Attachment 4

Surveillance for Highly pathogenic H5N1 avian influenza virus in Live Wild Birds

Overview

This surveillance strategy incorporates sampling of live-captured, apparently healthy migratory birds to detect the presence of highly pathogenic avian influenza (HPAI) H5N1 virus. Virus isolation from tracheal and cloacal samples is a common method for detecting avian influenza (AI) viruses and has been used before in various geographic regions, including Alaska (Ito et al., 1995; Hanson et al., 2003; Slemons et al., 2003; Krauss et al., 2004). This effort focuses on bird species in North America that represent the highest risk of being exposed to or infected with highly pathogenic H5N1 avian influenza virus because of their migratory movement patterns, which include birds that migrate directly between Asia and North America, or birds that may be in contact with species from areas in Asia with reported outbreaks.

In general, bird flyways represent migration corridors within continental land masses. However, Alaska and corresponding areas in the Russian Far East represent a unique case where major flyway systems cross continental boundaries. Two major Asian flyways (the East Asian-Australasian and East Asian) include both Southeast Asia, Oceania, and the arctic regions of Siberia, the Russian Far East, and Alaska. The East Asian-Australasian Flyway, defined primarily in the context of shorebird use, extends from the Siberian and Alaskan arctic through North and Southeast Asia including U.S. trust territories in the Pacific to Australia and New Zealand, covering 20 countries.

Similarly, in North America, the Pacific Flyway extends from Arctic Canada, Alaska, and Eastern Siberia through coastal and western regions of Canada, the United States and Mexico, and on to Central and South America. Many migratory species that nest in Arctic Siberia, Alaska, and Canada follow the Pacific Flyway to wintering areas. Although not considered a major pathway, birds from both Eastern Siberia and Alaska intermingle in both the Pacific and Central Flyways. The overlap at the northern ends of these flyways and in Hawaii and Oceania establishes a path for potential disease transmission across continents and for mixing, re-assortment, and exchange of genetic material among strains from Eurasia and North America.

There is concern about the spread of HPAI westward from Asia to Europe. However, there is comparatively little movement of wild birds between Europe and North America. Consequently, if highly pathogenic H5N1 avian influenza virus arrives in the U.S. or a U.S. territory in migratory birds, it would most likely arrive first in Alaska or one of the Pacific Islands. Such an event is not unreasonable, as the contribution of Eurasian AI viruses to the genetic composition of viruses in North American wild birds has already been shown.

Methodology

Identification of Priority Species

Birds should be sampled in conjunction with existing studies when possible, and additional bird captures should be initiated as necessary to provide a broad species and geographic surveillance effort. Initial efforts should focus on one or more species in each of the following three groups that could potentially bring highly pathogenic H5N1 avian influenza virus to the US Pacific Islands and trust territories and/or Alaska and, subsequently, southward through the Pacific and potentially the other North American flyways:

1. Species that travel directly to Alaska or Oceania from Southeast Asia or Australasia. Some of these birds winter in Southeast Asia while others migrate along coastal Southeast Asia to and from wintering areas in Australasia. Based on what is known about the geographic distribution of the current highly pathogenic H5N1 avian influenza virus outbreaks, this is the group most likely to bring the virus to Alaska or the U.S. Islands and trust territories in Oceania. Before any species in this group can be a source of infection for birds in other areas of North America, inter-specific transmission of the virus to temperate migrants must occur in Alaska. Examples include the bar-tailed godwit (Fig. 4-1), dunlin, and red knot.

2. Species that breed in Alaska, with some fraction of the population known to winter in Asia. Although the portion of the population that winters in Asia may be small, some of these species are highly gregarious at other times of the year, particularly during molting, staging, and on their primary wintering grounds. Because the primary wintering grounds of several of these species are in the North American Pacific Flyway, carriers arriving in Alaska from Asia could potentially transmit the virus to a large portion of the North American population. This scenario for highly gregarious species requires only intraspecific transmission in Alaska. The course of events for less gregarious species and those that tend to winter in more northerly latitudes is more likely to require interspecies transmission. Examples include the black brant, northern pintail (Fig. 4-1), long-tailed duck (Fig. 4-2), yellow-billed loon, and red-breasted merganser.

3. Species that intermingle across Siberia, the Russian Far East, and Alaska. This group has become more important with the confirmation of HPAI in poultry near Novosibirsk in Siberia. However, unless highly pathogenic H5N1 avian influenza virus spreads further north and east in this region, the most likely way for this group to become infected would be contact with species that winter in southern Asia and breed in northern Asia. Under such circumstances, inter-specific transmission would be required on both sides of the Bering Strait before the virus could be carried from Alaska to temperate regions of North America. Examples include the Steller's eider, spectacled eider, emperor goose (Fig. 4-3), sharp-tailed sandpiper, sandhill crane.

Figure 4-1. Migratory routes of two species that illustrate movements of birds between Asia and North America

