SURVEILLANCE FOR HIGHLY PATHOGENIC AVIAN INFLUENZA IN MINNESOTA'S MIGRATORY BIRDS FROM 2006–2010

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SUMMARY OF FINDINGS

As part of a national strategy for early detection of highly pathogenic avian influenza (HPAI) in North America, the Minnesota Department of Natural Resources (MNDNR) and the United States Department of Agriculture's Wildlife Services (USDA-WS) has been conducting surveillance for the virus in waterfowl in the state since 2006. In 2010, 1,016 birds were sampled for HPAI and no positive cases were detected; however, 57 strains of low pathogenic avian influenza (LPAI) were identified. From 2006 to 2010, a total of 9,017 wild birds have been sampled for HPAI throughout Minnesota; no HPAI was detected. Nationwide, approximately 410,600 wild birds have been sampled during 2006–2010, with no evidence of disease, yet this virus remains a major concern in many parts of the world, because of its zoonotic potential and threat to the domestic livestock industry. One particular strain of HPAI, called H5N1, has affected millions of birds and hundreds of people in parts of Asia, Europe, and Africa, and concerns about this strain developing into a worldwide pandemic remain. While concern about the virus entering North America through movements of infected poultry, poultry products, or migrations of wild birds continues, large-scale surveillance in wild bird populations in the United States has been discontinued. Minnesota will continue to monitor the health of wild birds by investigating morbidity and mortality events, and screening for HPAI when appropriate.

INTRODUCTION

Avian Influenza (AI) is a viral infection that occurs naturally in wild birds, especially waterfowl, gulls, and shorebirds. It is caused by type A influenza viruses that have 2 important surface antigens, hemagglutinin (H) and neuraminidase (N), that give rise to 144 possible virus subtypes. Influenza viruses vary widely in pathogenicity and ability to spread among birds. The emergence of an Asian strain HPAI H5N1 virus in 1996 and subsequent spread of the virus in Asia, Africa, and Europe has killed thousands of wild birds and millions of domestic poultry. In 1997, HPAI H5N1 became zoonotic in Hong Kong and to-date has infected at least 552 humans in Eurasia and Africa, resulting in over 322 deaths. The migratory movements of waterfowl and other shorebirds such as from Asia into North America, heightens concern for surveillance of HPAI H5N1, although movements of domestic poultry or contaminated poultry products, both legally and illegally, are believed to be the major driving force in this virus' spread.

Following the spread of HPAI H5N1 from Asia to Europe and Africa in 2006, the National Strategic Plan for early detection of HPAI H5N1 introduction into North America by wild birds was developed. This plan outlined a surveillance strategy that focused on sampling wild bird species in North America that have the highest risk of being exposed to or infected with HPAI H5N1, because of their migratory movement patterns. This includes birds that migrate directly between Asia and North America, birds that may be in contact with species from areas in Asia with reported outbreaks, or birds that are known to be reservoirs of AI.

Recognition that ducks, geese, and swans of the order *Anseriformes* are a primary reservoir for AI, reaffirmed the need for surveillance of these populations to understand the potential for the emergence of pathogenic human and avian strains (Hanson et al. 2003). This risk concern is not focused just on domestic or wild birds in the U. S., but includes the possibility of a worldwide pandemic. Minnesota is rated as a Level 1 state by the Implementation Plan for HPAI Surveillance in the U. S., because of its historic LPAI prevalence, species-specific migratory pathways, geographic size and location, wetland habitat and amount of shoreline, and band recovery information. This means Minnesota was awarded funds to collect an assigned

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number of wild bird species samples for HPAI H5N1 in cooperation with the USDA-WS.

Since 2006, the MNDNR has been working with USDA-WS to collect samples from wild birds for HPAI H5N1 testing. Last year (2010) marked the final year of this surveillance program. In total, $430,000 in federal funds were awarded to Minnesota to collect approximately 7,900 wild bird samples. Sampling goals were as follows: in 2006, 2,000 samples collected under an agreement of $100,000; in 2007, 1,500 samples collected under a $100,000 agreement; in 2008, 1,600 samples collected under a $90,000 agreement; in 2009, 1,400 samples collected under a $70,000 agreement, and again in 2010, 1,400 samples collected under a $70,000 agreement.

