, Mexico, and Great Britain (www.naga.org).

On the West Coast, producers are growing native quail species, whose populations were decimated by habitat loss, for reintroduction. In the Midwest, pheasants and chukar partridges are produced for outdoor sporting clubs and to provide frozen birds to restaurants. This same group also estimated that 250,000 quail are reared annually in the United States (Iowa State University 2006). Pennsylvania State University reported that 500,000 commercial pheasants would be reared in 2003 in Pennsylvania alone, in addition to those raised by the Pennsylvania Department of Natural Resources.

Pheasant and quail producers obtain chicks in different ways. They may incubate eggs laid by birds on the farm; they may purchase and incubate eggs; or, they may purchase day-old chicks. No data are available to indicate which of these methods is more common. Hunting preserves prefer to purchase pheasants at 12 to 13 weeks, and bobwhite quail at 15 to 16 weeks.

There is very little information on management practices actually used on upland gamebird operations. Some university extension Web sites suggest guidelines for raising gamebirds. These guidelines may not be a good indication of what the industry actually does, but they are a good indication of the “gold standard” for the industry. Extension agents recommend that chicks be brooded indoors at controlled temperatures until they are somewhat well feathered. In general, housing depends on the purpose of the bird. It is recommended that birds intended for meat be kept in a confined facility with controlled lighting and temperatures. The extension sites that offer advice on setting up and maintaining a gamebird operation make little mention of biosecurity other than brief instructions on predator exclusion. Extension references for this section include: North Dakota State University, Pennsylvania State University, University of Minnesota, North Carolina State University.

Pastured (Free Range) and Organic Poultry

"Certified organic" production means that the production methods meet the national standards established by USDA AMS, as certified by accredited State, private, foreign organizations, or certifying agents. The national standard requires that animals for slaughter must be raised under organic management from the last third of gestation, or no later than the second day of life for poultry. Producers are required to feed livestock agricultural feed products that are 100 percent organic, but may also provide allowed vitamin and mineral supplements. Organically raised animals may not be given hormones to promote growth, or antibiotics for any reason. Preventive management practices, including the use of vaccines, will be used to keep animals healthy. Producers are prohibited from withholding treatment from a sick or injured animal; however, animals treated with a prohibited medication may not be sold as organic. All organically raised animals must have access to the outdoors, including access to pasture for ruminants. They may be temporarily confined only for reasons of health, safety, the animal's stage of production, or to protect soil or water quality. Meat and poultry could not be labeled as organic until 1999 when USDA approved a label; between 2000 and 2003 the inventory of organic poultry (broilers, eggs, turkeys and other poultry) has increased 178 percent. However, between 2002 and 2003 both organic turkey and other poultry inventories decreased. Table A1 shows organic poultry inventories in 2003 and top producing States (USDA/Economic Research Service 2005). Certification is done by USDA approved certifiers, which may be either State or private organizations.

Table A1. Organic Poultry Inventories in 2003 and Top Producing States.

Poultry	Number Head	Top States
Layer hens	1,591,181	Wisconsin, Iowa, California, Florida, New Hampshire, Pennsylvania, North Carolina
Broilers	6,301,014	California, Nebraska, Virginia, Pennsylvania
Turkeys	217,353	California, Pennsylvania, Iowa, Texas
Other poultry	670,604	New York, Wisconsin, Florida, North Carolina, Connecticut
Total poultry	8,780,152	California, Nebraska, Virginia

Backyard Flocks

Backyard Flocks (hobby or menagerie flocks)

Exact estimates for the number of backyard flocks do not exist. A recent national study (NAHMS 2004) determined that on average there are 1.9 backyard flocks located within a 1-mile radius of commercial poultry operations.

The average backyard flock size was about 35 birds. Over half of flocks had fewer than 20 birds. Approximately 20 percent of backyard poultry flocks had ducks. A total of 8.7 percent of backyard flocks reported waterfowl other than ducks. While nearly one in four backyard flocks had gamefowl, they accounted for only 10 percent of backyard birds, indicating that gamefowl flocks tend to be small. Gamefowl breeder flocks, however, are large, well-organized, and operate under much different management than backyard flocks. Table A2 lists the common types of birds in backyard flocks.

Table A2. Common Types of Birds in Backyard Flocks (NAHMS 2004)

	% Flocks	% Birds
Table-egg chickens	63.2	37.5
Gamefowl	23.2	10.2
Ducks	20.6	6.4
Other Waterfowl	8.7	1.3
Meat-Type Chickens	17.2	11.5
Guinea Fowl	11.8	4.7
Gamebirds	4.4	17.8

Appendix B: Active Observational Surveillance Analysis for HPAI in U.S. Large-Volume Commercial Poultry Operations

Management practices in the poultry population that we have defined as large-volume commercial poultry operations include daily observation of flocks, defined as monitoring of mortality and morbidity by growers (please see Stakeholders and Responsible Parties, page 12). Because this surveillance method is active, ongoing, and is common operating procedure for large-volume commercial poultry operations, an analytic model was developed to predict the sensitivity (probability of detecting disease, if present) of the active observational surveillance method.

The model estimates the time from first exposure of a flock until a quarantine is placed on the premises and the probability that an infected flock will be detected in that amount of time.

Our analysis of the active observational surveillance that is currently conducted in U.S. commercial poultry operations concurs with the experiences recorded in the Netherlands (Elbers *et al.* 2005), which concluded that the observation of clinical signs followed by confirmatory testing is the most efficient and rapid method for detection of HPAI. Although this type of surveillance is likely to be much less effective in H5/H7 LPAI detection, H5/H7 LPAI represents smaller consequences to industry and public health and a slower rate of disease spread. Since Asian HPAI H5N1 is a disease presenting the greatest risk and consequences at this time, our analysis emphasizes surveillance methods to detect highly pathogenic AI viruses.

The goal of the analysis is to determine the likelihood that the disease would be detected if infection was introduced into one of the sectors of the large-volume commercial population defined in this plan. The chosen method of analysis, which is referred to as stochastic scenario tree analysis, is based on methods employed in similar assessments of NAI (Martin P.A. and Cameron J.A. 2002) and other foreign animal disease applications (de Vos *et al.* 2004).

A scenario tree is a schematic representation of the system of sequential events that must occur in order for a specific outcome to occur. An example of a scenario tree is given in Figure B1, which depicts the events that must occur for a flock to be detected with NAI. In this example, we look at the probability of detecting infection given that the sector is in fact infected with as few as one infected flock. The analysis assumes that the virus will cause clinical signs, someone inspects the flock daily, action is taken resulting in sample collection, and the test correctly identifies the sample as positive. At each node in the scenario tree, the probability of the event is determined and the probability of the final event occurring is the product of the individual events leading to the final event.

For HPAI viruses, the probability of clinical signs is very high (near 100 percent for Asian HPAI H5N1) and large-volume commercial industry practices indicate that the probability of observation of clinical signs and changes in production every day is also very high. The likelihood of action that results in sample collection is assumed to increase proportionately with the morbidity and mortality rate. In other words, a contract grower or flock serviceperson might be alert and astute enough to recognize AI from clinical signs in a few birds, but the probability of this happening in a very large flock is small. However, since the mortality and morbidity increase exponentially, the number of affected birds reaches a point where the magnitude and rapid increase almost guarantee that an observed flock will be sampled. We assume that this point is reached at approximately 10 times the normal morbidity and mortality and that the spread of the disease follows a modified Reed-Frost disease spread model for intra-flock transmission (2005). We assume that test sensitivity begins at the diagnostic sensitivity of the test(s), but increases with increasing mortality. This would be expected because false negatives would be accompanied by increasing morbidity and mortality, and we assume that samples would be re-submitted and retested multiple times until the disease agent is correctly identified.

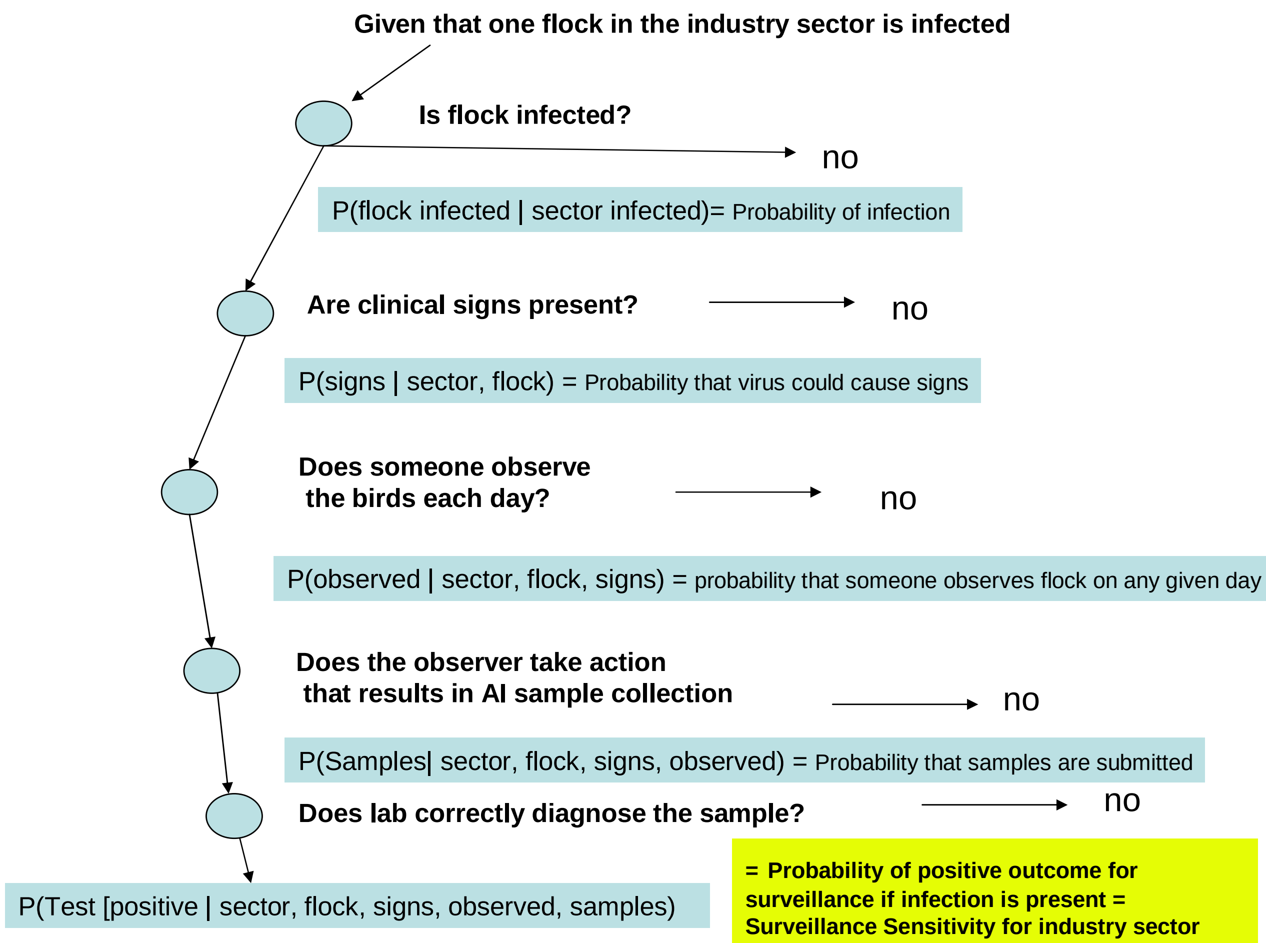


Figure B1. The scenario tree above depicts the pathway of events that must occur for a detection of HPAI by active observational surveillance. Each event is described in the model as a probability or by an uncertainty distribution and the final outcome—surveillance sensitivity (SSE)—is the probability of detecting HPAI if it were present in the industry sector.

Data Sources and Model Parameters

Sources of information for the sensitivity analyses include NASS data, poultry industry statistics, NAHMS studies, expert opinion, and peer reviewed literature (Table B1). Observational data for the HPAI analysis are collected by private companies, but not shared with or stored by APHIS' Veterinary Services unless an outbreak is suspected. For broilers and turkeys, cut-off points for each industry sector were chosen in order to include operations that we felt had large-volume commercial production system characteristics (Table B2). The number of table-egg layer operations was estimated by dividing the average number of layers on farm by the average estimated flock size and number of flocks per farm.

The surveillance unit used for computation in this model was the poultry house. The number of surveillance units was determined by multiplying the total number of houses per farm (operation) times the number of operations for each industry sector.

Pathogenicity characteristics for HPAI viruses and for Asian HPAI H5N1 virus were based on information received from expert opinion (Dr. David Swayne, researcher and poultry expert, Southeast Poultry Research Laboratory, USDA Agriculture Research Service; Dr. Huu Dung Do, epidemiologist having extensive field experience with Asian HPAI H5N1, Vietnam Ministry of Agriculture; and USDA/APHIS CEAH epidemiologists) and peer reviewed literature (van der Goot *et al.* 2003) (Table B3).

Estimations were made for diagnostic test sensitivities using data from field study evaluations of two antigen tests (Pedersen 2006) (Table B3). However, a great deal of uncertainty is present in the estimation of true sensitivity of the test because additional data are generally included or available such as necropsy results, clinical history, and multiple samples from a flock submission. We assumed that initial test sensitivity would reflect the performance of a test on a single submission that was not highly suspect due to clinical signs and the uncertainty distribution would range from 80 percent to 95 percent depending on type of test. We also assumed that the overall sensitivity of the laboratory results would increase rapidly with mortality and would reach 100 percent due to added information of clinical signs and retesting or resubmitting samples when an initial diagnosis was inconclusive or negative.