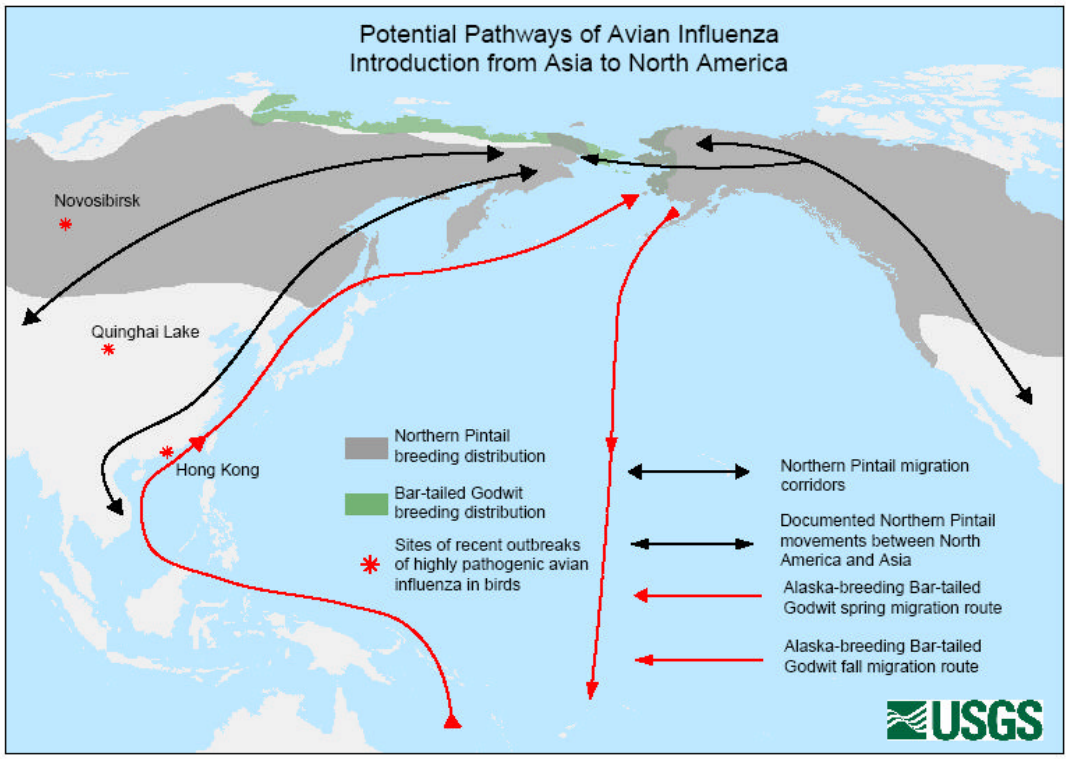


Figure 4-2. Migratory routes of long-tailed ducks between Alaska and Asia

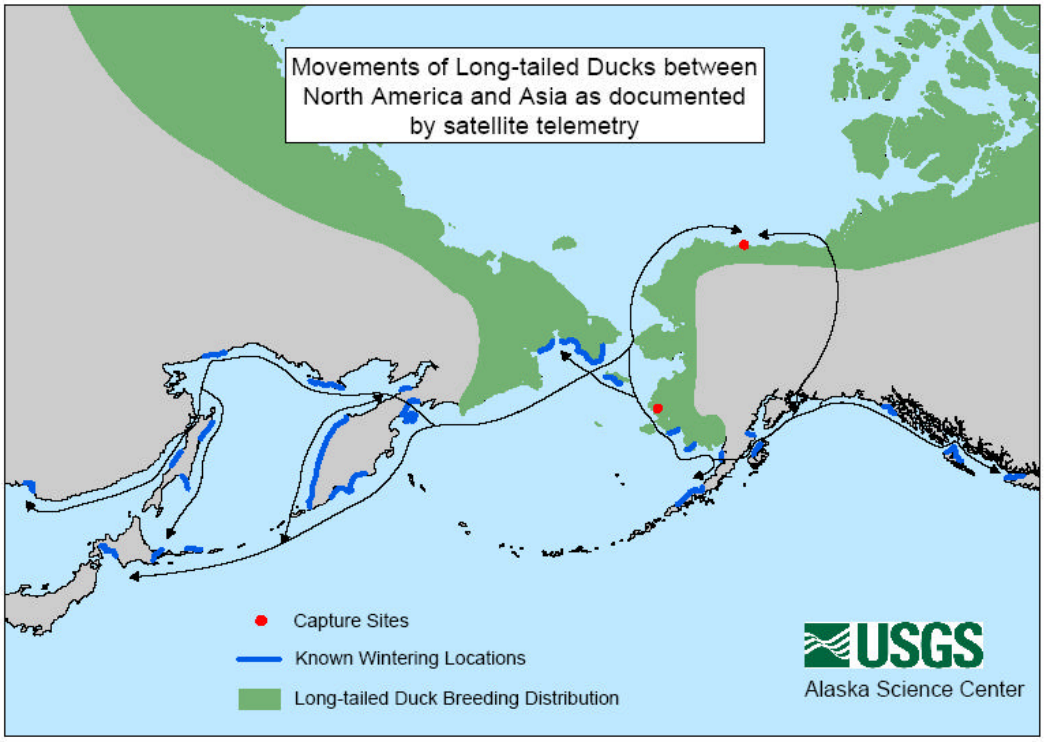
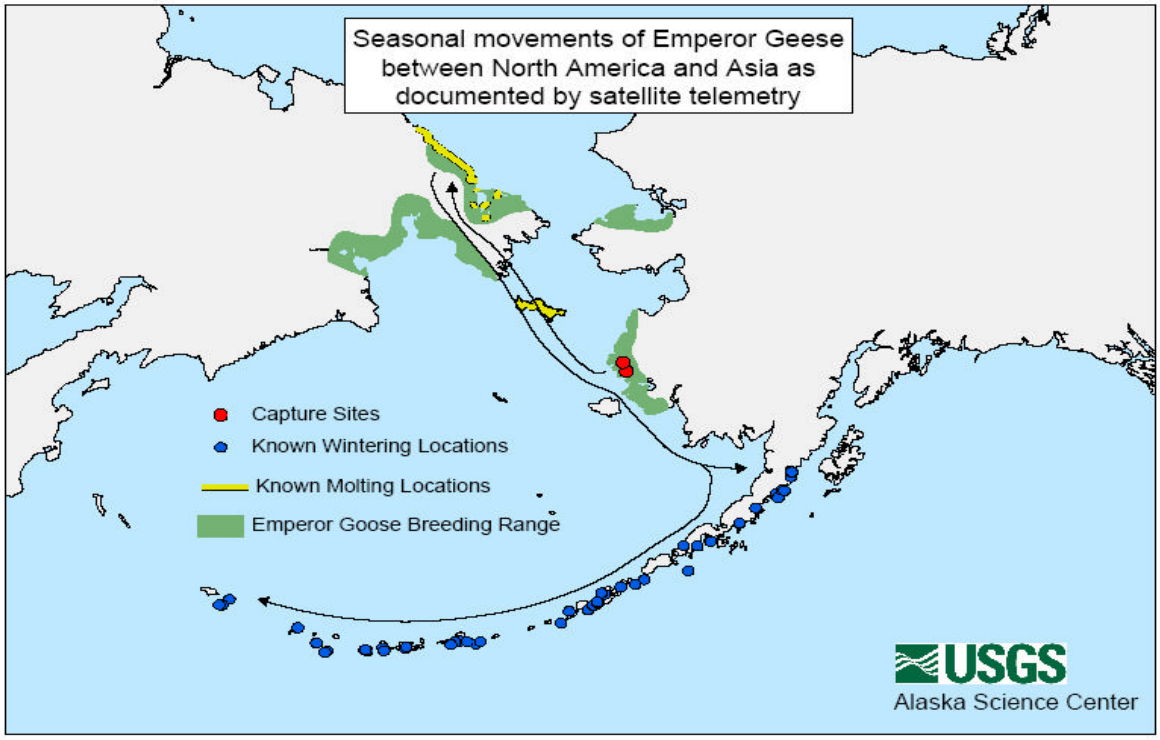