METHODS

In 2010, the MNDNR's surveillance goals included 50 common goldeneye (*Bucephala clangula),* 50 ring-neck ducks (*Aythya collaris),* 50 mallards (*Anas platyrhynchos),* and 30 blue-winged teal (*Anas discors)* to sample during the summer months, primarily in conjunction with planned banding activities. In the fall, hunter-harvested surveillance was used to obtain samples from approximately 80 northern pintails (*Anas acuta)*, 80 mallards, 80 American green-winged teal (*Anas crecca*), 80 blue-winged teal, 50 northern shovelers (*Anas clypeata*), and 50 American wigeons (*Anas Americana*). Focus was directed more on fall surveillance, because the prevalence of AI peaks in late summer and early fall, whereas infection rates are often lower than 1% outside of this period (Halvorson et. al 1985).

The USDA-WS planned to sample a similar number of ducks within the species mentioned above, as well as 100 Canada geese (*Branta canadensis).* If sampling goals per species could not be met, other waterfowl species within the same functional group (e.g., dabblers, divers) could be sampled and counted toward the state's total.

Sampling strategies were coordinated between the MNDNR and USDA-WS to maximize access to bird species through handling of live wild-caught birds from waterfowl banding programs, fall hunter-harvested birds at various sites, agency (USDA-WS) harvested birds, and mortality/ morbidity events. Sampling consisted of obtaining 2 cotton swabs cloacal and oropharyngeal for each bird. Both swabs were placed into a vial containing prepared brain heart infusion (BHI) media. These samples were then submitted to the University of Minnesota's Veterinary Diagnostic Laboratory in St. Paul for initial screening for the virus. If positive for AI, samples were forwarded to the National Veterinary Services Laboratories in Ames, Iowa for strain-typing. Environmental (fecal) samples were also collected from 2006 to 2008 in Minnesota and submitted for HPAI testing; this sampling method was suspended in 2009.

RESULTS AND DISCUSSION

From 1 April 2010 through 31 March 2011, the MNDNR and USDA-WS collected a combined total of 1,016 samples from wild birds. This included birds that were live-caught (n = 417), hunter-harvested (n = 552), agency-harvested (n = 40), and mortality/morbidity events (n = 7) throughout Minnesota (Table 1, Figure 1). No positive cases of HPAI H5N1 were identified; however, 7 American green-winged teal, 32 mallards, and 2 northern pintails tested positive for LPAI subtype H5 (Figure 2). The testing protocol limited the screening for H5, H7, and N1 subtypes only; however, in some cases other subtypes were identified and reported elsewhere (Table 2).

According to the latest numbers from the United States Geologic Survey's (USGS) website (http://wildlifedisease.nbii.gov/ai/), approximately 40,660 birds were sampled for HPAI H5N1 in the U. S. in 2010. No positive cases were found. From 2006 to 2010, over 410,000 wild birds have been sampled for HPAI H5N1 throughout the U. S., including 9,017 in Minnesota, and no HPAI H5N1 has ever been detected. Despite multiple wild bird mortality events in Asia and Europe, it does not appear that HPAI H5N1 has been introduced via migratory birds into the U. S.

From 2006 to 2010, of the 9,017 samples collected in Minnesota, there were 146 positive LPAI H5 subtypes and 7 LPAI N1 subtypes (Table 3). Approximately 26% of the total samples collected were in the summer months (presumably from resident/local birds), while 48% were from fall hunter-harvested birds that were migrating into Minnesota.

There has been additional AI research conducted by the Southeastern Cooperative Wildlife Disease Study (SCWDS) since 2006 in northwestern Minnesota. Primary focus areas include Roseau River Wildlife Management Area (WMA), Thief Lake WMA, and Agassiz National Wildlife Refuge (NWR). Sampling has also occurred at lakes around the Bemidji and Fosston areas. From 2006 to 2010, SCWDS sampled over 9,200 ducks, and based on virus isolation in embryonating chicken eggs, found 1,254 positive samples, of which 30 were LPAI H5 subtypes, and 20 LPAI H7 subtypes (Table 4). Throughout all testing, there was no HPAI H5N1 virus detected. Sampling in Minnesota will continue by SCWDS at least through 2013.