Estimations on the length of time from the contract grower reporting morbidity or mortality until diagnostic sample submission, delivery to laboratory, conducting tests, notification, and quarantine were based on expert opinion through interviewing poultry specialists. These specialist included epidemiologists, private poultry veterinary practitioners, laboratory staff, and regulatory veterinarians.

On a routine disease investigation, diagnostic sample submission is expected to occur on the same day as the investigation, and laboratory screening results would generally be available within 24 hours. While routine disease investigations would normally not be pursued over a weekend or holiday period, if mortality greatly exceeded the established trigger, emergency on-call notification procedures would result in rapid sample submission and priority laboratory testing yielding a screening test result in a few hours. Notification and quarantine of the premises is expected to occur rapidly following a presumptive diagnosis from the laboratory. Twenty-four hours were added to the high side of our estimate to account for overnight courier delivery in areas of the country where veterinary diagnostic laboratories services are not immediately accessible.

The total estimated time from the contract grower identifying a problem until a quarantine is placed is estimated to range from few hours up to 3–1/2 days.

We estimate time at which the grower would request a disease investigation and sample collection to be proportional to mortality and morbidity. Based on the average normal mortality of flocks, we assume that an observant contract grower might observe signs when a few birds were infected; growers are more likely to report a potential disease event as mortality and morbidity increase above normal. When the combination reaches ten times normal daily mortality and morbidity, we assume that the probability of reporting becomes 100 percent. We believe that this figure is reasonable because it also corresponds to the time when the mortality curve becomes very steep. The contract grower not requesting support at this time would rapidly accumulate massive numbers of dead carcasses. We use an internal disease transmission model (SEIR model) as surrogate information for reporting where the proportion of mortality and morbidity reflects the probability that the grower would report disease. (i.e., if mortality and morbidity is 2 times normal, the reporting probability is 20 percent; if 3 times normal, reporting is 30 percent; if 5 times normal, 50 percent; and so forth up to 100 percent.)

House sensitivity (probability of detecting house if infected) for each day was simulated as the product of uncertainty distributions [probability that contract grower requests an investigation of mortality or suspicious morbidity] * [probability of observation] * [binomial likelihood of virus being capable of causing signs] * [test sensitivity] * [test diagnostic sensitivity]. Sector sensitivity (probability of detecting at least one house if the sector is infected with one or more houses) was determined as 1-the hypergeometric probability of 0 detections in a sample size of [House Se * total number of houses] where the population prevalence is [1/total houses].

The probability of detection within a chosen number of days was calculated as 1- (1- sector sensitivity for day 1 * 1- sector sensitivity for day 2 … * 1- sector sensitivity for day 10)

Table B1. Model parameters: sources of information for surveillance system component sensitivity analysis.

Input Variable	Information Source
Number of large-volume commercial operations	NASS data • Farms having a minimum of 30,000 broilers sold annually per farm • Farms having a minimum of 8,000 mature turkeys sold annually per farm • Calculated from 2002 agricultural statistics and NPIP breeder enrollment
Management factors (i.e. flock size, birds per house, mortality)	Expert opinion (NPIP veterinary medical officer)
Virus pathogenicity characteristics (i.e. latency period, time from shedding until death, mortality estimates)	Expert opinion; personal communication (D. Swayne, Southeast Poultry Research Laboratory, USDA Agriculture Research Service; H. D. Do, poultry epidemiologist with extensive experience in HPAI H5N1 outbreaks in Vietnam) Peer reviewed literature [transmission studies (Van der Goot, 2003)]
Diagnostic test sensitivities	Data from USDA's National Veterinary Services Laboratories
Time from disease observation until diagnostic sample submission	Expert opinion (Industry veterinarian, poultry epidemiologists)

Table B2. Model parameters: estimated numbers of operations in each industry sector and other management characteristics used as input variables for sensitivity analysis

Variable	Broiler	Layer	Turkey	Breeder
# of operations	25,828	753	2,753	5,575
# houses per farm Pert distribution	Pert(1, 4, 12)	Pert(1, 1.3, 7)	Pert(2, 5, 8)	Pert(1, 2, 6)
Average house (birds/house) Pert distribution	Pert(6000, 15000, 20000)	Pert (30,000, 63,000, 175000)	Pert(4000, 7000, 8000)	Pert(4000, 15000, 20000)
Total flocks	Estimated as Normally distributed variable with mean = mean of "houses per farm" times "total # of operations" and standard deviation = standard error of "houses per farm"			
Normal daily mortality Average over flock life	0.0005 per day	0.00013 per day	0.00036 per day	0.00029 per day
Normal morbidity Estimated as ½ of mortality	Less than mortality rates	Less than mortality rates	Less than mortality rates	Less than mortality rates

Table B3. Model parameters: pathogenicity characteristics and estimations.

Pathogenicity characteristic and distribution variable	Estimations
Probability that virus is capable of causing signs = Proportion of HPAI field isolates that do cause mortality in laboratory inoculation studies	4% (24 HPAI outbreaks since 1959 and only one was categorized as HPAI based solely on molecular criteria [1]). For HPAI; Binomial output of random integer function (0,23) Value is 0 for no signs, 1 for viruses causing signs For Asian HPAI Set uniformly to 1
Number of days after shedding starts until death (Asian HPAI H5N1 or other HPAI)	*3/4 day. (D. Swayne), 1 to 3 days (D.H. Do), 2-3 days, (Van der Goot) Waiting time Exponential distribution (1.5)
Time of exposure until time of shedding for one bird (Asian HPAI H5N1 or other HPAI)	*3/4 day. (D. Swayne), 1 to 2 days (D.H. Do), ¼ to 2 days, (Van der Goot) Waiting time Exponential distribution (1.5)
Initial number infected	Set at 1 because this would be the most conservative value resulting in the longest time for transmission through flock
Number of effective contacts for an infected bird per day	Varied estimates from literature and expert opinion. We use an uncertainty pert distribution with parameters of ranging between low of 2 and high of 10.4 depending on flock type.
Test Sensitivity This distribution was modified to increase proportionate to mortality and morbidity and to reach 100% as mortality and morbidity approach 10-fold of normal	Directogen / VI — RRT-PCR / VI [2]Sensitivity: 80.5 — 95.1 Pert Distribution (0.8, 0.9, 0.95) increasing to 100%

[1] The molecular definition was not established until the late 1990s.
[2] (Pedersen 2006).
[*] Indicates uncertainty due to strain characteristics

Results of Active Observational Surveillance Analysis

The model output in Table B4 shows the estimated sensitivity (probability of detection, if disease is present) of surveillance for all HPAI viruses and again for the specific Asian HPAI H5N1 strain. The results for each assume that the detection threshold is one infected house out of all flocks in the industry sector. The confidence of detection for all HPAI viruses reaches a maximum at about 95 percent because some HPAI viruses have failed to demonstrate clinical sign (personal communication D. Swayne) e.g., Texas 2004 HPAI had a pathogenicity index of 0, (Pelzel *et al.* 2006). In comparison, the Asian HPAI H5N1 virus has consistently demonstrated high mortality in all poultry flocks.

Because of the very overt clinical signs, the probability of detecting Asian HPAI H5N1 becomes very close to 100 percent, even using the relatively conservative assumptions in the model. The maximum detection window for Asian HPAI H5N1 with greater than 99 percent probability is 14 days in the broiler industry due to the larger number of flocks, while the smaller industry sectors would likely be detected a few days earlier.

Table B4. Results: Window of detection (time from exposure until quarantine is placed) for HPAI and Asian HPAI H5N1 virus outbreaks.

Large-volume commercial industry sector	all HPAI virus outbreaks. >95% confidence of detection	HPAI Asian H5N1: >99% confidence of detection	HPAI Asian H5N1: >95% confidence of detection
Broiler	14 days	14 days	10 days
Breeder	10 days	10 days	7 days
Layer	10 days	10 days	7 days
Turkey	10 days	10 days	7 days

Data Analysis

Surveillance in the large-volume commercial poultry population is conducted by active observational surveillance, as well as laboratory testing using antibody and virus detection methods. Given the intensive management of large-volume commercial flocks, active observational surveillance should rapidly identify the increased morbidity, mortality, and clinical signs associated with HPAI. An analysis was conducted using a sensitivity model designed to estimate the probability of detection and the time until detection following exposure of poultry within this large-volume commercial sub-population to highly pathogenic viruses.

The estimated sensitivity (probability of detection if infection is present) of active observational surveillance in large-volume commercial flocks is very high in a relatively short time window after initial infection. The analysis predicts that we should be 95 percent confident of detecting and quarantining a flock infected with HPAI within 14 days in the commercial broiler sector and within 10 days in the breeder, layer, and turkey sectors. Since HPAI outbreaks have been reported having no clinical signs, 95 percent is the maximum probability of detection by active observational surveillance. However, HPAI viruses without clinical signs would very likely be detected in time by active laboratory surveillance. In the same time window, the model predicts that active observational surveillance would have 99 percent sensitivity (probability of detection) for an Asian HPAI H5N1 virus outbreak and would have 95 percent probability of detection within 10 days for broilers and 7 days for detection in the other sectors.

In summary, we expect that an outbreak of HPAI, including the Asian H5N1 virus, would be detected in less than 2 weeks in any sector of the large-volume commercial poultry industry by ongoing active observational surveillance. This fulfills the first purpose of the surveillance system in this population, rapid detection of HPAI. Serologic and swab testing can be expected to detect circulating pools of H5/H7 LPAI within the time period covered by the sampling frequency of the population sector. This fulfills the last two purposes of the surveillance system in the large-volume commercial population; an assurance that LPNAI strains are not allowed to enter and persist where they could spread and possibly mutate into HPAI; and consistency with international surveillance guidelines to support international efforts to ensure unimpeded trade, without incurring unacceptable risks to human and animal health.

Appendix C: Risk-Based Spatially Targeted Surveillance (Sentinels)

Backyard poultry flocks serve as an early warning system to detect the introduction of Asian HPAI H5N1 into the United States. Two risk factors increase the probability of disease emergence in backyard poultry flocks. First, husbandry practices that result in direct or indirect exposure to migratory waterfowl or waterfowl habitat (water); secondly, subsequent movement of birds or owners of small flocks to shows, fairs, or swap meets once disease has been introduced. No information is available concerning the geographic distribution and density of backyard flocks at the national level. However, studies have estimated the density of backyard flocks located near commercial poultry operations in selected States. Sampling backyard poultry located near commercial poultry operations exposed to high risk waterfowl populations and their habitat on a targeted or *a priori* basis would establish sentinel surveillance for the early detection of Asian HPAI H5N1 prior to introduction into the commercial poultry industry.

Analysis of both water and fecal material from waterfowl habitat provides evidence of AI virus circulating in wild bird populations, the specific AI subtypes, levels of pathogenicity, and possible risks to poultry. Monitoring of water and/or fecal samples gathered from waterfowl habitat appears to be a reasonably cost effective, technologically achievable means to assess risks to poultry, and should be incorporated into an early warning system at the agriculture-wildlife-environment interface. Fecal sampling is an established technique and is ready for use in surveillance with the establishment of sampling guidelines. Validation of water sampling methods is underway at APHIS National Wildlife Research Center. Here we provide an initial analysis of targeted risk-based sampling allocation using birds that breed in Alaska and Canada and migrate south to winter in southern areas of the United States. Further and more comprehensive analysis is currently being conducted to examine the role of all migrant waterfowl in not only the Pacific flyway but also the Atlantic flyway and Southern Central flyways.

To allocate sampling efforts for backyard flocks and waterfowl habitat near poultry populations at risk it is necessary to identify and prioritize locations with the highest probability for introduction of Asian HPAI H5N1. To identify high-risk waterfowl habitat in space and time, analysis focused on primary avian functional groups thought to be responsible for large-scale movements of Asian HPAI H5N1, which required information on continental scale movements of wild bird species. With certain limitations, continental movements can be estimated using data from bird band recoveries. Surveillance of backyard poultry or waterfowl habitat should target locations and times when water birds are found in high concentrations because this may provide the greatest opportunity for detecting avian influenza should transmission between wild and domestic bird populations occur.

Use of Band Recovery Data

Bird band recovery data is available at a continental scale and is distributed by USGS Patuxent Wildlife Research Center Bird Banding Laboratory. Bird banding is a mark recapture technique for studying the movement, survival, and behavior of birds. One attribute of critical interest for this analysis is that bird banding data provides both the origin of the banded bird and the recovery location. Birds are typically banded on their breeding grounds in northern latitudes with bands typically recovered during the fall migration. The North American Bird Banding Program is jointly administered by the U.S. Department of Interior and the Canadian Wildlife Service. Their respective banding offices have similar functions and policies and use the same bands, reporting forms, and data formats. Joint coordination of the program dates back to 1923. The majority of data contained in the bird banding data is information from hunter-shot birds, which provides locations and times where waterfowl have been harvested during their fall migration from summer breeding grounds. The recovery of bands is reported in 10-minute blocks of degrees for longitude and latitude.

Hunter-gathered data inherently contains biases and assumptions. The primary assumption is that hunter effort and selection of harvest locations corresponds to the presence of large aggregations of waterfowl. In addition, hunter-gathered data only represents the location of birds during the hunting season, which in the case of most waterfowl is from September through February depending on the State and species. The only notable exception is snow geese, which are also hunted in several States during the spring migration in March. Despite these biases, banding data is the best source of information on the spatial and temporal distribution of water fowl species.