Figure 4-3. Migratory pathways of emperor geese between Alaska and Russia.



The strategy for selection of species to be sampled should initially focus on migrants that have the greatest likelihood of making contact with wild migratory birds, domestic flocks, and geographic areas in Asia where highly pathogenic H5N1 avian influenza virus has been documented. Members of three taxonomic groups of waterbirds—loons, waterfowl, and shorebirds—offer the most immediate potential for meeting the selection criteria and being carriers of the virus (see Tables 4-1to 4-3).

Table 4-1. Loon species as potential carriers of the highly pathogenic H5N1 avian influenza subtype to North America.

	Asian Contact				
Species	**Direct**	**Indirect**	**Timing**	**Specifics[1]**	**Point of Contact**
Yellow-billed Loon	Yes	Yes	Oct-Apr	Birds breeding on Alaskan north slope winter off of Japan, Korea, China.	Coastal Japan, Korea, China
Red-throated Loon	Yes	Yes	Oct-Apr	Birds breeding on Alaskan north slope winter off of Chukotka and Kamchatka.	Coastal Chukotka and Kamchatka
Pacific/Arctic Loon				Little data is available but probably follow similar patterns to yellow-billed and red-throated loons.	

[1] For the most part, loon species mix with other waterbirds along migration routes and at staging and wintering areas.

Table 4-2. Waterfowl species as potential carriers of the Highly pathogenic H5N1 avian influenza subtype to North America.

	Asian Contact				
Species	**Direct**	**Indirect**	**Timing**	**Specifics**[1]	**Point of Contact**
Tundra Swan	Yes	Yes	Jun-Sep	Portion of breeding range in Chukotka. From there birds migrate to staging and wintering areas throughout Pacific Flyway.	Chukotka
Whooper Swan	Yes	Yes	Nov - Apr	Eastern Asian population breeds in E. Russia and NW China. Small numbers wintering in Aleutian and Pribilof islands.	E. Russia and NW China; Aleutian and Pribilof islands
Emperor Geese	Yes	Yes	Year round	Portion of breeding range in Chukotka and some AK breeders molt in Chukotka. From there birds migrate to staging and wintering areas in the W. AK and Aleutian Islands. Small segment of population stage and winter in Commander Islands and Kamchatka.	Chukotka and W. Alaska
Black Brant	Yes	Yes	Jun-Sep	Portion of breeding range in Chukotka, some AK breeders molt on Wrangel Island (Russia), and Siberian breeders molt on Alaskan North Slope (Teshekpuk). Most of population migrates to staging areas in W.AK and winters along Pacific coast to Mexico. Birds breeding west of Kolyma (Russia) winter in Korea, China, and Japan (mixing in fall and to some degree in spring).	Chukotka, and N. and W. Alaska, W. coast of N.A.
Aleutian Canada Geese	Yes	Yes	Jun-Sep	Portion of population breeds on Commander Island (Russia), then migrate through Alaska into Oregon and California.	Commander Island
Snow Geese	Yes	Yes	Jun-Sep	Portion of population breeds on Wrangel Island (Russia), then migrates through Alaska into Pacific Flyway states (mixing with other waterbird species).	Wrangel Island
Eurasian Wigeon	Yes	No		Regular vagrant along west coast of North America, especially Aleutian Islands.	W. coast of North America, especially Aleutian Is.
Northern Pintail	Yes	Yes	May-Sep	Some Siberian breeders winter in W. US (California). Also birds banded in North America have been recovered over large areas of E. Siberia and Kamchatka.	Siberia
Baikal Teal	Yes	No		Occasional vagrant to North America chiefly in Aleutians & extreme Western Alaska.	Aleutians & extreme Western Alaska
Common Pochard	Yes	No		Vagrant in W. Alaska (Aleutian and Pribilof Islands).	W. Alaska (Aleutian and Pribilof Islands)
Steller's Eiders	Yes	Yes	Nov-Sep	Most of the population breeds E. Siberian arctic, these birds molt on Alaska Peninsula (Izembek and Nelson Lagoons). Birds winter in largest numbers in Commander and Kuril Islands (Russia) and in smaller numbers in Northern Japan, along Alaska Peninsula, and Aleutian Islands.	Alaska Peninsula, and Aleutian Islands; E. Siberian arctic, Commander and Kuril Islands (Russia), Northern Japan
	Asian Contact				

