

Supplemental materials

Figure S1. H5 low pathogenic introductions in the United States and Canada detected by using the phylogenetic tree analyses of the H5 gene. The introductions were detected in poultry on 5 commercial poultry farms (CPFs), 2 backyard poultry operation (BYP), 2 game bird poultry farm (GBP), and 9 live bird markets (LBMs). H5 isolates and introductions detected from CPFs, BYP, GBP and LBMs are highlighted in red, green, cyan, and blue, respectively. Bootstrap phylogenetic trees with bootstrap values are shown for determination of H5 isolates.

Figure S2. Maximum clade credibility phylogenetic tree for phylogeographical analysis of H5 genes in the United States and Canada. Branches are colored according to the estimated ancestral state of the bird migration flyways from discrete trait reconstruction. Corresponding Bayes test results are listed in Table S2. Isolates in two sub-lineages are selected from maximum-likelihood phylogenetic tree of H5 gene and validated by a bootstrap maximum-likelihood phylogenetic tree.

Figure S3. The geographic, temporal, and taxa distribution of IAVs (n=166) collected and sequenced from domestic poultry and wild bird in the United States and Canada in this study. **A:** The number of sample collected in each state was indicated by the size of dots on the map (Alberta, Canada not shown). **B:** The distribution of host ecological groups. **C&D:** The temporal distribution of influenza A virus isolates from each year. C is filled according to host ecological groups. D is filled according to HA subtypes.

Figure S4. The temporal and taxa distribution of all influenza A viruses included in this study (including sequences both sequenced in this study and downloaded from public databases). **A:** The bar graph indicates the number of all IAVs in each year, filled according to functional groups. **B:** The distribution of function groups for all IAVs. **C:** The bar graph indicates the number of H5 samples in each year, filled according to functional groups. **D:** The distribution of function groups for all H5 IAVs.

Figure S1

- 11 H5 low pathogenic avian influenza A isolates detected in commercial poultry farm (CPF) from 5 introductions
- 62 H5 low pathogenic avian influenza A isolates detected in live bird market (LBM) from 9 introductions
- 3 H5 low pathogenic avian influenza A isolates detected in backyard flock poultry (BYP) from 2 introduction
- 2 H5 low pathogenic avian influenza A isolates detected in game bird flock poultry (GBP) from 2 introduction