For North American bird species that are banded, the banding record is extensive and dates back to the early 1920s. For this analysis, data were limited to the last 15 years (1991-2006) of banding data. Summarizing these data over a large time period had several advantages. First, using a large time span is more likely to smooth over biases, providing a more accurate representation of bird movements. Data were selected for the last 15 years as a compromise between using enough data to guard against yearly biases in hunter effort and location and including temporal biases associated with land-use change, such as wetland loss or conversion of habitat to other uses such as agricultural or urban use. The data were summarized by 10-minute blocks for functional groups though to present a higher risk for transmitting highly pathogenic avian influenzas and by band origin – for this initial analysis we selected birds banded in Alaska, northeastern Asia (primarily Wrangle Island), or Canada. The functional groups included in the analysis were dabbling ducks, dark geese, light geese, and swans. This resulted in a continental representation of band recoveries for the fall migration over the last 15 years, accounting for 241,619 total observations. Table C1 and Figure C1 present the number of band recoveries by State for the 15-year period. The 10-minute block data was aggregated up to the county level identifying the number of bands recovered from birds originating in Alaska, northeastern Asia, and Canada.

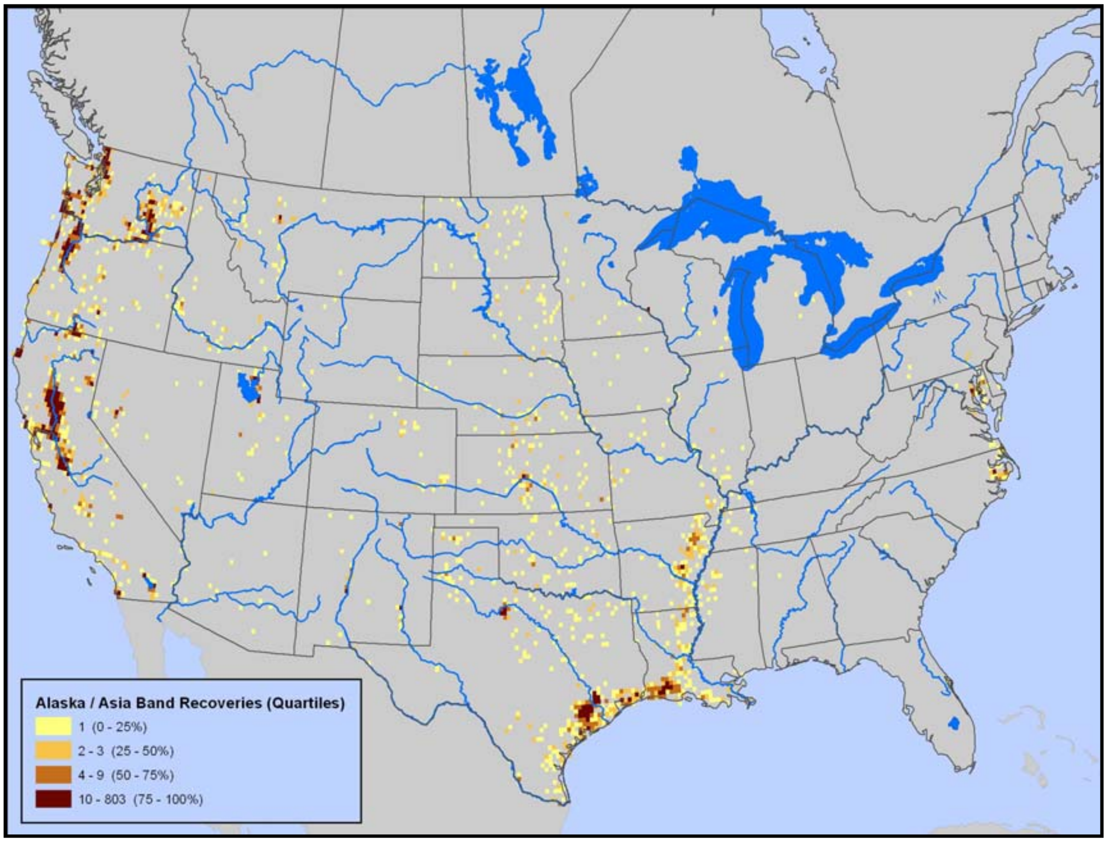
The analysis was done for both waterfowl originating in Alaska and northeastern Asia and also for all waterfowl (Alaska, northeastern Asia, and Canada). Migrants from Alaska and northeastern Asia have been hypothesized to pose a serious threat for movement of Asian HPAI H5N1, primarily because of a perceived risk of transmission from birds that over-winter in Southeast Asia to North American birds on Alaskan breeding grounds where birds from both locations commingle. Additionally, substantial intermixing of migrating waterfowl originating from Alaska and northeastern Asia occurs in southern Canada in the upper prairie pothole region and throughout the Pacific and Central flyways. For this reason, it is important to identify not only areas with high levels of migrant waterfowl originating from Alaska and northeastern Asia, but also the total number of migrant waterfowl. For the analysis we present here, the analysis was conducted for both high-risk migrants from Alaska and northeastern Asia and for all migrant waterfowl originating in Alaska, northeastern Asia, and Canada.

Table C1. Number of band recoveries by State from 1991-2006.

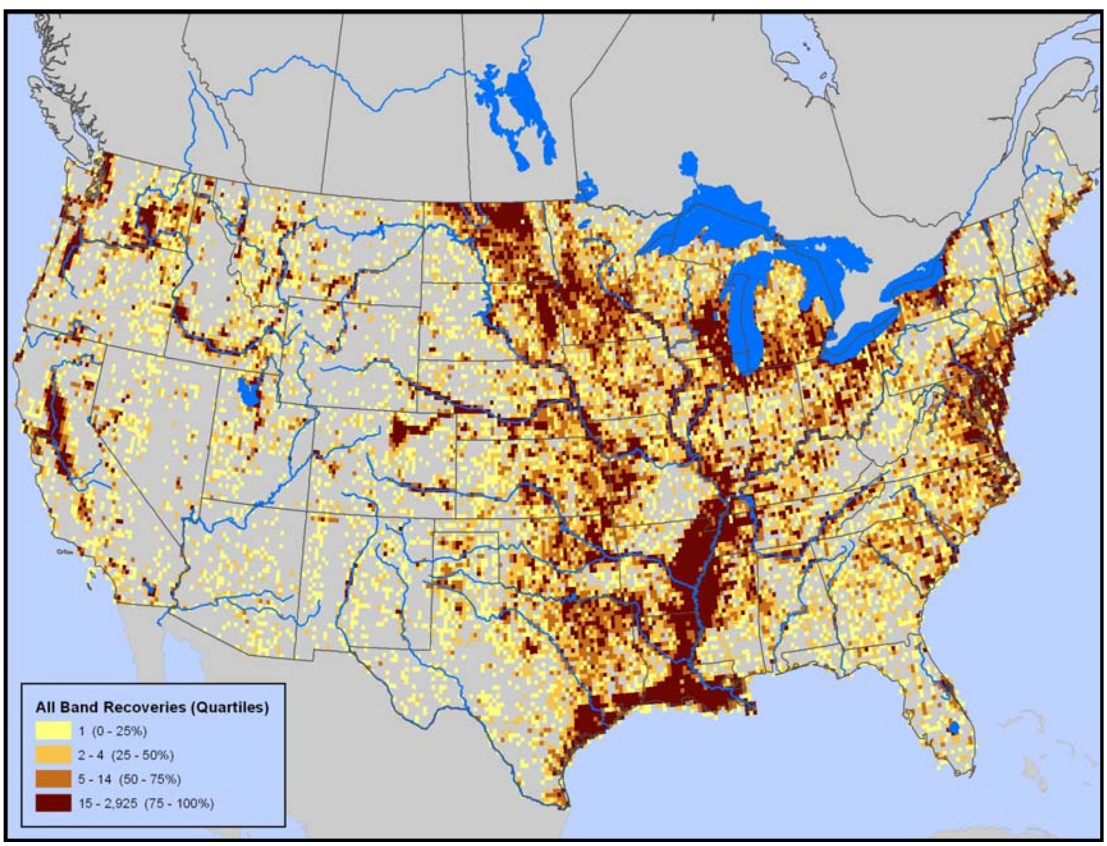
State	Total Recoveries	Canadian Origin	Alaska / Asia Origin
Alabama	1,428	1,424	4
Arizona	203	187	16
Arkansas	25,248	25,061	187
California	12,609	9,163	3,446
Colorado	3,087	3,032	55
Connecticut	710	710	
Delaware	3,347	3,346	1
Florida	918	917	1
Georgia	735	734	1
Idaho	6,507	6,445	62
Illinois	11,985	11,959	26
Indiana	2,635	2,634	1
Iowa	3,154	3,143	11
Kansas	4,330	4,228	102
Kentucky	3,357	3,352	5
Louisiana	17,691	17,356	335
Maine	539	539	
Maryland	5,144	5,130	14
Massachusetts	940	940	
Michigan	8,361	8,352	9
Minnesota	5,783	5,770	13
Mississippi	6,640	6,609	31
Missouri	8,188	8,143	45
Montana	3,759	3,681	78
Nebraska	6,021	5,940	81
Nevada	375	316	59
New Hampshire	284	284	
New Jersey	4,124	4,123	1
New Mexico	528	501	27
New York	7,955	7,951	4
North Carolina	3,246	3,223	23
North Dakota	5,568	5,533	35
Ohio	5,555	5,554	1
Oklahoma	5,283	5,235	48
Oregon	6,987	5,018	1,969
Pennsylvania	5,047	5,039	8
Rhode Island	334	334	
South Carolina	1,503	1,502	1
South Dakota	4,508	4,459	49
Tennessee	6,258	6,237	21
Texas	13,471	12,837	634
Utah	1,316	1,187	129
Vermont	1,858	1,858	
Virginia	3,360	3,356	4
Washington	12,228	10,208	2,020
West Virginia	222	221	1
Wisconsin	7,365	7,330	35
Wyoming	925	914	11
Total	**241,619**	**232,015**	**9,604**

Figure C1. Summarized band recoveries for migrant waterfowl (1991- 2006).

Bands originating in Alaska and northeastern Asia



Bands originating in Alaska, northeastern Asia, and Canada



County level summaries were then stratified into four categories at the national level using quartiles (25th, 50th, 75th). The result identified counties of critical concern for migrating waterfowl. Although it is possible to analyze these data at the species level, the high degree of commingling of species both within migratory corridors and on over-wintering areas in the United States, analysis by functional group may be more practical. If it becomes apparent that there exists homogeneity in over-wintering populations or specific migration corridors during the fall migration, then it may be necessary to stratify the data by species.

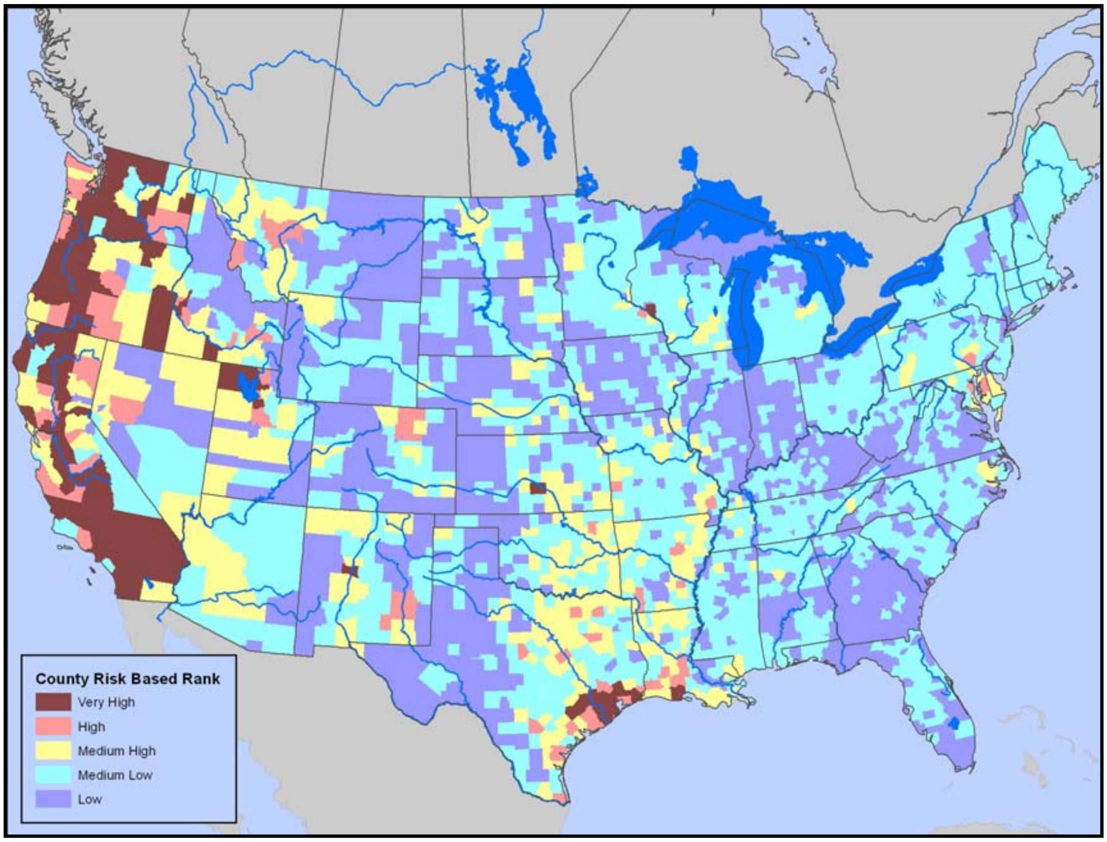
Poultry-related data

An important concern related to AI viruses is to protect commercial production (bird health and producer income) and the national supply of poultry and poultry products. Therefore, this analysis relied on the USDA National Agricultural Statistics Survey data (NASS) for commercial poultry producer information as described in the 2002 Census of Agriculture. Similar to the bird banding data, county level NASS data for the number of poultry farms by county was stratified into four categories at the national level using quartiles (25th, 50th, 75th). These data were not subset by production type and includes all production types, including broilers, layers, pullets, turkeys, and other poultry, such as ducks and gamebirds. The result identified counties critically important to the United States commercial production of poultry products. More specific data concerning the number of farms by inventory category and sales category has been requested from NASS, but has not yet been received. This more specific county level data will enable better identification of small producers that have been identified as having a higher over all risk for avian influenzas, thereby improving the geographic risk-based ranking of counties.