Species	Direct	Indirect	Timing	Species	Point of Contact
Common Eiders	Yes	Yes	Year round	Portion of AK and Canada breeders molting and wintering in Chukotka. Portion of E. Siberian breeding population winters in Bering Sea (Aleutian Islands) mixing with AK and Canada breeders.	Chukotka and Aleutian Is.
King Eiders	Yes	Yes	Year round	Portion of AK and Canada breeding population molt and winter in Kamchatka and Kuril islands (Russia). Portion of E. Siberian breeding population winters in Bering Sea (Aleutian Islands) mixing with AK and Canada breeders.	Kamchatka and Kuril islands (Russia) and E. Siberian arctic
Spectacled Eiders	No	Yes	Nov-Apr	E. Siberian arctic and Alaska breeders mix during winter in Bering Sea.	Bering Sea
Long-tailed Ducks	**Yes**	**Yes**	**Oct-Apr**	**Yukon Kuskokwim Delta breeders and North Slope molters molt and winter along Chukotka, Kamchatka, south along the Russian coast, and Kuril and Sakhalin islands.**	**Chukotka and Kamchatka**
Tufted Duck	Yes	No		Regular vagrant along west coast of North America.	W. coast of North America

Other Possibilities

Species	Specifics
Greater White-fronted Geese	Circumpolar distribution.
Green-winged Teal	Breed throughout middle latitude Northern Hemisphere.
Mallard	Holarctic distribution.
Northern Shoveler	Holarctic distribution.
Gadwall	Breed on Alaskan peninsula, Kamchatka, China, Russia.
Greater Scaup	Holarctic distribution. AK breeders winter on Atlantic coast
Harlequin Ducks	Pacific population breeds from E. Siberia through Alaska to W. Canada.
Black Scoters	Pacific population breeds in Siberia and Kamchatka, into western Alaska and sparsely across Canada.
Common Goldeneye	Circumpolar distribution.
Red-breasted Merganser	Holarctic distribution.

[1] For the most part, all the waterfowl species mix with other waterbirds along migration routes and at staging and wintering areas.

Table 4-3. Shorebird species as potential carriers of the Highly pathogenic H5N1 avian influenza subtype to North America.

	Asian Contact				
Species	**Direct**	**Indirect**	**Timing**	**Specifics**	**Point of Contact**
Pacific Golden-Plover	Yes	Yes	Jun-Sep	Pop. nesting in Siberia/Chukotka returns to North America; during passage through AK mixes with local nesting Pacific Golden-Plovers that winter in Hawaii and central Oceania. Breeding birds from Siberia thought to also migrate overland to Southeast Asia and Oceania. Birds wintering in the Marshall and Mariana Islands migrate through Southeast Asia whereas birds wintering in the Hawaiian Islands thought to migrate through Alaska.	Russian Far East and w. Alaska; Oceania, main Hawaiian Islands, Northwestern Hawaiian Islands, Marshall Islands, Guam and the Northern Marianas
Black- bellied Plover	Yes	Yes	Jun-Sep	Pop. nesting in Siberia/Chukotka returns to North America, mixing with birds in w. Alaska before both migrate to nonbreeding areas in North and Central America.	Russian Far East and w. Alaska
Semipalmated Plover	Yes	Yes	Jun-Sep	North American breeding and North and South American nonbreeding species with small breeding pop. recently established in Chukotka. Chukotka pop. mixes with other species from the East Asian flyway (EAF) before returning to the Americas.	Chukotka, w. Alaska
Bar-tailed Godwit	Yes	Yes	Apr-Nov	About 90,000 birds migrate along the coast of E. Asia en-route to breeding grounds in n. and w. Alaska. Coastal w. Alaska principal autumn staging area where birds mix with 15-20 spp. of shorebirds and equal number of waterfowl spp. that migrate to the Americas.	Birds spending nonbreeding season in Australia with potential to also mix with other pop. of godwits (*L. l. menzberi*) that are restricted to coastal E. Asia
Marbled Godwit	No	Yes	Aug-Oct	Mixes with Bar-tailed Godwits at staging sites on AK Pen. Migrates to Pacific NW.	AK Peninsula
Whimbrel	No	Yes	Jul-Aug	Contact occurs with Bar-tailed Godwits and plovers (Black-bellied and Pacific Golden) in w. AK & on AK Pen. Estuaries.	AK Peninsula
Bristle-thighed Curlew	Yes	Yes	May-Sep	Possible direct contact on nonbreeding grounds in Oceania; indirect through contact with Bar-tailed Godwits on w. AK breeding and YKD staging grounds	Seward Pen., Andreafsky Wilderness, Yukon Delta NW Hawaiian Is. and the Marshall Is.
Greater Yellowlegs	No	Yes	Aug-Sep	Mixes with Bar-tailed Godwits at staging sites on YKD & AK Pen.	W. Alaska
Wandering Tattler	Yes	Likely	May-Sep	Birds breeding in AK migrate to Hawaii and likely elsewhere in Oceania. Bird in Australia during nonbreeding season may be from Alaska and/or part of breeding range in Chukotka.	Chukotka, W. Alaska
Ruddy Turnstone	Possibly	Likely	May-Sep	Not known if birds nesting on Chukotka come to AK postbreeding. However, birds nesting in AK known to migrate to sites in EAF & Oceania. Birds from Eastern Siberia and Western Alaska also migrate along the East Asian coast, and a portion winter in the Mariana and Marshall Islands.	W. Alaska; Oceania, NW Hawaiian Islands, Marshall Island, Guam and Mariana Islands
	Asian Contact				