Other AI research has been conducted throughout the state by University of Minnesota (UMN) since 2008, mostly in conjunction with MNDNR's sampling efforts. From 2008 to 2010, the UMN sampled over 3,100 ducks, have analyzed 3,092 to-date, and used both a plaque reduction neutralization test (PRNT) and a virus isolation (VI) test; 72 LPAI isolates have been detected. Sub-types isolated by species to-date include LPAI H1N1, H6N1, H1N1, H3N8, and H3N2 in mallards; LPAI H4N8, H4N2, H3N8, H3, and H11N9 in blue-winged teal; and LPAI H4N8 in ring-necked ducks. No H5 or H7 LPAI or HPAI has been encountered to-date.

Federal AI funding for most wild bird surveillance in the U. S. is no longer available; however, federally-funded efforts to monitor for the disease in domestic poultry will likely continue. Even though USDA-WS and MNDNR will no longer be conducting large-scale surveillance for HPAI H5N1 in wild birds, AI samples will continue to be collected at all mortality/morbidity events involving wild birds in the state.

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Table 1. Bird species sampled in Minnesota for highly pathogenic avian influenza H5N1 by the Minnesota Department of Natural Resources (MNDNR) and United States Department of Agriculture-Wildlife Services (USDA-WS), 2010. These wild birds were live-caught, hunter-harvested, agency-harvested, or subjects of morbidity/mortality events.

Agency	Species sampled	*n*
MNDNR	Black duck (American)	2
	American green-winged teal	86
	American coot	6
	American wigeon	26
	Blue-winged teal	84
	Common goldeneye	50
	Common merganser	3
	Gadwall	4
	Greater scaup	2
	Hooded merganser	1
	Lesser scaup	40
	Mallard	218
	Northern pintail	39
	Northern shoveler	35
	Redhead	6
	Ring-necked duck	127
	Ruddy duck	1
	Wood duck	25
	Total	755
USDA-WS		
	American green-winged teal	2
	American wigeon	4
	Blue-winged teal	11
	Canada goose	84
	Double-crested Cormorant	57
	Mallard	82
	Northern shoveler	2
	Wood duck	19
	Total	261
Grand Total		1016

Table 2. Subtyping results of bird species sampled in Minnesota by the Minnesota Department of Natural Resources and United States Department of Agriculture-Wildlife Services, 2010.

Species	H10N7	H3N2	H3N8	H4N6	H5N2	H6N1	N2	N4	N8	TOTAL
American green-winged teal				1		1	1	1		4
Mallard	2	1		1	3	1	1		1	10
Northern pintail				1						1
Wood duck			1							1
Total	2	1	1	3	3	2	2	1	1	16

Table 3. Low pathogenic avian influenza strains detected in wild birds sampled in Minnesota by the Minnesota Department of Natural Resources and United States Department of Agriculture's Wildlife Services, 2006–2010.

Year	TotaL samples	Species	LPAI H5	LPAI N1
2006	2,065			
		American green-winged teal		1
		Northern pintail	1	
		Ring-necked duck	1	
		Total	2	1
2007	2,264			
		American green-winged teal 8		1
		American wigeon	5	
		Blue-winged teal	6	
		Lesser scaup	3	
		Mallard	8	1
		Northern pintail	9	1
		Northern shoveler	1	
		Total	40	3
2008	2,263			
		American green-winged teal 4		
		American wigeon	4	
		Bufflehead	1	
		Blue-winged teal	4	
		Gadwall	2	
		Lesser scaup	1	
		Mallard	24	1
		Northern pintail	2	
		Northern shoveler	1	
		Total	43	1
2009	1,409			
		American green-winged teal 3		
		American wigeon	1	
		Blue-winged teal	5	1
		Mallard	2	1
		Northern pintail	4	
		Ring-necked duck	4	
		Wood duck	1	
		Total	20	2
2010	1,016			
		American green-winged teal 7		
		Mallard	32	
		Northern pintail	2	
		Total	41	0
Total	9,017	Grand Total	146	7

Table 4. Avian influenza samples collected in Minnesota by the Southeastern Cooperative Wildlife Disease Study , Athens, Georgia, 2006–2010.

Year	Total samples	Positive (%)	# of Subtypes	LPAI H5	LPAI H7
2006	130	17 (13%)	4	0	0
2007	2,441	222 (9%)	27	2	15
2008	2,452	438 (18%)	31	16	2
2009	2,341	238 (10%)	Pending [a]	6	3
2010	1,896	339 (18%)	Pending [a]	6	0

[a] All H5 and H7 viruses recovered during these years have been tested by National Veterinary Services Laboratories.