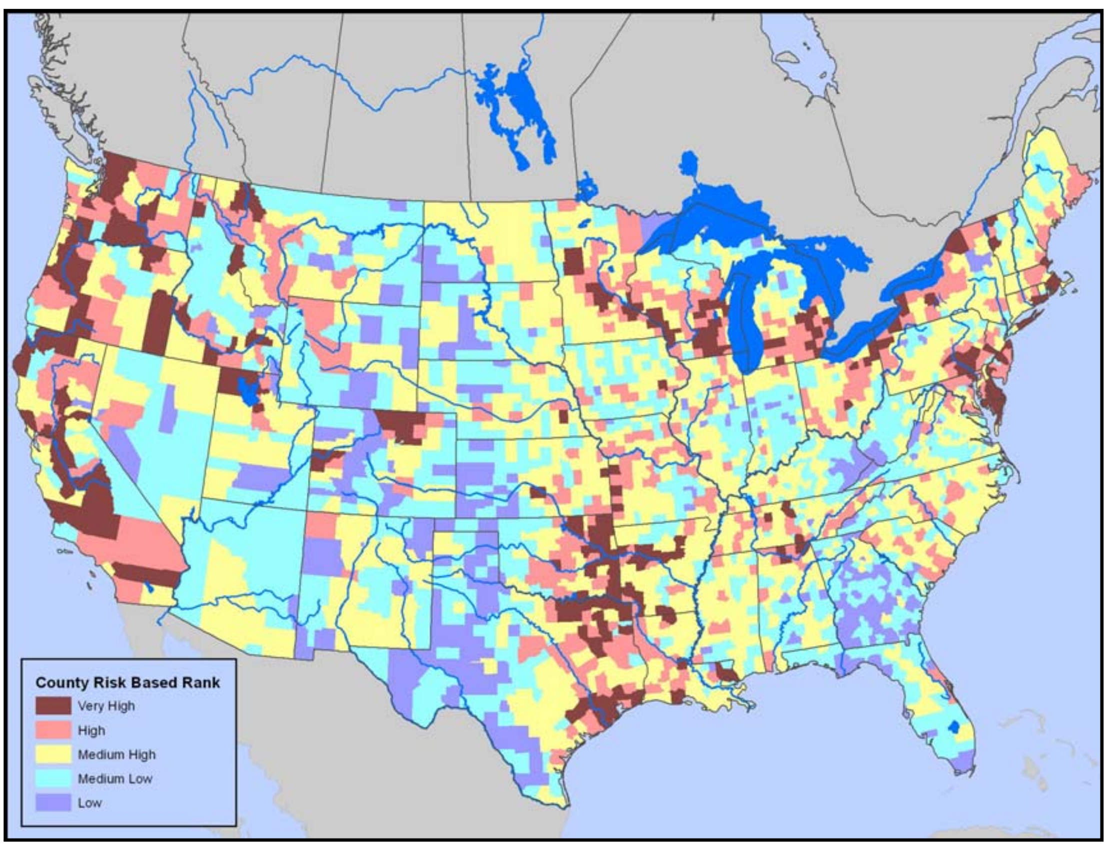
Risk-based ranking

To identify areas of critical concern and overlap between commercial poultry production and concentrations of migratory waterfowl, each dataset (commercial poultry and band recoveries) was stratified into quartiles (1-25%, 25-50%, 50-75%, and 75-100%) in terms of number of individual band recoveries or poultry inventory occurring within a county. These quartiles were assigned an ordinal ranking from one (25th percentile) to four (75th percentile) (Figure C2). Counties that did not have any band recoveries or poultry production were given a rank of 0. Both datasets were then spatially merged assuming an additive relationship between each dataset-quartile combination resulting in a subjective ranking for each county ranging from 0 to 8. The rankings were then assigned a subjective relative risk rank of very high (8), high (7), medium high (5, 6), medium low (3, 4), or low (0, 1, 2). This resulted in the identification of areas having relatively high levels of poultry production and high levels of migrating waterfowl. This ranking assumes that counties with a higher rank have a greater risk of contact between domestic poultry and migrating waterfowl and are therefore identified as high importance for surveillance of Asian HPAI H5N1 in domestic poultry.

Figure C2. County risk-based rank for Alaska and northeastern Asia migrant waterfowl.



County risk-based rank for Alaska, northeastern Asia, and Canada migrant waterfowl



This spatial analysis identified 483 counties (15 percent of total) as very high, high, and medium high priority for surveillance, when analysis was restricted to migrants originating from Alaska and northeastern Asia. These counties are primarily located along the Pacific flyway and critical over-wintering areas along the Gulf Coast of Texas and Louisiana. Counties with critical migration stopover points in Utah, New Mexico, Kansas, and other Midwestern States also ranked high. These 483 counties account for 29 percent of poultry farms and 26 percent of domestic poultry population according to 2002 NASS data. Table C2 presents the number of counties in each risk category along with the number of commercial poultry farms represented by those counties. Table C3 presents the data broken out by State when only wild birds banded in Alaska and northeastern Asia are considered; the top 10 highest risk States with farms or poultry are noted. Table C4 is the same as C3 except that birds banded in Canada are also considered in the ranking.

Table C2. Summary of counties by risk-based rank with Alaska, northeastern Asia, and Canadian migrant waterfowl.

Risk Rank	Number of Counties		Number of Farms		Estimated Poultry Population	
		%		%		%
Very High	210	7	26,887	18	342,437,349	21
High	428	14	35,282	24	285,690,255	17
Medium High	1,208	38	62,173	43	858,185,648	52
Medium Low	895	28	19,465	13	138,389,285	8
Low	400	13	2,320	2	17,768,505	1
TOTAL	3,141		146,127		1,642,471,042	

Table C3. Summary by State of counties with risk-based ranks of very high, high, or medium high for Alaska and northeastern Asia migrant waterfowl.

State	Number of Counties		Number of Farms		Estimated Poultry Population	
		%		%		%
Alabama	1	1	89	2	3,395,012	2
Arizona	4	27	409	55	4,745	37
Arkansas * +	32	43	3,028	55	131,882,719	63
California * +	48	83	4,086	96	43,833,739	100
Colorado	8	13	764	36	2,953,358	99
Delaware +	2	67	681	98	39,958,436	100
Idaho	17	39	1,133	69	29,292	74
Illinois	4	4	122	6	2,735	0
Iowa	3	3	107	4	5,771	0
Kansas	19	18	895	36	760,246	94
Kentucky	1	1	110	3	6,614,963	15
Louisiana * +	28	44	1,189	64	39,569,530	87
Maryland +	10	42	638	39	18,363,918	36
Michigan	2	2	172	4	5,158	0
Minnesota	7	8	582	13	1,280,019	6
Mississippi	4	5	234	5	1,863,125	1
Missouri * +	22	19	1,375	22	7,677,414	18
Montana	14	25	702	48	218,722	50
Nebraska	11	12	410	23	988,202	63
Nevada	6	35	239	71	4,758	72
New Mexico	9	27	715	49	17,039	48
North Carolina +	4	4	174	3	6,936,957	4
North Dakota	4	8	65	11	1,402	1
Oklahoma * +	31	40	3,612	63	34,884,429	85
Oregon *	33	92	4,496	98	3,546,173	100
Pennsylvania * +	8	12	2,022	29	29,738,941	58
South Dakota	5	8	138	14	21,768	2
Tennessee	5	5	274	5	1,563,738	6
Texas * +	83	33	8,305	59	31,898,317	34
Utah *	15	52	1,152	77	14,597	69
Virginia	1	1	77	2	5,891,861	11
Washington *	32	82	2,960	96	6,122,120	100
Wisconsin	9	13	879	15	2,387,908	23
Wyoming	1	4	50	7	1,258	7
Total	483	15	41,884	29	422,438,370	26

* State is in the top 10 for number of farms in the high risk categories.
\+ State is in the top 10 for the number of poultry in the high risk categories.

Table C4. Summary by State of counties with risk-based ranks of very high, high, or medium high for Alaska, northeastern Asia and Canadian migrant waterfowl.

State	Number of Counties	%	Number of Farms	%	Estimated Poultry Population	%
Alabama [+]	39	58	3,772	85	160,989,605	94
Arizona	5	33	519	69	7,331	57
Arkansas * [+]	64	85	5,236	95	205,709,949	99
California	46	79	4,034	95	43,832,268	100
Colorado	23	36	1,587	75	2,972,998	100
Connecticut	8	100	683	100	71,319	100
Delaware	3	100	697	100	39,958,436	100
Florida	13	19	1,124	46	9,166,831	46
Georgia [+]	20	13	2,187	53	143,534,492	64
Idaho	24	55	1,400	85	34,432	88
Illinois	66	65	1,558	72	1,016,460	65
Indiana	35	38	1,786	60	8,954,504	63
Iowa	56	57	1,745	66	10,286,113	88
Kansas	51	49	1,862	75	791,525	98
Kentucky	54	45	2,165	66	39,727,376	89
Louisiana [+]	54	84	1,759	94	45,684,944	100
Maine	14	88	1,107	91	60,890	95
Maryland [+]	21	88	1,598	97	51,607,196	100
Massachusetts	11	79	1,007	98	85,882	99
Michigan	61	73	4,048	93	6,842,262	100
Minnesota	76	87	4,260	97	20,644,155	100
Mississippi [+]	58	71	3,688	82	120,606,910	87
Missouri *	89	77	5,445	86	41,458,301	99
Montana	25	45	1,033	70	168,664	39
Nebraska	53	57	1,366	75	1,553,964	99
Nevada	6	35	239	71	4,758	72
New Hampshire	6	60	538	76	20,755	63
New Jersey	15	71	1,280	96	50,371	93
New Mexico	16	48	1,106	75	27,699	77
New York	47	76	3,077	92	856,717	98
North Carolina * [+]	63	63	5,462	87	167,555,821	95
North Dakota	34	64	380	64	178,902	96
Ohio *	71	81	5,309	92	28,395,478	99
Oklahoma *	58	75	5,424	94	41,241,702	100
Oregon *	30	83	4,465	97	3,545,716	100
Pennsylvania * [+]	53	79	6,720	95	50,762,454	100
Rhode Island	4	80	166	96	39,558	100
South Carolina	31	67	1,729	88	35,253,060	89
South Dakota	37	56	746	74	1,250,469	89
Tennessee *	77	81	4,642	92	25,380,138	96
Texas * [+]	134	53	12,623	89	91,961,672	98
Utah	18	62	1,364	91	17,925	85
Vermont	10	71	857	87	25,418	86
Virginia [+]	50	37	2,495	75	51,732,320	95
Washington	32	82	2,958	96	6,121,341	100
West Virginia	14	25	1,139	50	15,516,634	100
Wisconsin *	62	86	5,526	97	10,594,915	100

State	Number of Counties		Number of Farms		Estimated Poultry Population	
Wyoming	9	39	431	63	12,622	67
Total	1,846	59	124,342	85	1,486,313,252	90

* State is in the top 10 for number of farms in the high risk categories.
+ State is in the top 10 for the number of poultry in the high risk categories.

It is possible to further refine this analysis to identify areas within high-risk counties, where interaction between poultry and aggregations of waterfowl are possibly more likely to occur. Data such as the 10-minute block band recoveries, national wetland inventory, and other waterfowl habitat related information can be used to further refine the perceived areas at risk for interactions between waterfowl and domestic poultry. In addition, surrogate data for identifying concentrations of backyard poultry operations could potentially be used, including locations of poultry suppliers and poultry feed stores, and zoning code violations and noise violations related to excess or crowing poultry.

This analysis focused entirely on the spatial aspects of waterfowl populations to the degree that band recovery data can act as a surrogate for waterfowl populations and the potential overlap with the commercial poultry industry. However, the temporal aspects of migratory bird movement are also critical when designing a surveillance strategy. Maintenance and movement of AI viruses in a population is both density dependent and associated with the presence of immunologically naive hosts. Both of these factors are temporal in nature and differ across the migratory pathway of waterfowl. It is possible to define the temporal period most important for surveillance of Asian HPAI H5N1 based on the typical migration and over wintering period of waterfowl. This time period will differ greatly between southern and northern States and is critical for collecting samples at the optimum time. The temporal aspects of waterfowl migration should be included in future analysis to better define best surveillance practices.

Sampling Methods

Backyard flocks are randomly chosen for targeted surveillance based on the occurrence and observation of mortality incidence (refer to Backyard Poultry, page 30). For passive surveillance, flock owners are encouraged to submit dead birds to State diagnostic laboratories, or contact county extension service agents or use telephone hotlines established through programs such as USDA's "Biosecurity for the Birds" to report sick birds. Convenience sampling at shows, fairs, and exhibits augments surveillance methods for H5/H7 LPAI for birds that move frequently and is administered through *The Prevention and Control of H5 and H7 Low Pathogenicity Avian Influenza in the Live Bird Marketing System* cooperative agreement funding.