Species	Direct	Indirect	Timing	Specifics	Point of Contact
Black Turnstone	No	Yes	Jul-Sep	On YKD mingles with species (Bar-tailed Godwit, Sharp-tailed Sandpiper, and *C. a. arcticola* Dunlin) that pass along EAF during migration.	W. Alaska
Long-billed Dowitcher	Yes	Yes	Jun-Oct	Birds nesting in Chukotka/Siberia return to AK and then migrate to nonbreeding areas in temp. NA. When in Russia there exists potential to have contact with numerous species that migrate along the EAF.	Siberia, W. Alaska
Surfbird	No	Yes	Jul-Sep	At AK Peninsula estuaries mixes with flocks of Bar-tailed Godwits that migrate along the EAF.	SW Alaska
Red Knot	Yes	Yes	May-Oct	Subspecies *C. c. roselaari* breeds in w. and n. Alaska and on Wrangel I. and spends nonbreeding season along Pacific coast of N. & C. America. Birds staging on YKD in spring possibly mix with *C. c. rogersi* pop. that reaches Alaska via Australia & EAF. If no mixing with *C. c. rogersi*, then birds on Wrangel I. are in direct contact with other spp. of waders and waterfowl from EAF.	Wrangel Is., W. Alaska
Sanderling	?	Likely	Sep-Oct	Birds in autumn in W. Alaska likely from Asian nesting areas where direct contact likely. Nonbreeding areas of birds in w. AK in autumn unknown.	W. Alaska
Semipalmated Sandpiper	No	Yes	Jun-Aug	Widespread nesting species in n. Alaska where in direct contact with Dunlin (*C. a. arcticola*) that migrate through and winter in EAF.	N. and W. Alaska
Western Sandpiper	Possibly	Yes	Jun-Sep	Breeds in Chukotka with birds returning to nonbreeding areas in NA; also has contact with *C. a. arcticola* Dunlin in N. AK.	N. and W. Alaska
Red-necked Stint	Yes	Yes	Jun-Sep	Old World species that occasionally nest in w. Alaska with Western Sandpipers.	N. and W. Alaska
Pectoral Sandpiper	Yes	Yes	Jun-Aug	Birds nesting in Siberia/Russian Far East return to nonbreeding areas in SA via passage through N. America. In Siberia the species is in direct contact with numerous spp. of waders and waterfowl from the EAF.	W. & N Alaska
Sharp-tailed Sandpiper	Yes	Yes	Aug-Oct	Possibly the entire annual cohort of juveniles comes to w. AK from Siberian nesting grounds where they have had contact with several pop. of birds that have migrated along the EAF.	Mostly W. Alaska
Buff-breasted Sandpiper	Yes	Yes	Jun-Aug	Breeds in Canada, AK but pop. also nests on Wrangel Is. and migrates through AK & N.A. to reach nonbreeding areas in S.A.	Wrangel Is., W. Alaska
	Asian contact				
Species	**Direct**	**Indirect**	**Timing**	**Specifics**	**Point of Contact**

Rock Sandpiper	Yes	Yes	Jun-Oct	*C. p. tschuktschorum* subspecies has portion of breeding range in Chukotka. Birds from there migrate to nonbreeding areas in the Pacific NW via w. AK staging sites where they mix with Dunlin (*C. a. pacifica)* & Rock Sandpipers (*C. p. ptilocnemis*).	W. & SW Alaska
Dunlin	Yes	Yes	May-Oct	*C. a. arcticola* nests in n. AK and migrates to nonbreeding areas in central EAF (Japan, Korea, Taiwan). While in AK it has contact with numerous spp. of waders and waterfowl that migrate to N, C. & S. America.	N. & W. Alaska
Buff-breasted Sandpiper	Yes	Yes	Jun-Aug	Breeds in Canada, AK but pop. also nests on Wrangel Is. and migrates through AK & N.A. to reach nonbreeding areas in S.A.	Wrangel Is., W. Alaska

To further focus sampling, five criteria were employed to rank these migratory waterbirds and other migrants that are potential carriers of highly pathogenic H5N1 avian influenza virus (see Tables 4-4 to 4-6 below). These ranking criteria include 1) proportion of the population occurring in Asia, 2) contact with a known area of highly pathogenic H5N1 avian influenza virus, 3) habitats used in Asia, 4) population size in Alaska, and 5) likelihood of obtaining a representative sample of sufficient size. Table 4-7 is a summary of primary and secondary species that should be considered as sampling targets for highly pathogenic H5N1 avian influenza virus in the four major flyways (see also Attachment 5).

Table 4-4. Ranking matrix for populations of waterfowl and cranes to be sampled for HPAI during the 2006 field season in Alaska.

Taxon	Total or partial contact with Asia	Contact with known "hot spot"	Habitat used in Asia	Pop. in Alaska	Can samples be obtained?	Score
Steller's Eider	**4**	**1**	**4**	**3**	**3**	**15**
	Most (>90%) of the Pacific-wintering population (250,000) breeds in northeastern Asia	No known use of AI-infected areas	Uses estuarine and freshwater habitats	Winter pop approx 80,000 Breeding population <1,000	Relatively easy to trap during fall molting period	
Northern Pintail	**2**	**2**	**4**	**4**	**3**	**15**
	Unknown number of Siberian-breeding birds migrate through Alaska to winter in North America	Asian summer range overlaps with known AI-infected areas	Freshwater marshes, ephemeral wetlands	Summer population approximately 1 million	Easy to capture in Alaska in autumn	
Taxon	**Total or partial contact with Asia**	**Contact with known "hot**	**Habitat used in Asia**	**Pop. in Alaska**	**Can samples be obtained?**	**Score**