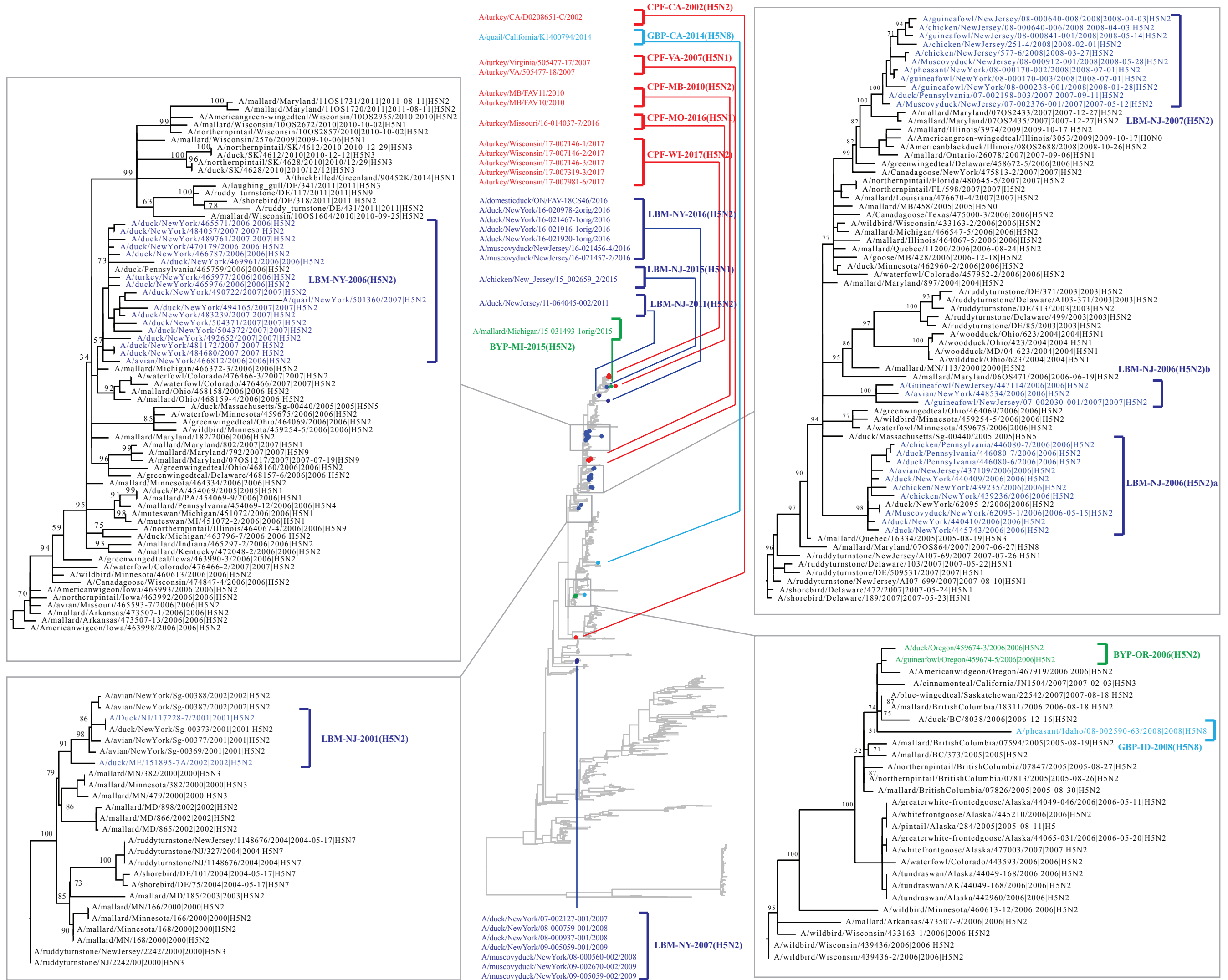


Figure S2

- Atlantic bird migratory flyway
- Central bird migratory flyway
- Mississippi bird migratory flyway
- Pacific bird migratory flyway