Appendix D: Testing Assays

The use of acute and convalescent sera is recommended for serologic diagnosis of AI virus infection in domestic poultry (Beard C.W. 1989). Serologic tests on a flock basis are considered a useful tool for determining whether a flock has been infected with influenza, but serological tests may miss recent flock infection because a measurable antibody titer does not develop until after approximately one week (Swayne *et al.* 1998). The AGID assay has been validated as a serologic screening tool for domestic poultry and is widely used for active surveillance to detect influenza A antibodies at a flock level (Beard 1970). It is preferred by most poultry diagnostic laboratories for diagnosis and surveillance because of its simplicity, reliability, and broad specificity for detecting all type A influenza virus infections (Swayne *et al.* 1997).

Although validated only for domestic poultry, the AGID has been used in diagnostic veterinary laboratories for many years as a serological screening test for other avian species, including waterfowl (Shafer 2006). The turn-around time for AGID is 24 hours for a positive and 48 hours for a negative sample (Akey 2003). AGID reagents are not available commercially, but are produced by and distributed by USDA's National Veterinary Services Laboratories. Reagents sufficient to perform approximately 2.5 million AGID tests are provided to State, university, and industry diagnostic laboratories annually. AGID has been shown to be less sensitive than ELISA, which is also used widely to identify type-specific antibodies (Meulemans *et al.* 1987).(Snyder *et al.* 1985) Two commercial antibody ELISA assays have been licensed by the USDA Center for Veterinary Biologics (CVB) and are approved for use in the NPIP programs – the Synbiotics ProFLOK® AIV test kit and the Idexx FlockCheck® AIV test kit.

Avian influenza agent assays detect AI antigen or AI ribonucleic acid (RNA). Similar to the antibody detection methods, these agent assays are screening assays. The USDA AI RRT-PCR assays for RNA detection include a matrix (M) assay that detects any influenza A virus and two H-subtype-specific assays (H5 and H7). The sensitivity of the M assay is similar to virus isolation, while the H5 and H7 assays are slightly less sensitive than the M assay. The Synbiotics® Avian Influenza Antigen Test kit (AIVAT), which detects antigen for all influenza A viruses, was recently granted conditional licensure by CVB. It has similar sensitivity to the M RRT-PCR assay in birds with clinical signs, but is less sensitive than the M assay in apparently healthy birds (Schmitt 2006). Both RRT-PCR and the Synbiotics antigen assay have been approved for use in the NPIP programs. Another antigen detection assay, the Becton-Dickinson Directigen® Flu A test kit, has been approved for use in human testing, but has not been approved for veterinary use. However, this test was used to screen poultry samples during the 2002 LPAI outbreak in Virginia, and data on this test was utilized for developing the testing parameters in the active observational surveillance analysis.

An important factor when estimating time until detection is that the length of virus shedding differs in young (5 weeks) versus old (23 weeks) chickens: two weeks and one week respectively (Lu and Castro 2004). Detecting antigen requires a minimum of one or two sample collections per week, and LPAI strains that fail to produce overt clinical signs may be missed if a sample collection does not occur during short virus shedding periods. In monitoring for LPAI virus in flocks that do not express clinical signs, fresh dead birds (natural mortality), rather than randomly selected live birds, should be sampled for virus (Dunn *et al.* 2003).

The diagnostic procedures used for confirming AI used at the NVSL are classical methods that have been described with minor modifications (Pearson J.E. *et al.* 1992). Any available serologic, tissue, swab, and virus isolate samples are submitted to NVSL for appropriate analyses for H- and N-subtyping and pathogenicity determination. Tissues requested from dead birds are trachea, lung, spleen, and large intestine submitted in plastic bags or tubes containing 2.0 ml. of brain-heart infusion. Swab specimens requested by NVSL are tracheal and cloacal swabs in tubes of brain-heart infusion (BHI) broth (tracheal swabs may be pooled with up to five swabs per tube; cloacal swabs should not be pooled). Upon receipt, samples undergo a routine confirmatory testing scheme. Although RRT-PCR may provide preliminary results within a few hours, virus isolation is necessary to confirm virus subtype by hemaglutinin and neuramidase inhibition assays, determine pathogenicity by in vivo testing in chicks, and determine relatedness of the isolate to previously identified strains by genetic sequencing. Complete confirmatory testing on samples can generally take 1 or 2 weeks to complete.

Appendix E: Economic Considerations for NAI Surveillance

The U.S. poultry industry is primarily composed of three valuable sub-industries: broilers, layers (table-egg and broiler-hen layers), and turkeys (described in Appendix A). Other poultry related industries exist in the United States, such as duck meat, and organic and specialty chickens; however, their relative value is minor and therefore, they are not considered in this discussion.

The broiler industry is the largest and most valuable of the U.S. poultry industries. Farm cash receipts for broiler production in 2005 were $20.9 billion. Broiler production is the second most valuable livestock product at the farm level, behind cattle, which had a value of $36.7 billion (cattle and calf production) in 2005. The other poultry industries were less valuable in 2005, with egg production at $5.3 billion; turkey production, $3.2 billion; and other chicken production, $64.5 million.

At the retail level, the value of the U.S. poultry industry is concentrated in the meat products of broilers; of these products, boneless, skinless chicken breasts have the highest value. Other meat products of the broiler, the bulk of which are dark meat, are of less value in the U.S. retail marketplace. Consequently, a significant portion of the meat from each broiler is processed (51 percent in 2005), frozen, or both, and exported. The domestic retail value of the U.S. broiler industry in 2004 was $43 billion and exports were valued at $1.7 billion.

The total value of the turkey industry in 2004 was $3.07 billion, and exports of turkey meat in 2004 were valued at $252 million. The United States is the world's largest producer and consumer of turkey meat. Retail sales of turkey were historically related to seasonal holiday demand, but significant development and marketing of turkey meat products, including deli meats, turkey breasts, legs and ground turkey meat, have reduced the seasonal peaks in turkey demand. While per capita consumption of turkey meat is now above 16 pounds, this is significantly less than the 87 pounds per capita consumption of broiler meat.

The total value of all egg production in 2004 was $5.3 billion and egg exports were valued at $249 million. Data on egg production combines both production for table eggs and hatching eggs; though about 85 percent of eggs produced in the U.S. are table eggs. Table eggs are sold as dozens of eggs (table eggs) for multiple uses and liquid eggs used in manufactured foods, restaurant meals, and for retail sales. Of the 206.9 million cases of table eggs produced in 2003, 61 percent were sold at retail outlets, 29 percent were further processed, 9 percent were used for food service and less than one percent were exported (National Agricultural Statistics Service 2006b; USDA/Economic Research Service 2006a; World Agricultural Outlook Board 2006, United Egg Industry 2006; National Chicken Council 2005; U.S. Poultry and Egg Association 2006).

Economic Impacts of NAI Surveillance

The economic impacts associated with NAI surveillance are related to the probability of an outbreak of an NAI strain occurring in the United States. There is concern that the Asian HPAI H5N1 strain of AI has the potential to mutate into a virus capable of transmission between humans. While NAI strains are controlled in the poultry industry because of their potential to have large impacts on the poultry industry, in some cases, such as what we are experiencing now, the zoonotic potential of an NAI strain must also be considered. In the event of a NAI incident in the U.S. poultry industry, the costs of surveillance, costs of controlling the outbreak, and indirect costs incurred by the poultry industry and related industries as a result of a disease should be considered. If the Asian HPAI H5N1 strain were to occur in the United States, then it would also be appropriate to consider the potential benefits in protecting human health, which would result from government actions to eradicate the disease from the poultry population.

The benefits of conducting surveillance to measure ongoing prevention and detection programs for NAI to the U.S. commercial poultry flock, in the event of a disease outbreak, are the stream of expected returns from a healthy poultry population and the value of poultry exports in the international marketplace. When sampling and testing during surveillance do not identify a positive NAI flock, the benefits are limited to the expected stream of returns from maintaining the poultry export market. The benefits to protecting human health from Asian HPAI H5N1 could be the human cases avoided by the prevention and eradication of the HPAI from the U.S. poultry population. There may be some additional benefits to surveillance, such as improved consumer confidence, which results in increased poultry sales, and these benefits can be considered when they are identified.

To date, NAI consumer impacts have been minimal or immeasurable when disease outbreaks of NAI have been identified within the United States. Expected consumer response from an Asian HPAI H5N1 outbreak has been the subject of consumer surveys and survey responses indicate that a negative consumer response to Asian HPAI H5N1 could initially be large. In addition to reduced domestic demand, an Asian HPAI H5N1 outbreak (or any HPAI) would also result in international trade restrictions on exports of poultry and poultry products. The excess supply of poultry meat would result in oversupply of poultry meat and lower prices at the grocery store. Over time, low prices could overcome the substitution away from poultry and sales of poultry meat would recover. Consumers will also choose other meat instead of poultry in the event of an Asian HPAI H5N1 outbreak, and beef, pork, and fish products could all be expected to benefit from higher sales if consumers purchase less poultry meat. The time of return to normal poultry purchases will depend on penetration of accurate information about the risk of HPAI and the evidence of prompt government action to consumers. The already implemented federal and state governments and poultry industry education will be essential in a rapid return to the current poultry demand level.

In the event that the particular NAI strain identified has zoonotic potential, then the cost and benefit estimations should consider potential benefits to human life of eradicating a zoonotic strain of HPAI. A number of human AI pandemic estimates have been developed in 2006, and those estimates usually do not consider the animal impacts of an Asian HPAI H5N1, which could be the cause of a human pandemic. In the event of a human health incident involving Asian HPAI H5N1, the impacts to the animal sectors will be quickly dwarfed by the impacts to human health. Also, once the disease has left the poultry industry and become fully transmissible human-to-human, then the role of the poultry industry in maintaining the outbreak will likely be irrelevant.

The Congressional Budget Office estimated the annual impact of pandemic influenza on the U.S. economy would range between $623 billion for a severe outbreak and $187 billion for a less severe scenario (CBO 2006). An Asian HPAI H5N1 outbreak, identified through animal health surveillance and contained within the U.S. poultry population, would have a significantly smaller impact than if such a disease outbreak was not identified and a pandemic human flu strain arose from the poultry outbreak. Estimates of the cost of an Asian HPAI H5N1 outbreak in the U.S. commercial poultry industry are preliminary and vary significantly depending on estimated consumer demand response and export market recovery.

Production Impacts from an NAI Outbreak

In the event of an NAI outbreak in the United States, the impact to commercial poultry productivity is likely to be limited. This is because of the strict biosecurity measures practiced by the U.S. commercial poultry production industries. Biosecurity measures such as all-in/all-out and restricted access to poultry houses, result in little chance of spreading the disease across a wide section of the U.S. commercial poultry industry. Also, it is expected that the commercial poultry industry will take prompt action to quarantine and depopulate a suspect house, and to notify State and Federal authorities of such an incident. Additionally, the limited interaction of poultry between or during production stages reduces the potential for the disease to spread because bird-to-bird contact beyond houses is limited. Breaches on the human side of biosecurity are more likely to provide a transmission route for NAI, though this risk can be mitigated by managing employees' adherence to biosecurity practices.

The situation is more complicated in small volume, non-traditional, marginal or backyard poultry production sectors. Because much of this production is extensive and birds are allowed access to the outdoors and therefore wild birds, the risk of introduction into this sector of the poultry industry is more likely. However, even if there were significant productivity impacts to non-commercial poultry production, these industry groups are relatively small and the nationwide productivity impact would likely be too small to measure. There could be a significant impact on a single sector or region of these smaller industry groups, but when that impact is compared to the value of the commercial poultry industry, it will be relatively minor.

If the NAI incident is the result of a low pathogenicity strain and low mortality, then the impact on nationwide productivity can be expected to be very low and likely immeasurable.

Impact of NAI Outbreak on U.S. Poultry Exports

An important consideration in the surveillance and the potential impacts of Asian HPAI H5N1 is that, while most of the value of the U.S. poultry industry is represented by commercial broiler, turkey, and egg producers, the biosecurity practices of small-volume high-value and non-commercial poultry producers represent a high risk to the total value of the U.S. poultry industry. If HPAI is identified in the small-volume high-value or non-commercial poultry segment, commercial poultry producers would be impacted, because the expected reactions to an Asian HPAI H5N1 outbreak are reduced poultry meat purchases (possibly 20 percent or higher in the short run) and a loss of access to export markets. Non-commercial or low-volume producers would not be impacted at the same rate, since not all of the value in those industries is related to poultry product sales or export markets.

Compartmentalization and regionalization can be used to reduce the economic impacts from trade export losses to the poultry industry, though application of these trade policies may not be uniformly or expeditiously applied by all trading partners. There is little protection from consumer demand reductions, though historically U.S. consumers have not reacted as adversely to animal disease scares as consumers in European or Asian countries. Government and industry commitments to transparency and education have been effective strategies for maintaining consumer confidence in U.S. livestock products. Therefore, an effective and well understood surveillance plan in both the commercial and non-commercial poultry sectors is important to the value of the U.S. poultry industry.

Value and Volume of Exports

In 2005, about $2 billion worth of broilers or broiler meat products was exported. Broiler exports represented 10 percent of the total value of U.S. broiler production in 2005. Exports of broiler meat as a percentage of the value of production have remained at this level for the past few years, and since the incidence of bovine spongiform encephalopathy (BSE) in the U.S. beef herd, broiler exports are more valuable than beef exports. Export volume in 2006 is predicted to increase over 2005 because of the deeply discounted prices for broiler parts, especially thighs and legs. In 2006, value and volume of poultry exports are both up in 2006 over the same period in 2005.