		spot"				
Lesser Snow Goose	**5**	**1**	**4**	**3**	**2**	**14**
	The Wrangel Island colony of 110,000 breeding birds is managed as a discreet population	No known use of AI-infected areas	Freshwater marshes, ephemeral wetlands	Entire breeding population of 110,000 breeding birds plus young of the year migrate through Alaska en-route to the west coast states	Could be difficult to obtain target number depending on timing and route of migration.	
Emperor Goose	**2**	**1**	**4**	**3**	**3**	**13**
	Approximately 20,000 birds molt in Chukotka, several thousand breed in the Anadyr lowlands	No known use of AI-infected areas	Breeds moist tundra meadows and near wetlands	approximately 90% of the population winters in Alaska and approximately 60% summers in Alaska	Relatively easy to trap during summer and fall molting period	
Black Brant	**1**	**1**	**4**	**3**	**3**	**12**
	Several thousand birds nest in the Anadyr lowlands and on Wrangel Island	No known use of AI-infected areas	Breeds in moist sedge coastal tundra areas	Near entire Pacific population of 130,000 birds stage at Izembek Lag prior to fall migration to winter from B.C. to Mexico	Samples could be obtained easily from fall birds	
Spectacled Eider	**4**	**1**	**4**	**2**	**1**	**12**
	Over 90% of the world population (approx 300,000) nests in Arctic Russia	No known use of AI-infected areas	Breeds moist tundra meadows and near wetlands	Approximately 9,000 birds breed on the Arctic Slope, and 8,000 on the Yukon-Kuskokwim Delta	Could be difficult to obtain target number	
Aleutian Cackling Goose	**1**	**1**	**4**	**3**	**2**	**11**
	Small numbers breed on Commander Islands and winter in Asia	No known use of AI-infected areas	Breeds on Aleutian Islands in wet, grassy freshwater meadows	Approximately 70,000 birds in fall population	Could be difficult to obtain target number	
Long-tailed Duck	**2**	**1**	**2**	**3**	**3**	**11**
	Approx 250,000 breed in northeastern Russia, unknown numbers cross to North America	No known use of AI-infected areas	Nests coastal tundra; postbreeding use estuarine areas	Approx 80,000 summer in western Alaska, 600,000 in northern Alaska and western Canada	Samples could be obtained easily from fall birds	

Taxon	Total or partial contact with Asia	Contact with known "hot spot"	Habitat used in Asia	Pop. in Alaska	Can samples be obtained?	Score
Tundra Swan	**1**	**1**	**4**	**3**	**2**	**11**
	Unknown numbers breed in eastern Chukotka; may be associated with Pacific Flyway	No known use of AI-infected areas	Nests coastal tundra; migration and non-breeding in coastal habitats	Approximately 150,000 summer in Alaska	Could be difficult to obtain target number	
Common Eider	**2**	**1**	**2**	**3**	**2**	**10**
	Approx 30,000 breed in northeastern Russia	No known use of AI-infected areas	Breeds in wet or moist tundra meadows near wetlands or on barrier islands	Alaska population believed to be 25,000 western Alaska plus 120,000 in northern Alaska plus western Canada	Could be difficult to obtain target number in most locations	
King Eider	**2**	**1**	**2**	**3**	**2**	**10**
	Approx 150,000 breed in northeastern Russia	No known use of AI-infected areas	Breeds in moist and upland tundra	Approx 360,000 breed in northern Alaska and western Canada	Could be difficult to obtain target number in most locations	
Lesser Sandhill Crane	**2**	**1**	**3.5**	**3**	**2**	**11.5**
	unknown numbers of mid-continent population breed in Siberia	No known use of AI-infected areas	Breeds in wet or moist tundra meadows near wetlands or on barrier islands, often feeds in agricultural areas where available	Alaska population believed to be in the low tens of thousands	Could be difficult to obtain target number	
Ranking criteria:						
	1. Proportion of the population occurring in Asia. Score as 1-5 where 5=100%	2. Contact with a known 'hotspot' or source. Score as 1=no contact, 2=contact	3. Habitats used in context of likelihood of exposure 1=Offshore marine, 2=Estuary, 3=Terrestrial, 4=Freshwater.	4. Population size in Alaska during 2006. Score to the closest number 1=1,000, 2=10,000, 3=100,000, 4=1,000,000	5. Can we obtain a representative sample of sufficient size (n=200)? Score 1=no, 2=maybe, 3=yes.	

Table 4-5. Ranking matrix for populations of shorebirds to be sampled for avian influenza during the 2006 field season in Alaska.

Taxon	Total or partial contact with Asia	Contact with known "hot spot"	Habitat used in Asia	Pop. in Alaska	Can samples be obtained	Score
Dunlin (*C. a. arcticola*)	**5**	**2**	**3**	**4**	**3**	**17**
	Entire pop. winters from Taiwan north to Yellow Sea and n. Japan	Winters throughout areas where H5N1 identified	Estuarine and freshwater habitats; also ephemeral inland lakes where domestic waterfowl raised	Est. at 650,000	Relatively. easy to trap on nest and during post-breeding when in flocks	
Sharp-tailed Sandpiper	**5**	**1**	**3.5**	**2**	**3**	**14.5**
	Breeding restricted to n. central Siberia with annual cohort of immatures coming to Alaska; adults move through EAA flyway	Migrating adults pass through known "hot spots" in central E. Asia. Species of concern if adults can pass virus to offspring on breeding grounds	Freshwater marshes, brackish wetlands, salt ponds, sewage farms, ephemeral wetlands	Between 10,000 and 40,000 depending on annual production	Easy to capture in Alaska in autumn	
Bar-tailed Godwit (*L. l. baueri*)	**5**	**2**	**2**	**3**	**2**	**14**
	Entire pop. nests w. and n. Alaska & stages central E. Asia (Yellow Sea, Korea, Japan) in spring; southward migration direct across Pacific	On migration stops in central E. Asia (Yellow Sea, Japan, Korea)	Estuarine	Est. at 120,000, but 2005 census efforts accounted for <50,000	Could be difficult to obtain target number	
Ruddy Turnstone (*A. i. interpres*)	**3**	**2**	**2.5**	**2.5**	**3**	**13**
	Portion of W. Alaska nesting pop. migrates to SE and E Asia; pop. nesting Chukotka moves to W. Alaska in fall before returning to E and SE Asia. Eastern Siberia and West Alaska breeding birds also migrate down the East Asian coast, with some birds wintering in the Mariana and Marshall Islands	On migration stops in central E. Asia (Yellow Sea, Japan, Korea)	Breeds upland tundra; migration and non-breeding coastal (rocky intertidal, sand beaches, & mudflats)	>35% of North American pop. (= ~20,000 birds) in Alaska, plus historically large numbers visit (>20,000 on Pribilof Is.) from Chukotka	Unless post-breeding concentrations found (e.g., Pribilof Is.) could be difficult to meet target sample. 200 turnstones can be captured in either the Marshall or Mariana Islands or both	