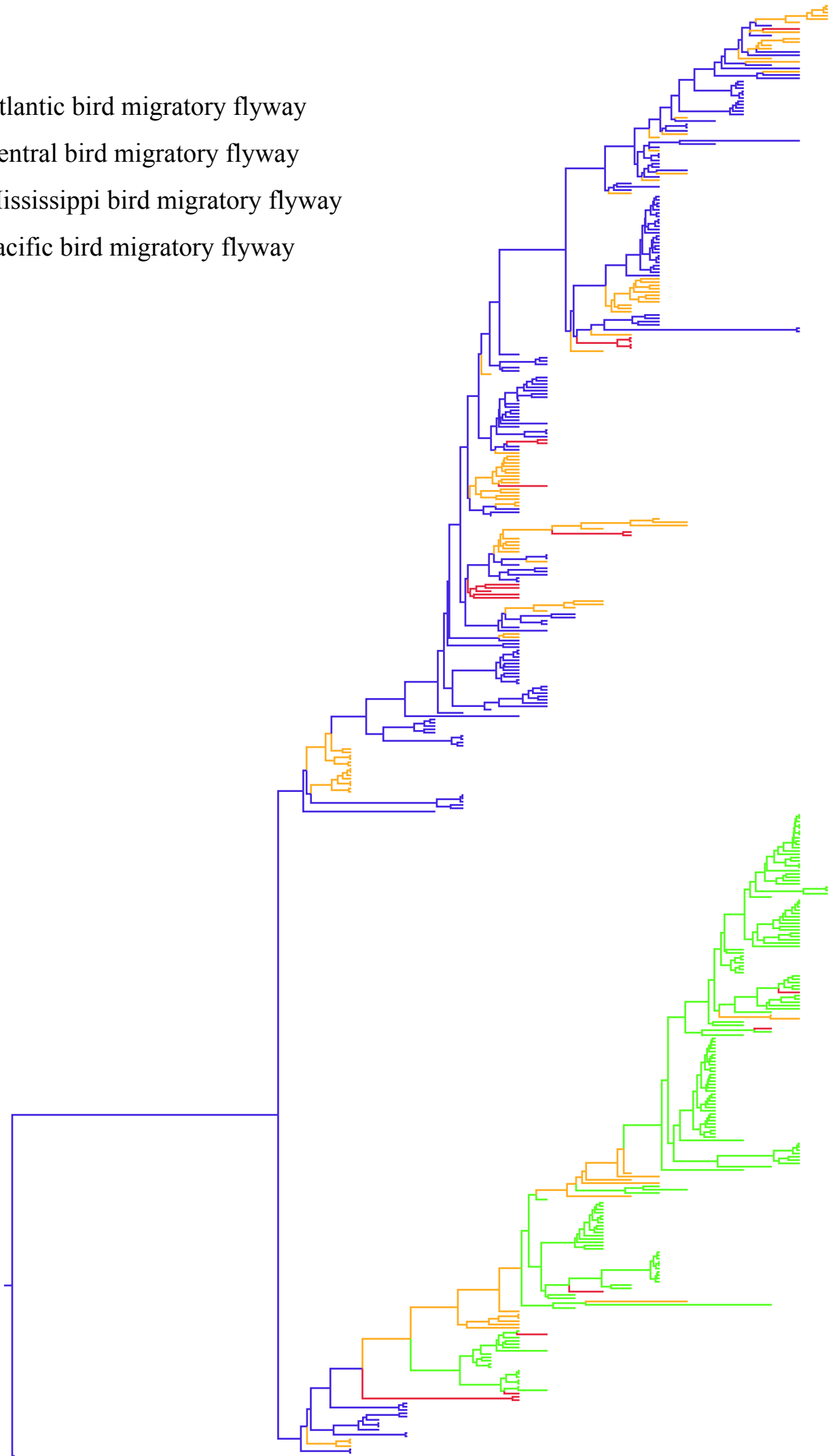


Figure S3