The worldwide outbreak of Asian HPAI H5N1, beginning in 2003, has been expected to have a significant impact on the world market for poultry products. However, the USDA World Agriculture Outlook Board's forecasts for 2006 U.S. broiler meat exports are predicted to be above 2005 levels. Total U.S. poultry meat exports, including turkey meat, prior to the international Asian HPAI H5N1 outbreak, were $1.6 billion in 2002 and increased to over $2.6 billion in 2005.

The egg industry, on a value basis, exported about 5 percent of production in 2005. Egg export value had fallen in 2002 to a low of $169 million, but has increased since then. Egg export volumes are predicted to decline in 2006.

Historically, the turkey industry has not relied heavily on the export market, but in 2005 the turkey industry exported about 10 percent of the value of production.

Appendix F: National Poultry Improvement Plan (NPIP) Implementation and Release Plan, Version 1.3

Prepared for

USDA United States Department of Agriculture

Animal and Plant Health Inspection Service

Prepared by

Communications Resource Incorporated (CRI)

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November 30, 2006

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CHANGE MANAGEMENT TABLE

Name	Date	Version	Revision Notes
C. Cang	07/14/2006	0.0	Initial document created.
M. Gilliland	07/26/2006	1.0	Internal review
D. Freitag	07/31/2006	1.0	Internal review
M. Gilliland	11/16/06	1.1	Management Review & update based on CEAH input and internal CRI Review. Modify the schedule for 9-7 which is no longer required.
M. Rachell / M. Gilliland	11/28/06	1.2	Peer Review & Final Release
M. Gilliland	11/30/06	1.3	Final Review rearrange schedule to support commercial functionality in Version 2

OVERVIEW

Background

Currently, NPIP users, including participating poultry producers, laboratories, and state inspectors, manually fill out forms to enter and report information. The NPIP Online project will automate the current manual data entry by providing participants with web-based forms to complete and a central database as the repository for data storage. The NPIP Online will be made available to users in four major release events.

Document Purpose

This document was developed to identify the functionality being planned for each of the releases, provide generic schedule information and to tie the functionality back to the functional Use Cases. These functional use cases were identified during requirements gathering and as part of the initial design.

Functionality identified as "*-New" and "#- Enhance" in the Requirement ID/ Requirement Description section of the use case were formally identified during the requirements gathering and working session with the end users. These new requirements were reviewed by APHIS and funded under a task order modification in September 2006; development of the functionality to support these new requirements is covered in all four major releases scheduled for the NPIP Online system.

Document Scope

This document covers Planned Release Versions 1.0 through 4.0. Minor releases which may include bug fixes and updates will be reviewed by the government through the Configuration Control Board process and are not included in this document. The following releases are planned for NPIP Online. Unless otherwise annotated, each release provides full Create, Retrieve, Update and Delete (CRUD) functionality for the use cases identified.

- **Version 1.0**
    - VS Form 9-2 Flock Selecting & Testing Report (qualification test)
    - VS Form 9-2 Flock Selecting & Testing Report (renewal test)
    - VS Form 9-3 Report of Sales of Hatching Eggs, Chicks, and Poults
    - VS Form 9-5 Report of Hatcheries, Dealers, and Independent Flocks
    - Authorized Laboratories *
    - Authorized State Representative *
    - User Management Module

- **Version 2.0**
    - Slaughter Plant Registration
    - Slaughter Plant or Pre-Slaughter Plant Testing and Test Results
        - Commercial Meat Type Chickens (replaces NCC)
        - Commercial Meat Type Turkeys
        - Commercial Table-Egg Layers
- **Version 3.0**
    - VS 9-8,
    - VS 9-9 Modules
    - In-basket,
    - e-mail notification, and
    - Alerts.
- **Version 4.0**
    - Web Services API

RELEASE SCHEDULE

Within the scope of this document, we have projected the schedule release for all releases; however, this schedule is contingent on the availability of technical resources such as Test / Production servers and personnel resources such as testers and technical support staff.

Release v 1.0

NPIP Online version 1.0 focuses on completion of the fundamental functionality used to track the certification and movement of NPIP Breeder flocks.

Initial User Testing

The v 1.0 was released for Testing on 08/01/2006. Testing was accomplished by the NPIP Staff and a volunteer group of state representatives including Alabama, Arkansas, Georgia and North Carolina. Bugs were tracked in CRI's bug tracking software – Mantis and have been resolved, retested and closed.

Pilot Release

Version 1.0 will be released for a pilot user group for Beta Testing, initial data capture and limited distribution to NPIP Staff, Authorized State Representatives, poultry producers and laboratories. This pilot group includes the four states listed above and expands that group to include Indiana. It is anticipated that this release be available on or about 01/03/2007. Figure 1 provides a more granular view of the actions required prior to this release.

ID	Task Name	Duration	Start	Finish
1	**NPIP Phase I Rollout Plan - Pilot**	**40 days**	**Wed 11/1/06**	**Wed 1/3/07**
2	**Planning & Program Management**	**24 days**	**Fri 11/24/06**	**Wed 1/3/07**
3	**Assessment Meetings**	**21 days**	**Wed 11/29/06**	**Wed 1/3/07**
10	**Implementation Plan**	**6 days**	**Fri 11/24/06**	**Fri 12/1/06**
14	**Data Conversion Plan**	**5 days**	**Mon 12/11/06**	**Fri 12/15/06**
15	Draft Plan	2 days	Mon 12/11/06	Tue 12/12/06
16	Review Draft Plan	2 days	Wed 12/13/06	Thu 12/14/06
17	Finalize Plan	1 day	Fri 12/15/06	Fri 12/15/06
18	**Infrastructure**	**36 days**	**Wed 11/1/06**	**Thu 12/21/06**
19	Identify Server Configuration	2 days	Wed 11/1/06	Thu 11/2/06
20	Assess Server Configuration Options	10 days	Fri 11/3/06	Thu 11/16/06
21	Procure Hdw/Sft	10 days	Fri 11/17/06	Fri 12/1/06
22	Build Appropriate Production Environment	**5 days**	**Mon 12/4/06**	**Fri 12/8/06**
23	Provide Access to Production Environment	0 days	Fri 12/8/06	Fri 12/8/06
24	Test Production Environment	5 days	Mon 12/11/06	Fri 12/15/06
25	Install NPIP Pre-Production Software	2 days	Mon 12/18/06	Tue 12/19/06
26	Install NPIP Production Build	1 day	Thu 12/21/06	Thu 12/21/06
27	**Security**	**18 days**	**Fri 11/17/06**	**Wed 12/13/06**
28	**CEAH Assessment of PHASE I Docs**	**18 days**	**Fri 11/17/06**	**Wed 12/13/06**
29	**Provide Documents for CEAH Review**	**8 days**	**Fri 11/17/06**	**Wed 11/29/06**
33	Review Documentation	9 days	Thu 11/30/06	Tue 12/12/06
34	Provide Recommendation for C&A	1 day	Wed 12/13/06	Wed 12/13/06
35	Go - No Go Decision	0 days	Wed 12/13/06	Wed 12/13/06
36	**Data Conversion**	**27 days**	**Fri 11/17/06**	**Tue 1/2/07**
37	Provide Current NPIP Data	5 days	Fri 11/17/06	Fri 11/24/06
38	Assess Data	10 days	Mon 11/27/06	Fri 12/8/06
39	Freeze NPIP Data Entry	0 days	Fri 12/8/06	Fri 12/8/06
40	Convert Data	5 days	Mon 12/18/06	Fri 12/22/06
41	Test / Verify Data Conversion	2 days	Mon 1/1/07	Tue 1/2/07
42	Go - No Go Recommendation	0 days	Tue 1/2/07	Tue 1/2/07
43	**Development**	**40 days**	**Wed 11/1/06**	**Wed 1/3/07**
44	Identify Changes to 9-2 Samples, Tests & Resul	5 days	Wed 11/15/06	Tue 11/21/06
45	Modify 9-2 to support changes	10 days	Wed 11/15/06	Wed 11/29/06
46	Remediation of Test Results	5 days	Thu 12/14/06	Wed 12/20/06
47	Phase II Development (As Applicable)	40 days	Wed 11/1/06	Wed 1/3/07
48	**Testing**	**16 days**	**Thu 11/30/06**	**Thu 12/21/06**
49	**Pilot Phase Implementation**	**16 days**	**Thu 11/30/06**	**Thu 12/21/06**
50	Unit Test 9-2	5 days	Thu 11/30/06	Wed 12/6/06
51	CEAH Integration Testing of 9-2	5 days	Thu 12/7/06	Wed 12/13/06
52	Final Integration Testing of Phase I	3 days	Thu 12/7/06	Mon 12/11/06
53	Test Production Environment & Communica	2 days	Wed 12/20/06	Thu 12/21/06
54	**Delivery**	**1 day**	**Wed 1/3/07**	**Wed 1/3/07**
55	Deliver to "Pilot Users Group"	1 day	Wed 1/3/07	Wed 1/3/07

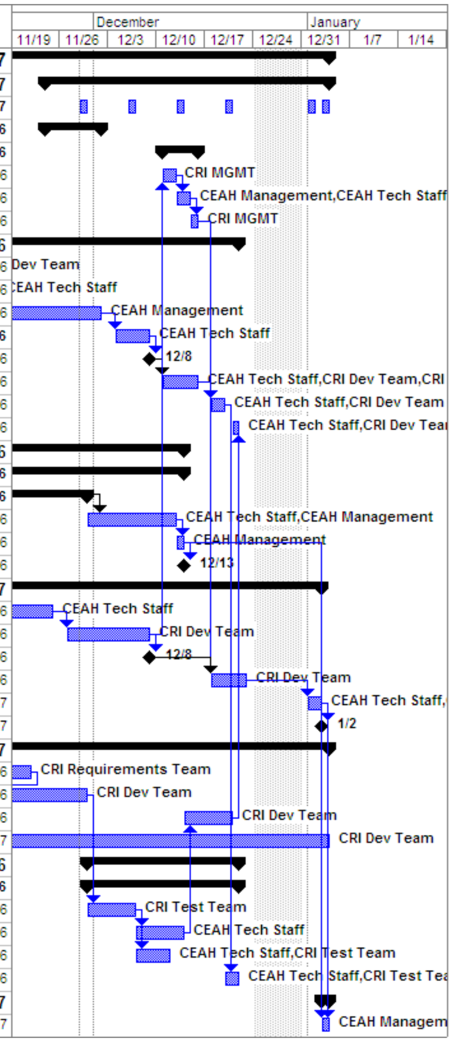

Figure 1 - Pilot Release Schedule

Release for Production

Upon completion of the Pilot Phase, NPIP Online version 1.0 is scheduled to become released for full production on 01/26/2007. This release will be announced at the Poultry Expo in Atlanta GA on 01/23/2007 and user accounts will be established for the remaining States. Figure 2 provides a detailed summary of the tasks required to be accomplished in order to support this production date.

ID	WBS	Task Name	Duration	Start
56	2	**NPIP Phase I Rollout Plan - Production**	**22 days**	**Thu 12/21/06**
57	**2.1**	**Planning & Program Management**	**17 days**	**Thu 1/4/07**
58	**2.2**	**Assessment Meeting**	**11 days**	**Wed 1/10/07**
59	2.2.1	Assessment Meeting 1	1 day	Wed 1/10/07
60	2.2.2	Assessment Meeting 2	1 day	Wed 1/17/07
61	2.2.3	Assessment Meeting 3	1 day	Wed 1/24/07
62	**2.3**	**Infrastructure**	**10 days**	**Thu 1/11/07**
63	2.3.1	Stress Test Infrastructure for Full Production	5 days	Thu 1/11/07
64	2.3.2	Remediate Infrastructure Deficiencies	5 days	Thu 1/18/07
65	**2.4**	**Development**	**21 days**	**Thu 12/21/06**
66	2.4.1	Support Remediation of Phase I CRs	15 days	Thu 1/4/07
67	2.4.2	Phase II Development (As Applicable)	21 days	Thu 12/21/06
68	**2.5**	**Testing**	**16 days**	**Thu 1/4/07**
69	2.5.1	Pilot User Feedback	12 days	Thu 1/4/07
70	**2.5.2**	**CCB Assessment of CR**	**13 days**	**Tue 1/9/07**
71	2.5.2.1	CCB Assessment of CR 1	1 day	Tue 1/9/07
72	2.5.2.2	CCB Assessment of CR 2	1 day	Thu 1/11/07
73	2.5.2.3	CCB Assessment of CR 3	1 day	Tue 1/16/07
74	2.5.2.4	CCB Assessment of CR 4	1 day	Thu 1/18/07
75	2.5.2.5	CCB Assessment of CR 5	1 day	Tue 1/23/07
76	2.5.2.6	CCB Assessment of CR 6	1 day	Thu 1/25/07
77	**2.6**	**Delivery**	**1 day**	**Thu 1/25/07**
78	2.6.1	CCB Recommendation	0 days	Thu 1/25/07

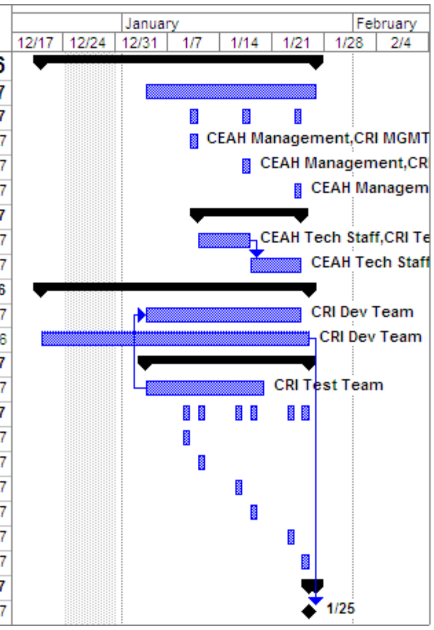

Figure 2 - Version 1 Full Production Rollout

Release v 2.0

Release version 2.0 provides a major enhancement to the NPIP Online system by adding the capability to track testing and test results for commercial poultry. This functionality will replace the operational National Chicken Council (NCC) system as it expands that functionality to include Meat Type Turkeys and Table Egg Layers. This version will also replace the annual 9-4 report with an online summary of 9-2 test results. Releasing the 9-4 in release 2.0 allows assessment of live 9-2 data collected through the version 1.0 pilot and full production release.