Taxon	Total or partial contact with Asia	Contact with known "hot spot"	Habitat used in Asia	Pop. in Alaska	Can samples be obtained?	Score
Pectoral Sandpiper	**3**	**1**	**4**	**3**	**2**	**13**
	Greater than 50% of pop. nests in Russia west to Eastern Taimyr Peninsular.	To date no known use of "hot spots"	Breeds marshy/grassy tundra; post-breeding uses brackish ponds freshwater marshes	200,000-300,000	Could be difficult to obtain target number	
Red Knot (*C. c. rogersi & roselaari*)	**4**	**2**	**2**	**2.5**	**2**	**12.5**
	C.c. roselaari pop. nests Wrangel I. and w. Alaska and winters Pacific coast of the Americas. *C. c. rogersi* nests Chukotka/New Siberian Isl. & winters Aust./New Zealand, passing through c. E. Asia	On migration *C. c. rogersi* passes through areas where H5N1 identified	Estuarine	*C. c. roselaari* <50,000; C. c. *rogersi* 220,000. *C. c. rogersi* thought to stop in Alaska in spring but numbers unknown (possibly several 10,000s)	Could be difficult to obtain target number	
Long-billed Dowitcher	**3**	**1**	**3**	**3**	**2**	**12**
	>30% of pop. breeds in Russia where range expanding w. to Taimyr Pen.; >95% of entire pop. winters in North and Central America. Unknown numbers winter in Asia (Japan)	To date no known use of "hot spots"	Breeds coastal lowlands in wet, grassy freshwater meadows; uses estuarine and managed wetlands during migration & winter	North American pop. = 450,000 (>90% of this in Alaska during migration)	Could be difficult to obtain target number	
Rock Sandpiper (*C. p. tschuktschorum*)	**3**	**1**	**2.5**	**2**	**3**	**11.5**
	~ 20-30% of pop. nests in Chukotka	To date no known use of "hot spots"	Nests upland tundra; post-breeding use estuarine areas	Total pop. 50,000. ~20K nest Chukotka but all return to AK en route to non-breeding areas in Pacific NW	Easy to trap on nest and during post-breeding flocking	

Taxon	Total or partial contact with Asia	Contact with known "hot spot"	Habitat used in Asia	Pop. in Alaska	Can samples be obtained?	Score
Pacific Golden-Plover	**3**	**2**	**2.5**	**2**	**2**	**11.5**
	Nesting occurs w. & sw Alaska and over large portion of n. Siberia and Chukotka. Interchange known between Asia and Alaska but not quantified. Alaska-nesting birds disperse to Oceania and Pacific coast of N & C America. Birds wintering in the Marshall or Mariana Islands are believed to be birds that have migrated overland from Siberia to Southeast Asia and Oceania.	Likely in c. East Asia	Nests upland tundra; migration and nonbreeding in coastal habitats	16,000	Could be difficult to obtain target number in Alaska; however, 200 plovers can be captured in either the Marshall or Mariana Islands or both	
Buff-breasted Sandpiper	**2**	**1**	**3**	**2**	**2**	**10**
	Small portion of pop. nests Wrangel I. & Chukotka then returns to non-breeding area in southern S. America	To date no known use of "hot spots"	Variable but generally dry upland tundra	3,000, including ~1000 birds from Chukotka/Wrangel I. stopping on southward migration	Could be difficult to obtain target number	

Ranking criteria:

1. Proportion of the population occurring in Asia. Score as 1-5 where 5=100%
2. Contact with a known 'hotspot' or source. Score as 1=no contact, 2=contact
3. Habitats used in context of likelihood of exposure 1=Offshore marine, 2=Estuary, 3=Terrestrial, 4=Freshwater.
4. Population size in Alaska during 2006. Score to the closest number 1=1,000, 2=10,000, 3=100,000, 4=1,000,000
5. Can we obtain a representative sample of sufficient size (n=200)? Score 1=no, 2=maybe, 3=yes.

Table 4-6. Ranking matrix for populations of passerines and a larid to be sampled for HPAI during the 2006 field season in Alaska.

Taxon	Proportion of population in Alaska	Contact with known "hot spot"	Habitat used in Asia	Population. in Alaska	Can samples be obtained	Score
Arctic Warbler (*Phylloscopus borealis kennicotti*)	**5**	**2**	**3**	**4**	**3**	**17**
	Endemic subspecies to Alaska	Winters in Myanmar, Thailand, se. China, Taiwan, Philippines south to Andaman Is., Malay Peninsula, and Indonesia east to Moluccas	Terrestrial. Wooded habitats, cultivated areas, grasslands, gardens, and mangroves	Est. at 2,700,000	Many locations where the most abundant breeding bird. Easy to capture during breed and migration	
Eastern Yellow Wagtail (*Motacilla tschutschensis*)	**5**	**2**	**3.5**	**4**	**3**	**17.5**
	Endemic species to Alaska	Taiwan, Indonesia, Sunda Isles, and Moluccas	Terrestrial. Open areas with water, sugarcane fields, rice fields, sparse grasslands, cassava plots; usually in association with wild and domestic grazing mammals	Est. 1,400,000	Easy to capture and areas with known concentration of breeding birds already identified	
Gray-cheeked Thrush (*Catharus minimus*)	**3**	**2**	**3**	**4**	**3**	**15**
	48% of global population in Alaska	Breeds in E. Siberia	Terrestrial. Shrubs often in riparian habitats	Est. 5,000,000	Most abundant bird in many locations. Already captured at many banding sites.	
Glaucous Gull (*Larus hyperboreus)*	**2**	**2**	**3**	**2**	**3**	**12**
	40,000 (100%) of US breeding population in AK	Contact with humans and garbage dumps	Terrestrial/coastal	Approx 40,000	Samples easily obtainable	

Table 4-7. Suggested migratory bird species for highly pathogenic H5N1 avian influenza surveillance in the four North American flyways.