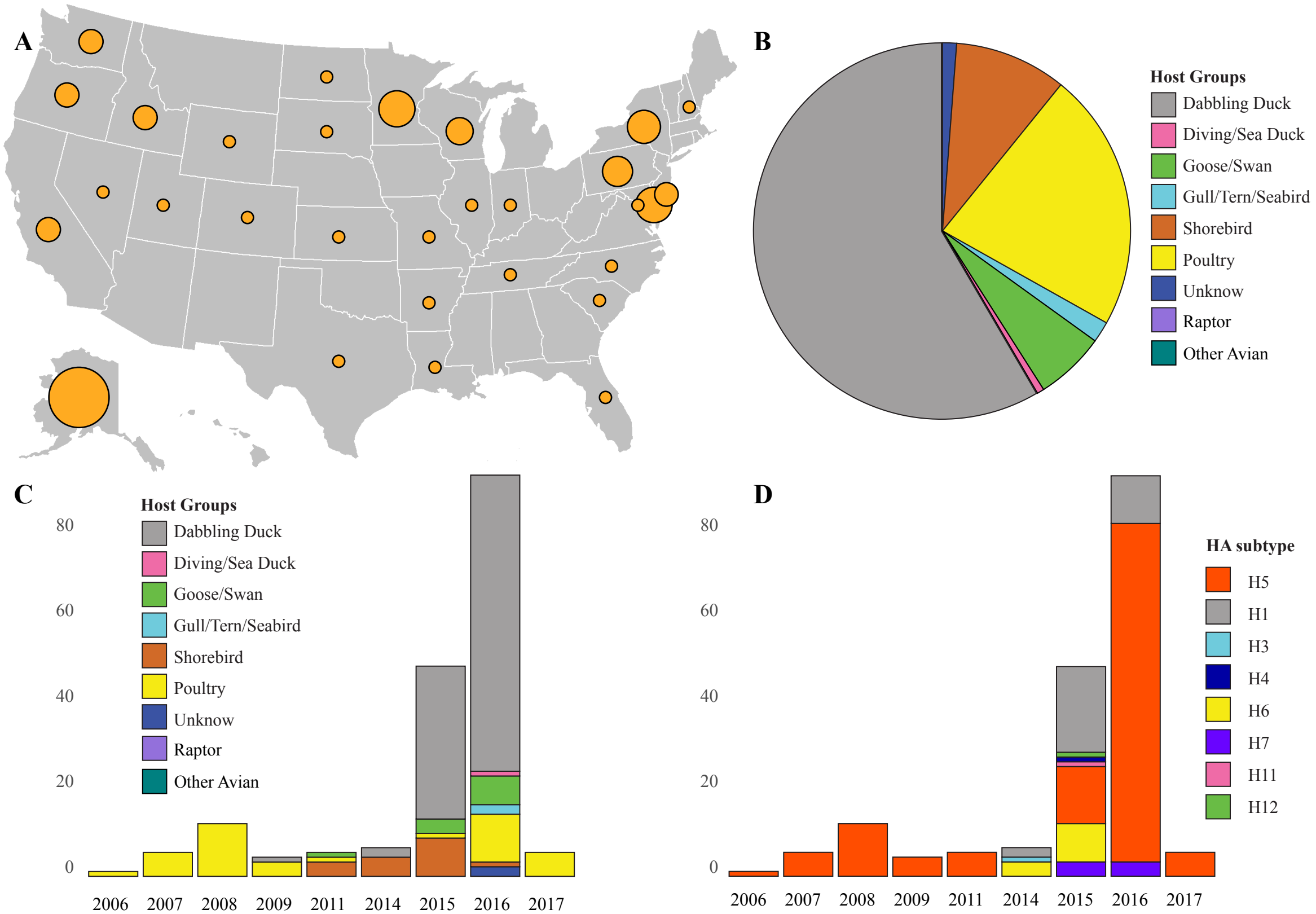
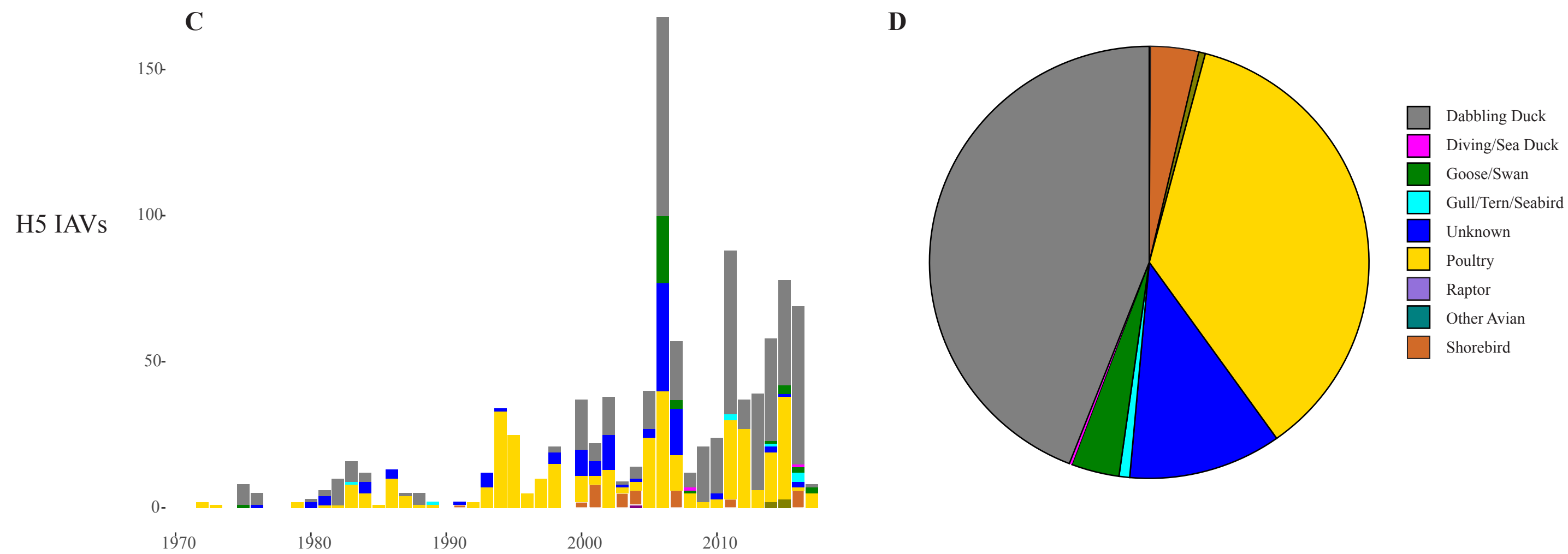