- Integration Testing 02/01/07 through 02/15/07
- CEAH Integration Testing / UAT 02/15/07 through 02/28/07
- Parallel Operation with NCC system 02/28/07 through 03/30/07
- Release to Full Production 03/30/07

Figure 3 provides a summary of tasks that need to be completed in order to support this release schedule. It includes a parallel operation of the NCC system and the NPIP Online in order to evaluate the consistency in collecting and reporting critical test and test result data.

ID	Task Name	Start	Finish	Duration
1	Finalize Design	12/1/2006	12/1/2006	0w
2	Development	12/1/2006	1/25/2007	8w
3	Tier I – Integration Testing	1/26/2007	2/8/2007	2w
4	Tier 2 – Integration Testing	2/9/2007	2/15/2007	1w
5	User Acceptance Testing	2/16/2007	2/22/2007	1w
6	Install – Configure - Deploy	2/23/2007	2/28/2007	4d
7	Deploy to Production	3/1/2007	3/1/2007	0w
8	Parallel Operation with NCC	3/1/2007	3/28/2007	4w

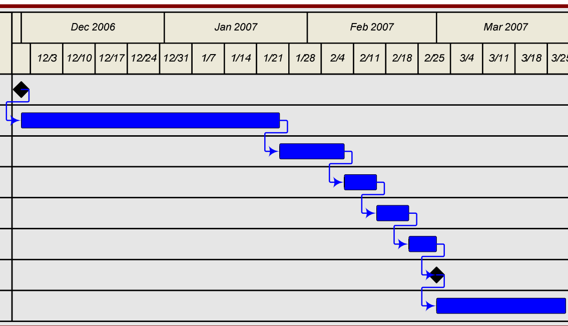

Figure 3 - Version 2.0 Release Schedule

Release v 3.0

Release version 3.0 provides enhancements to the NPIP Online system. Development on these enhancements is complete; however, testing is not complete. As a result, these features are being held for the 3.0 release to reduce the burden on state and industry testers and to ensure maximum focus on critical operations. Version 3.0 will also be used to incorporate bug fixes or industry driven changes where approved by the CCB.

- Integration Testing 02/16/07 through 02/28/07
- CEAH Integration Testing / UAT 03/01/07 through 03/15/07
- Release for Full Production 03/30/2007

Release v 4.0

Release Version 4.0 focuses on the final component of the NPIP Online system which is to provide a Web Service API that will allow users to directly update flock selection, testing and transportation from existing system using an XML protocol.

- Integration Testing 03/16/07 through 03/30/07
- CEAH Integration Testing / UAT 04/01/07 through 04/15/07
- Release for Full Production 04/30/2007

RELEASE CROSS REFERENCE TO FUNCTIONAL USE CASES

The following provides a functional cross-reference from the functional use case to the anticipated major release. It covers releases 1.0 through 3.0; the Web Services API will be added to these matrices in a future release of this document.

Administration Module

The Administration Module allows State and NPIP Administrators to manage user access. Below are line item requirements and/or use cases pertaining to the user administration module based on the Software Requirements Specification (SRS).

High-level Administration Functionality

Use Case I through VII in the SRS	v.1.0	v.2.0	v.3.0
Have a web based user administration module	X		

User Roles

Use Case I through VII in the SRS	v.1.0	v.2.0	v.3.0
Use a role based approach	X		
Allow assignment of roles permitting various level of access	X		
Allow individual users to be assigned with more than one user role.	X		
Maintain an audit trail of user activities.	X	X	X
NPIP Staff: access to all accounts information	X	X	X
State Inspector: access only to user account within their state.	X	X	X
State Representative: access only to user account within their state	X	X	X
Authorized Laboratory: access only to their account information	X	X	X
Participating Poultry Producers: access only to their account information	X	X	X

Create User Account

Use Case I in the SRS	v.1.0	v.2.0	v.3.0
Provide NPIP administrator the function to assign user's role(s).	X		
Record the date on user creation and modification.	X		
Collect the following information during the creation of an account: first name, last name, middle name, username, assigned password, role(s) and new participant or existing approval number.	X		
Allow the NPIP Administrator to add user accounts.	X		
Allow the NPIP State Representative to add user accounts	X		

Allow the NPIP Administrator to add user roles for a specific user.	X		

Manage User Account

Use Case III in the SRS	v.1.0	v.2.0	v.3.0
Allow the NPIP Administrator to modify user accounts.	X		
Allow the NPIP administrator to reset user passwords.	X		
Not allow the NPIP administrator to view existing passwords.	X		
Secure access to the system based on unique user identifier and password.	X		

Deactivate User Account

Use Case IV in the SRS	v. 1.0	v. 2.0	v. 3.0
Allow the NPIP Administrator to deactivate user accounts.	X		

Reactivate User Account

Use Case V in the SRS	v. 1.0	v. 2.0	v. 3.0
Allow the NPIP Administrator to reactivate user accounts that were previously deactivated.	X		
Allow the NPIP Administrator to inactivate user roles for a specific user.	X		

View/ Sort User Account

Use Case II in the SRS	v. 1.0	v. 2.0	v. 3.0
Allow the NPIP Administrator to search for existing accounts by username.	X		

View/ Update Own Profile

Use Case III in the SRS	v. 1.0	v. 2.0	v. 3.0
Allow the user to view their personal user account details and change their password.	X		
Assign a default password to the user which the user must change during initial access	X		

Administration Audit Details

Use Case Line Item Requirement UA-29 in the SRS	v. 1.0	v. 2.0	v. 3.0
Shall delete records by setting a delete flag. Actual record will not be deleted from database	X		
The system shall provide record level audit information to include date of creation, update and user	X		

Create, Retrieve, Update and Delete (CRUD) Functionality

Data Entry

Table 1 - CRUD Functionality

Use Case VIII through LV in the SRS	v. 1.0	v. 2.0	v. 3.0
Provide a graphical interface that allow user to do data entry.	X		
Perform data validation for all fields on the form based on business rules/logics. For release 1.0 only VS 9-2 and VS 9-5 will have business rules/logics.	X		
Perform data validation for VS 9-3.	X		
Perform data validation for VS 9-8, and VS 9-9			X
Perform data validation for Authorized Lab and State Representative	X		
Provide look-up values where applicable.	X		
Provide the following data entry screens and full CRUD functionalities: ▪ VS Form 9-2 Flock Selecting & Testing Report ▪ VS Form 9-2 Flock Selecting & Testing Report Renewal	X		

Use Case VIII through LV in the SRS	v. 1.0	v. 2.0	v. 3.0
▪ VS Form 9-5 Report of Hatcheries, Dealers, and Independent Flocks			
Provide the following data entry screens and full CRUD functionalities: ▪ VS Form 9-3 Report of Sales of Hatching Eggs, Chicks, & Poults	X		
Provide the following data entry screens and full CRUD functionalities: ▪ VS Form 9-8 Flock Inspection & Check-Testing Report ▪ VS Form 9-9 Hatchery Inspection Report			X
Provide the following data entry screens and full CRUD functionalities: ▪ Authorized Laboratories * ▪ State Representative	X		
Provide a graphical interface to create Section I of the VS 9-2 Flock Selecting & Testing Report	X		
Provide the user the ability to retrieve Section I of the VS 9-2 Flock Selecting & Testing Report	X		
Provide the user the ability to update Section I of the VS 9-2 Flock Selecting & Testing Report	X		
Provide the user the ability to delete Section I of the VS 9-2 Flock Selecting & Testing Report (before submitted for Participating Poultry Producer).	X		
Provide a graphical interface to create Section II of the VS 9-2 Flock Selecting & Testing Report	X		
Provide the user the ability to retrieve Section II of the VS 9-2 Flock Selecting & Testing Report	X		
Provide the user the ability to update Section II of the VS 9-2 Flock Selecting & Testing Report.	X		
Provide the user the ability to delete Section II of the VS 9-2 Flock Selecting & Testing Report (before submitted for authorized laboratory).	X		
Provide the NPIP staff and State Representative the ability to approve or reject VS 9-2 Flock Selecting & Testing Report	X		
Provide a graphical interface to create VS 9-3 Report of Sales of Hatching Eggs, Chicks, and Poults	X		
Provide the user the ability to retrieve VS 9-3 Report of Sales of Hatching, Eggs, Chicks, and Poults	X		
Provide the NPIP staff and State Representative the ability to approve or reject VS 9-3 Report of Sales of Hatching, Eggs, Chicks, and Poults	X		
Provide a graphical interface to create VS 9-5 Report of Hatcheries, Dealers, and Independent Flocks	X		
Provide the user the ability to retrieve VS 9-5 Report of Hatcheries, Dealers, and Independent Flocks.	X		
Provide the user the ability to update VS 9-5 Report of Hatcheries, Dealers, and Independent Flocks.	X		
Provide the user the ability to delete VS 9-5 Report of Hatcheries, Dealers, and Independent Flocks	X		
Provide the NPIP Staff and State Representative the ability to approve or reject VS 9-5 Report of Hatcheries, Dealers, and Independent Flocks.	X		
Provide a graphical interface to create VS 9-7 Investigations of Salmonella Isolations in Poultry.			OBE
Provide the user the ability to retrieve VS 9-7 Investigations of Salmonella Isolations in Poultry.			OBE
Provide the user the ability to retrieve VS 9-7 Investigations of Salmonella Isolations in Poultry.			OBE
Provide the user the ability to delete VS 9-7 Investigations of Salmonella Isolations in Poultry.			OBE
Provide the NPIP Staff and State Representative the ability to approve or reject VS 9-7 Investigations of Salmonella Isolations in Poultry.			OBE
Provide a graphical interface to create VS 9-8 Flock Inspection & Check Testing Report.			X
Provide the user the ability to retrieve VS 9-8 Flock Inspection & Check Testing Report.			X

Use Case VIII through LV in the SRS	v. 1.0	v. 2.0	v. 3.0
Provide the user the ability to update VS 9-8 Flock Inspection & Check Testing Report.			X
Provide the user the ability to delete VS 9-8 Flock Inspection & Check Testing Report.			X
Provide the NPIP Staff and State Representative to approve or reject VS 9-8 Hatcher Inspection Report.			X
Provide a graphical interface to create VS 9-9 Hatchery Inspection Report.			X
Provide the user the ability to retrieve VS 9-9 Hatchery Inspection Report.			X
Provide the user the ability to update VS 9-9 Hatchery Inspection Report.			X
Provide the user the ability to delete VS 9-9 Hatchery Inspection Report.			X
Provide the NPIP Staff and State Representative to approve or reject VS 9-9 Hatchery Inspection Report.			X
Provide a graphical interface to create Authorized Laboratories.	X		
Provide the user the ability to retrieve Authorized Laboratories.	X		
Provide the user the ability to update Authorized Laboratories.	X		
Provide the user the ability to delete Authorized Laboratories.	X		
Provide the NPIP Staff and State Representative to approve or reject Authorized Laboratories.	X		
Provide a graphical interface to create State Representative form.	X		
Provide the user the ability to retrieve State Representative form.	X		
Provide the user the ability to update State Representative form.	X		
Provide the user the ability to delete State Representative form.	X		
Provide the NPIP Staff and State Representative to approve or reject State Representative form.	X		
Allow users with the appropriate user role to edit their own records	X		
Allow users to edit the records if the record is less then one year.	X		
Delete records by setting a delete flag. Actual record will not be deleted from database	X		
Allow only NPIP staff to delete record that have been created and saved to the NPIP database.	X		
The system shall validate the required fields before saving data into the NPIP application.	X		
Shall require State Representative to approve VS 9-2, 9-5 before being released for review by NPIP staff.	X		
Send a notification to State Representative/State Inspector to perform an inspection on VS 9-7.	X		
Allow NPIP users to enter data for VS 9-5 Slaughter Plant or Commercial Table-Egg Layer Flock Registration into the NPIP application.		X	
Allow the State Representative, NPIP Staff and Commercial Poultry Participant to retrieve data for VS Form for Commercial Poultry Registration.		X	
Allow the State Representative, Commercial Poultry Participant, and NPIP Staff to update data for VS 9-5 form for Commercial Poultry Participant.		X	
Allow the NPIP Staff to delete data for VS 9-5 form for Commercial Poultry Registration.		X	
Allow the State Representative and NPIP Staff to approve or reject VS 9-5 Form For Commercial Poultry Registration.		X	
Allow NPIP users and Commercial Poultry Participant to enter data for VS 9-2 Flock Selecting and Testing Report into the NPIP application.		X	
Allow the State Representative, NPIP Staff, Slaughter Plant Staff and Commercial Poultry Participant to retrieve data for VS 9-2 Flock Selecting and Testing Report for Commercial Poultry.		X	
Allow the State Representative, Commercial Poultry Participant, Slaughter Plant Staff and NPIP Staff to update data for VS 9-2 Flock Selecting and Testing Report for Commercial Poultry.		X	
Allows the NPIP Staff to delete data for VS 9-2 Flock Selecting and Testing Report for Commercial Poultry.		X	
Allows the State Representative, NPIP Staff, Authorized Laboratory and Slaughter Plant Staff to enter data for VS 9-2 Test Result.		X	

Use Case VIII through LV in the SRS	v. 1.0	v. 2.0	v. 3.0
Allow the State Representative, NPIP Staff, Slaughter Plant Staff and Authorized Laboratory to retrieve data for VS 9-2 Test Result.		X	
Allow the State Representative, Authorized Laboratory, Slaughter Plant Staff and NPIP Staff to update data for VS 9-2 Test Result.		X	
Allows the NPIP Staff to delete data for VS 9-2 Test Result.		X	
Allows the National Veterinary Services Laboratories (NVSL) Staff to enter data for VS 9-2 Test Result for NVSL.		X	
Allows the State Representative, NPIP Staff, and NVSL Staff to retrieve data for VS 9-2 Test Result.		X	
Allow the NVSL Staff and NPIP Staff to update data for VS 9-2 Test Result for NVSL.		X	
Allows the NPIP Staff to delete data for VS 9-2 Test Result for NVSL.		X	

Search Functionality

Above and beyond the standard CRUD functionality, the NPIP Online system will provide Users with the ability to search for data using predefined search criteria. Table 2 below provides a cross reference from the functional requirements defining search capability to the release candidate the functionality is provided in.