Pacific Flyway	
Taxon	**Ranking**
Tundra Swan (Western Population)	Primary
Lesser Snow Goose (Wrangel Island Population)	Primary
Northern Pintail	Primary
Long-billed Dowitcher	Primary
Red Knot (small numbers)	Primary
Pacific Golden Plover (small numbers)	Primary
Ruddy Turnstone (very small numbers)	Primary
Black Brant (Pacific Population)	Secondary
Cackling Goose	Secondary
Pacific Greater White-fronted Goose	Secondary
Mallard	Secondary
American Wigeon	Secondary
American Green-winged Teal	Secondary
Northern Shoveler	Secondary
Central Flyway	
Taxon	**Ranking**
Lesser Sandhill Crane (Mid-continent)	Primary
Tundra Swan (Eastern Population)	Primary
Northern Pintail (low percentage from Alaska)	Primary
Pectoral Sandpiper	Primary
Buff-breasted Sandpiper	Primary
Long-billed Dowitcher	Primary
Greater White-fronted Goose (Mid-continent)	Secondary
Lesser Snow Goose (Western Central Flyway)	Secondary
Mallard	Secondary
American Wigeon	Secondary
American Green-winged Teal	Secondary
Northern Shoveler	Secondary

Mississippi Flyway	
Taxon	**Ranking**
Pectoral Sandpiper	Primary
Dunlin	Primary
Long-billed Dowitcher	Primary
Greater White-fronted Goose	Secondary
Northern Pintail	Secondary
Mallard	Secondary
American Wigeon	Secondary
American Green-winged Teal	Secondary
Northern Shoveler	Secondary
Lesser Scaup	Secondary
Greater Yellow-legs	Secondary
Lesser Yellow-legs	Secondary
Ruddy Turnstone	Secondary
Gray-cheeked Thrush	Secondary
Atlantic Flyway	
Taxon	**Ranking**
Tundra Swan (Eastern Population)	Primary
Greater Scaup	Primary
Horned Grebe (possibly Europe/Greenland breeders)	Primary
Lesser Scaup	Secondary
Canvasback	Secondary
Long-tailed Duck (unknown east-west interchange)	Secondary
Western Sandpiper	Secondary
Least Sandpiper (do not breed in Asia)	Secondary
Greater Yellow-legs (do not breed in Asia)	Secondary
Black-bellied Plover	Secondary

Sample Size

When sampling for highly pathogenic H5N1 avian influenza virus it is critical that an appropriate sample size for each species or species group in each designated sample population is obtained. Equation 1 provides a method for calculating the recommended sample size:

$$n = \log (1-c) / \log(1-p) \qquad \text{(eq. 1)}$$

where n is the sample size, c is the desired level of confidence, and p is the prevalence of positive samples in the population. An adequate sample size should allow for >95%

confidence that AI is detected at $\leq$ 1.5% prevalence. These criteria result in an estimated sample size of 200:

$$n = \log (1-.95) / \log (1-0.015) = 200$$

Thus, a minimum of 200 samples should be collected from the population of interest based on an assumed prevalence of 1.5% of highly pathogenic H5N1 avian influenza. We caution that this calculation is very sensitive to the assumed prevalence, which we can not know a priori. For example, if prevalence of the disease at the time of sampling is 0.1% (i.e., 1 in 1000 birds is infected) the necessary sample size is 3000. As prevalence decreases the likelihood of detecting the disease in an individual bird also decreases due to the low probability of detection and practical limitations on laboratory processing capability. We also caution that this formula is weakened here because it is based on assumptions that may not apply to H5N1 virus in wild birds, namely that the agent is homogeneously distributed within a host population that also is homogeneously distributed.

Sample Collection

Tracheal and cloacal swabs should be collected from individuals of each species at each location using the procedures identified in Attachment 9.

Discussion

Wild birds, particularly waterfowl and other waterbirds, are natural hosts of avian influenza viruses and are believed to play an important role in the epizootiology of these viruses. All hemagglutinin and neuraminidase subtypes have been found in waterfowl and shorebirds (Webster et al., 1992; Krauss et al., 2004; Widjaja et al., 2004). This proposed sampling effort provides the best opportunity for detection of highly pathogenic H5N1 avian influenza virus in live migratory birds that may bring the disease from Asia to Alaska, the Pacific Islands and the west coast of the U.S. The primary advantage to this approach is that species will be sampled that travel directly to Alaska or the US Pacific Islands and trust territories from Southeast Asia or Australasia, have some fraction of the population known to winter in Asia or Pacific trust territories, or intermingle with other species across Siberia, the Russian Far East, and Alaska. The primary disadvantage is the logistical considerations in live capture of the birds in remote areas.

Recommendations

Sampling live birds will allow us to determine if they are currently infected with highly pathogenic H5N1 avian influenza virus or other AI viruses. When collecting samples from live birds, tracheal and cloacal swabs are preferred. Most AI strains tend to replicate more efficiently in the intestinal tract than in the respiratory tract of natural host species (i.e., waterfowl and shorebirds). Consequently, cloacal swabs are generally

preferred. However, recent isolations of highly pathogenic H5N1 avian influenza virus in wild birds have documented higher levels of virus in tracheal samples. Therefore, it is recommended that both samples be collected from birds when possible. While, the collection of cloacal swabs is a relatively easy procedure, obtaining proper tracheal swabs can be problematic and requires personnel trained in the sampling technique. Examples of tracheal/cloacal swab collection protocols can be found in Attachment 9. Tracheal and cloacal swabs should be placed in separate tubes, and swabs should not be pooled across individuals.

Specific implementation plans should be developed for each state/flyway. It is strongly advised that agencies and organizations coordinate their sampling efforts to assure that adequate sample sizes are obtained from each species within each state/flyway. Coordination can be achieved through the existing migratory bird flyway councils.

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