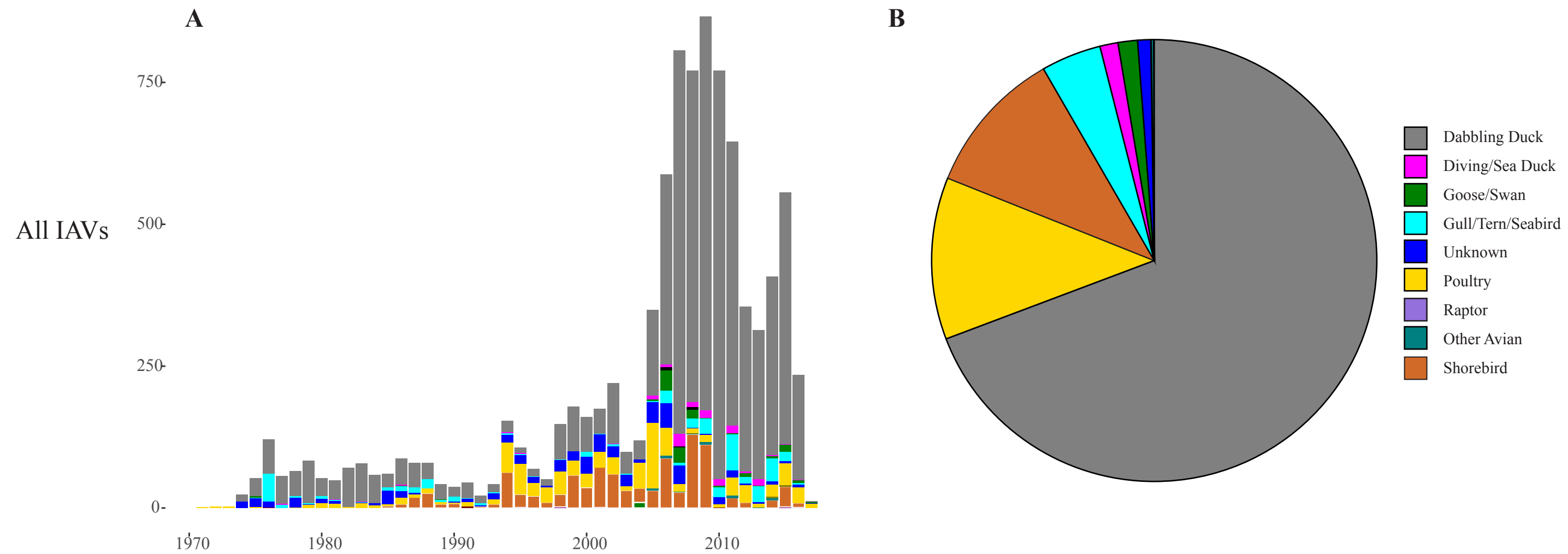