NPIP Search Web Interface

Table 2 - Search Capability

Use Case 6.2	v.1.0	v.2.0	v.3.0
The system shall have a user role that provides access to the NPIP database (i.e., searching and viewing data).	X		
Allow NPIP users search functionality.	X		
Allow users to search data using one or a combination of selected fields.	X		
Allow users to view search results from the NPIP database	X		
Allow users to search for VS 9-2 and VS 9-5.	X		
Allow users to search for VS 9-3	X		
Allow users to search for VS 9-8 and VS 9-9.		X	
Allow users to search for authorized Laboratories, and State Representative.		X	
Allow State Representative/State Inspector and NPIP staff to search outstanding transactions.		X	
Allow users to search for forms using one or a combination of the following key fields: ➢ VS Form 9-2 Flock Selecting & Testing Report are: - Subpart - Classification – U.S. - Type - Name of Flock owner - Approval Number - Date ➢ The searchable fields for VS From 9-5 Report of Hatcheries, Dealers, and Independent Flocks are: - State - Approval Number - Subpart	X		

Use Case 6.2	v.1.0	v.2.0	v.3.0
- Active - Submitted by - Dealer Type - Sub Type - Hatchery Capacity			
Allow users to search for forms using one or a combination of the following key fields: ➢ The searchable fields for VS Form 9-3 Report of Sales of Hatching Eggs, Chicks, & Poults are: - Report No - Date of Shipment - Purchaser - Product - Type - Classification – U.S.	X		
Allow users to search for forms using one or a combination of the following key fields: ➢ The searchable fields for VS 9-7 Investigations of Salmonella Isolations in Poultry are: - Isolation Report - Specimen Submitted - Owner - Purpose of Flock - Suspected Source of Infection - Corrective Measures Applied - Hatchery - Approval Number - Laboratory Examination of Specimens ➢ The searchable fields for VS 9-8 Flock Inspection & Check-Testing Report are: - Flock Owner - Selected by - Tested by ➢ The searchable fields for VS 9-9 Hatchery Inspection Report are: - Hatchery - Classification of Products	X		
Allow users to search for forms using one or a combination of the following key fields: ➢ Authorized Laboratories - Lab ID - Laboratory - State ID ➢ State Representative - State ID - State Representative first name - State Representative last name			

Report Module

The NPIP Online system provides fundamental reporting capability to track flock selection and testing status (9-4 Reporting) and the sales of hatching eggs, chicks and Poults (9-3). Table 3 provides the cross reference between requirements and/or use cases and their release version.

NPIP Report Module

Table 3 - Report Module

Use Case LVII	v.1.0	v. 2.0
Report of Sales of Hatching Eggs, Chicks, and Poults Summary	X	
Incoming Shipment for VS 9-3	X	

Use Case LVII	v.1.0	v. 2.0
Shipment to for VS 9-3	X	
VS 9-4 Report		X

SUMMARY

This Initial Release Plan is provided to facilitate dialog between the various parties responsible for implementing the NPIP Online system.

Appendix G: Overview of 2006 Accomplishments for the 'Biosecurity For the Birds' Program

Prepared by APHIS Legislative and Public Affairs, February 2007

The Biosecurity for the Birds program received $836,000 in supplemental funding in February 2006 enabling APHIS to continue the outreach program begun in 2004. Late in the year, the program received $973,000, which has been allocated for the outreach program for 2007.

Outreach Efforts

Stakeholder Briefings. One of the major accomplishments for 2006 were four stakeholder briefings on avian influenza held during the fall in Georgetown, Delaware; Tacoma, Washington; Madison, Wisconsin; and Gainesville, Georgia. The briefings covered steps being taken at the Federal, State and local levels to address high pathogenicity avian influenza (HPAI) should it be discovered in domestic poultry or wild bird populations. The half-day morning meetings were held in conjunction with the individual States (in the case of Delaware, both Delaware and Maryland participated), and were planned with our Communication Officers of State Departments of Agriculture (COSDA) counterparts. Panelists were drawn from a variety of agencies and included the State veterinarian, the APHIS area veterinarian in charge or his/her representative, an APHIS Wildlife Services representative and a person representing the public health sector. Dr. John Clifford, Deputy Administrator, Veterinary Services of APHIS, served as the keynote speaker for the first briefing in Delaware.

Between 80 and 100 stakeholders attended each briefing with excellent participation from State, county, and Federal agencies. Three of the four briefings were opened by the U.S. Secretary of Agriculture and one by the Deputy Secretary. Briefings were attended by the media, resulting in excellent coverage with news stories that were carried on local television and in local and regional newspapers.

Future Farmers of America (FFA) and 4-H. Once again, APHIS partnered with the nationwide youth organization FFA to exhibit at county and State fairs, and this year the national 4-H program also exhibited poultry biosecurity materials at fairs as well. Combined, the two organizations exhibited at more than 160 county and State fairs throughout the year. Each FFA chapter received a package of literature, a backdrop and giveaways. This was the third year for this effort with the FFA.

The interactive avian influenza educational materials produced with FFA went live in 2006 at http://www.agedlearning.org. FFA has featured the materials at several agriculture educator conferences, and APHIS had a promotional flyer in the agency's booth at the FFA annual meeting. When the "Biosecurity For the Birds" site is revamped this year, the materials will be featured and APHIS will link to the site.

ECHO. APHIS also had a cooperative agreement with Emergency and Community Health Outreach (ECHO) in Minnesota in to produce a program, "Keeping Birds Free of Avian Influenza" which aired four times on Minnesota public television in seven languages (English, Spanish, Somali, Hmong, Lao, Vietnamese, and Cambodian).

Petsmart Charities. Petsmart Charities, for the second time, offered APHIS the chance to produce a webinar. In the spring of 2006, APHIS produced an avian influenza webinar which is on the Petsmart Charities site and is linked with the APHIS website.

Veterinarian Outreach. Outreach to veterinarians continued through exhibits at all major veterinary conferences.

Barrow, Alaska, Media Event. Because of the overwhelming media interest in the surveillance and sampling of wild migratory birds (particularly in Alaska), APHIS hosted an interagency media event in Barrow, Alaska, June 5-9, 2006. The event was planned and implemented with the help of several Federal, State and local governments in Alaska. The event offered information about:

- Wild bird surveillance in Alaska, including:
  - Sampling live birds
  - Sampling hunter-harvested birds
  - Collecting environmental samples (bird feces), and
- Outreach activities to the local community.

The media event resulted in five major news stories highlighted in approximately 141 media outlets, approximately 75 photographs, a 1-hour radio show, and one local newspaper article.

Educational Materials

Several new educational materials were produced and more than 1.5 million items were distributed in 2006. Key publications were:

Biosecurity Guide for Poultry and Bird Owners. A bilingual, wire-bound guide covering practicing biosecurity, avian influenza, and exotic Newcastle disease as well as a resource section.

2007 Backyard Biosecurity planner (calendar). A bilingual calendar with important biosecurity and disease information throughout including biosecurity tips concerning wild birds.

Protect Your Pet Bird From Bird Flu. A bilingual pamphlet for pet bird owners that tells how to protect birds and what to look for in sick birds and the six biosecurity steps they can take.

Guide to Birds Common to the Live-Bird Marketing System. A small wire-bound flip book designed to help those working in the live-bird marketing system to identify poultry found in the system.

Advertising

To reach our target audience, APHIS has had to look beyond the traditional news outlets. The focus was on-:

*Feed sack advertising. Working with the American Feed Industry Association, APHIS continued feed sack advertising program. This is one of the largest efforts undertaken in the campaign. Tens of thousands of feed sacks with bi-lingual ads outlining the six biosecurity steps have been distributed through feed stores across the country as well as Wal-Mart.

*Cooperative Magazines: Research showed that many poultry owners read magazines produced by local electrical cooperatives. As a result, APHIS has been able to cost-effectively reach nearly 30 million readers through these magazines.

*Hunter/Wildlife Magazines: With the heightened interest in wild birds and high pathogenicity avian influenza, we sought to educate bird hunters and bird enthusiasts about the importance of reporting signs of illness or bird die-offs and safe-handling techniques of wild life by advertising in a variety of hunter and wildlife publications.

*Ethnic radio: APHIS ran a radio announcement on select Spanish language radio stations.

*Pet bird publication: APHIS has been running an ad in Bird Times magazine.

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Definitions of Terms/Acronyms Used In This Document

AGID	Agar-gel immunodiffusion assay; one of several screening assays used to detect antibodies against avian influenza
AOS	Active Observational Surveillance
ALS	Active Laboratory Surveillance
Avian influenza (AI)	Infection of birds by any orthomyxovirus of the influenza A genus
AVHS	Avian Health Surveillance database, housed and maintained by the USDA.
BHI	Blood-heart infusion media
Botanica	Retail live-bird markets where live birds are sold for off-site slaughter
Commercial meat-type flock	At the discretion of the Official State Agency, any group of poultry which is segregated from another group in a manner sufficient to prevent the transmission of H5/H7 LPAI and has been so segregated for a period of at least 21 days may be considered as a separate flock
Contract grower	Poultry producers who contract with integrators (companies) to grow poultry under very specific management programs
DOI	Department of Interior
ELISA	Enzyme-linked immunosorbent assay. Commercially available test kits used to screen for antibodies against or antigens of influenza A viruses in domestic poultry
Exhibition poultry	Domesticated fowl that are bred for the combined purposes of meat or egg production and competitive showing
Flock	A group of birds of similar age considered as a production unit
Functional group	Groups of wild migratory birds (e.g., dabbling ducks, light geese, dark geese, and swans) that share similar characteristics including, but not limited to, behavior, habitat use, geographic distribution, migration patterns, and host pathogen dynamics.
Gamebirds	Domesticated gallinaceous birds such as pheasants, partridge, quail, grouse and guineas
Gamefowl	Breeds of chickens, such as Kelso, Hatch, Claret, and Roundhead, intended primarily for exhibition/competition and bred for beauty, strength, health, vitality, and longevity
Highly pathogenic notifiable avian influenza (HPNAI)	NAI viruses that have been shown to fulfill virulence criteria established by OIE

Live-Bird Market (LBM)	Any facility that gathers live poultry to be slaughtered and sold on site
Live-Bird Marketing System (LBMS)	The Live-Bird Marketing System includes live-bird markets and their production and distribution systems
Low pathogenicity avian influenza (LPAI)	All AI viruses that are not NAI viruses
Low pathogenicity notifiable avian influenza (H5/H7 LPAI) viruses	H5 and H7 viruses that do not fulfill a virulence criterion established by the OIE.
Meat-type chicken	A domesticated chicken grown for the primary purpose of producing meat, including but not limited to broilers, roasters, fryers, and Cornish
Meat-type chicken slaughter plant	A federally inspected meat-type chicken slaughter plant
Meat-type turkey	A domesticated turkey grown for the primary purpose of producing meat
Notifiable avian influenza viruses (NAI)	All H5 and H7 viruses and those meeting the virulence criteria established by the OIE
NPIP	National Poultry Improvement Plan
NSU	USDA APHIS Veterinary Services National Surveillance Unit
NWHC	U.S. Geological Survey National Wildlife Health Center, Madison WI.
NWRC	USDA National Wildlife Research Center
OIE	Office International des Epizooties. Currently known as World Organization for Animal Health
Raised-for-Release	Upland gamebirds or waterfowl that are raised for eventual release in game preserves and are not breeding stock
RRT-PCR	Real-time reverse transcriptase polymerase chain reaction. Screening assays used to detect genetic material (RNA) of avian influenza viruses.
Table-egg layer	A domesticated chicken grown for the primary purpose of producing eggs for human consumption
Table-egg layer flock	All of the birds in one barn or house
Table-egg layer operation	All of the flocks under common ownership on one premises
Upland gamebirds	Domesticated fowl such as pheasants, partridge, quail, grouse, but not doves and pigeons.
VI	Virus isolation
Waterfowl	Domesticated fowl that normally swim, such as ducks and geese

WDIN	Wildlife Disease Information Node, a component of the National Biological Information Infrastructure, housed by the Department of Interior