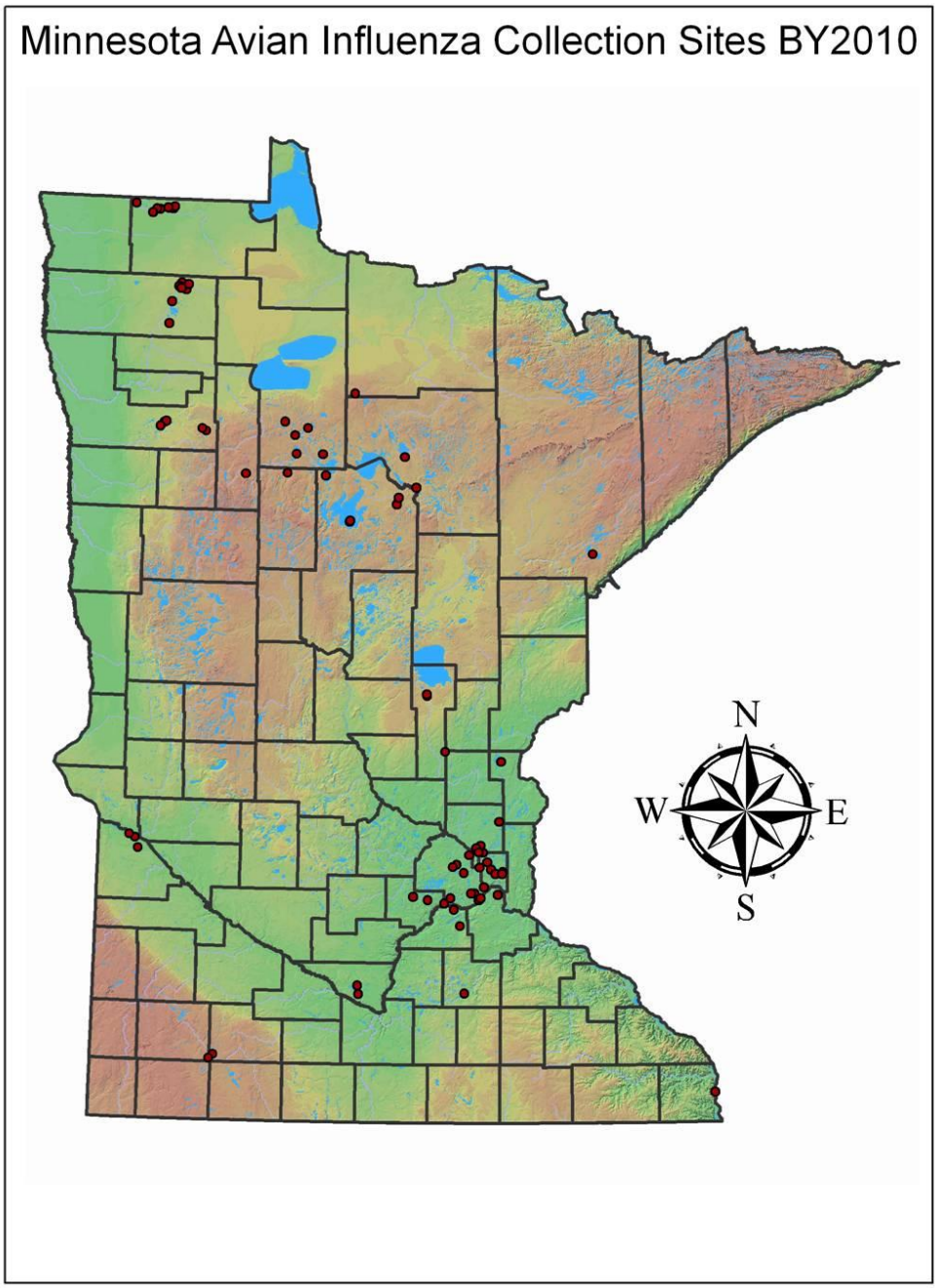

Figure 1. Sites in Minnesota from which wild bird samples (*n* = 1,016) were collected and tested for highly pathogenic avian influenza by the Minnesota Department of Natural Resources and United States Department of Agriculture's Wildlife Services, 2010.