Figure S4



Supplementary Tables

Table S1. Possible progenitor genes for H5 low pathogenic avian influenza viruses detected in domestic poultry in the United States and Canada (2001-2017).

Representative isolate	Introduction	HA		NA	
		Isolate	Identity	Isolate	Identity
A/turkey/Wisconsin/170071461/2017	CPF-WI-2017(H5N2)	A/mallard/Minnesota/UGAI16-4786/2016(H5N5)	99.31	A/mallard duck/Ohio/15OS5882/2015(H6N2)	99.0
A/turkey/Missouri/160140377/2016	CPF-MO-2016(H5N1)	A/Canada goose/DelawareBay/601/2016(H5N1)	98.82	A/mallard/Ohio/15OS4367/2015(H1N1)	99.6
A/turkey/MB/FAV10/2010	CPF-MB-2010(H5N2)	A/mallard/Minnesota/464334/2006(H5N2)	99.02	A/northern shoveler/Missouri/298/2009(H9N2)	99.7
A/turkey/VA/50547718/2007	CPF-VA-2007(H5N1)	A/mallard/PA/454069-9/2006(H5N1)	99.20	A/mallard/ON/499/2005(H5N1)	99.4
A/turkey/CA/D0208651C/02	CPF-CA-2002(H5N2)	A/mallard/Minnesota/346250/2000(H5N2)	98.51	Genomic sequence not available	
A/duck/NewYork/16-020978-2orig/2016	LBM-NY-2016(H5N2)	No possible progenitor gene detected in wild bird			
A/chicken/NewJersey/150026592/2015	LBM-NJ-2015(H5N1)	A/northern pintail/Ohio/15OS5861/2015(H5N2)	99.29	A/mallard/Maryland/13OS3036/2014(H1N1)	99.4
A/duck/NewJersey/11-064045-002/2011	LBM-NJ-2011(H5N2)	A/mallard/Ohio/11OS1961/2011(H5N2)	99.60	A/mallard/Ohio/11OS1961/2011(H5N2)	99.8
A/duck/NewYork/08-000759-001/2008	LBM-NY-2007(H5N2)	No possible progenitor gene detected in wild bird		A/mallard/Michigan/466372-3/2006(H5N2)	99.4
A/chicken/NewJersey/2514/2008	LBM-NJ-2007(H5N2)	A/mallard/Maryland/07OS2435/2007(H5N2)	98.96	A/northern shoveler/California/8855/2008(H5N2)	98.9
A/turkey/NewYork/465977/2006	LBM-NY-2006(H5N2)	A/mallard/Michigan/466372-3/2006(H5N2)	99.66	A/mallard/Michigan/466372-3/2006(H5N2)	99.8
A/chicken/Pennsylvania/4460807/2006	LBM-NJ-2006(H5N2)a	A/mallard/Maryland/897/2004(H5N2)	98.91	A/mallard/Ontario/15873/2005(H3N2)	99.5
A/avian/NewYork/448534/2006	LBM-NJ-2006(H5N2)b	A/mallard/Maryland/897/2004(H5N2)	98.62	A/mallard/Michigan/466372-3/2006(H5N2)	98.8
A/duck/NJ/1172287/2001	LBM-NJ-2001(H5N2)	A/ruddy turnstone/New Jersey/2242/2000(H5N3)	98.42	A/green-winged teal/Ohio/203/1998(H6N2)	98.7
A/mallard/Michigan/15-031493-1orig/2015	BYP-MI-2015(H5N2)	A/northern pintail/Ohio/15OS5861/2015(H5N2)	99.54	A/mallard duck/Ohio/15OS5289/2015(H5N2)	99.1
A/duck/Oregon/4596743/2006	BYP-OR-2006(H5N2)	A/mallard/British Columbia/18311/2006(H5N2)	99.71	A/American widgeon/Oregon/467919/2006(H5N2)	100.0
A/quail/California/K1400794/2014	GBP-CA-2014(H5N8)	A/mallard/California/1375/2013(H5N5)	98.23	A/northern pintail/Alaska/916/2013(H6N8)	99.3
A/pheasant/Idaho/08-002590-63/2008	GBP-ID-2008(H5N8)	A/mallard/British Columbia/18311/2006(H5N2)	98.26	A/blue-winged teal/Minnesota/Sg-00037/2007(H3N8)	98.4