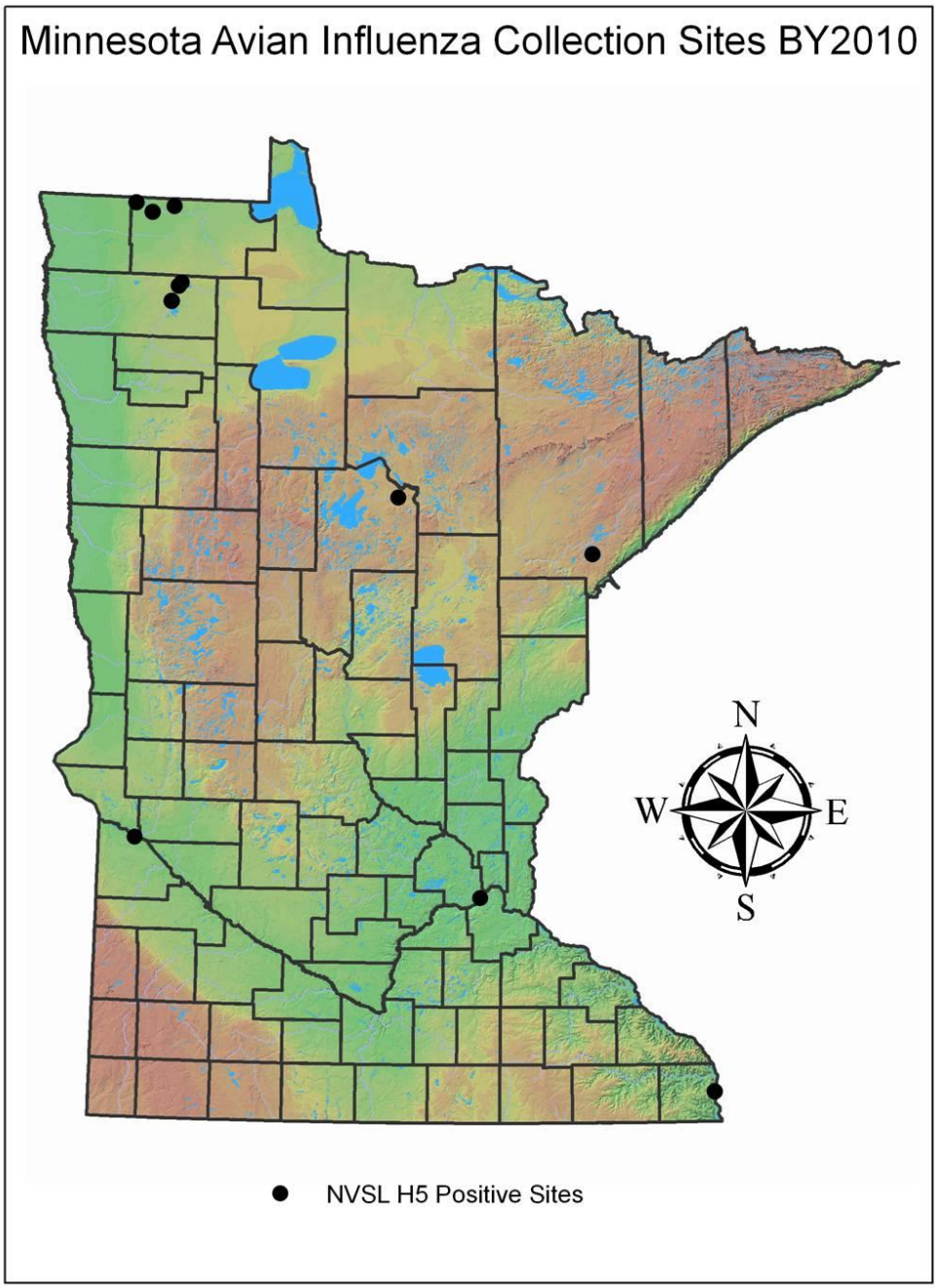

Figure 2. Collection sites in Minnesota where a low pathogenic avian influenza H5 strain was detected among the waterfowl (*n* = 41) sampled by the Minnesota Department of Natural Resources and United States Department of Agriculture's Wildlife Services, 2010.