Representative isolate	Introduction	PB2		PB1	
		Isolate	Identity	Isolate	Identity
A/turkey/Wisconsin/170071461/2017	CPF-WI-2017(H5N2)	A/blue-wingedteal/Texas/UGAI15-6626/2015(H3N8)	98.99	A/mallard/Ohio/15OS4000/2015(H1N1)	99.62
A/turkey/Missouri/160140377/2016	CPF-MO-2016(H5N1)	A/blue-wingedteal/Ohio/15OS3662/2015(H4N6)	99.52	A/mallard/Pennsylvania/UGAI15-5019/2015(H3N8)	99.60
A/turkey/MB/FAV10/2010	CPF-MB-2010(H5N2)	A/northernshoveler/California/HKWF2031/2008(H7N3)	99.26	A/Americangreen-wingedteal/Illinois/10OS3589/2010(H6N2)	99.18
A/turkey/VA/50547718/2007	CPF-VA-2007(H5N1)	A/waterfowl/Colorado/457952-2/2006(H5N2)	99.05	A/mallard/Maryland/07OS66/2007(H10N7)	98.87
A/turkey/CA/D0208651C/02	CPF-CA-2002(H5N2)	Genomic sequence not available			
A/duck/NewYork/16-020978-2orig/2016	LBM-NY-2016(H5N2)	No possible progenitor gene detected in wild bird			
A/chicken/NewJersey/150026592/2015	LBM-NJ-2015(H5N1)	A/blue-wingedteal/Iowa/13OS2367/2013(H4N8)	99.34	A/mallard/Wisconsin/13OS2767/2013(H3N8)	99.30
A/duck/NewJersey/11-064045-002/2011	LBM-NJ-2011(H5N2)	A/northernpintail/Wisconsin/10OS2857/2010(H5N2)	99.48	A/mallard/Michigan/10OS1491/2010(H4N6)	99.57
A/duck/NewYork/08-000759-001/2008	LBM-NY-2007(H5N2)	No possible progenitor gene detected in wild bird			
A/chicken/NewJersey/2514/2008	LBM-NJ-2007(H5N2)	A/mallardduck/Minnesota/Sg-00117/2007(H3N8)	99.02	A/mallard/Ontario/26078/2007(H5N1)	99.30
A/turkey/NewYork/465977/2006	LBM-NY-2006(H5N2)	A/mallard/Alberta/166/2006(H1N1)	99.18	A/mallard/Ohio/1506/2006(H3N6)	99.43
A/chicken/Pennsylvania/4460807/2006	LBM-NJ-2006(H5N2)a	A/mallard/Quebec/11103/2006(H4N6)	99.78	A/mallard/Maryland/897/2004(H5N2)	99.22
A/avian/NewYork/448534/2006	LBM-NJ-2006(H5N2)b	A/mallard/Ohio/657/2002(H4N6)	99.18	A/mallard/Ohio/793/2004(H11N2)	99.14
A/duck/NJ/1172287/2001	LBM-NJ-2001(H5N2)	A/mallard/Alberta/125/1999(H11N6)	99.18	A/pintail/Ohio/226/1998(H6N2)	98.47
mallard/Michigan/15-031493-1orig/2015	BYP-MI-2015(H5N2)	A/green-wingedteal/Ohio/14OS2001/2014(H6N2)	99.35	A/mallardduck/Ohio/15OS4285/2015(H3N8)	99.65
A/duck/Oregon/4596743/2006	BYP-OR-2006(H5N2)	A/Americanwidgeon/Oregon/467919/2006(H5N2)	99.83	A/mallard/BritishColumbia/18311/2006(H5N2)	99.91
A/quail/California/K1400794/2014	GBP-CA-2014(H5N8)	A/woodduck/Wisconsin/11OS2912/2011(H3N6)	98.40	A/mallard/Idaho/ND0002645/2013(H4N6)	99.34
A/pheasant/Idaho/08-002590-63/2008	GBP-ID-2008(H5N8)	A/ruddyturnstone/NewJersey/AI06-582/2006(H6N7)	98.40	A/mallard/Quebec/11063/2006(H2N3)	98.83

Representative isolate	Introduction	PA		NP	
		Isolate	Identity	Isolate	Identity
A/turkey/Wisconsin/170071461/2017	CPF-WI-2017(H5N2)	A/mallard/Ohio/15OS3602/2015(H3N6)	99.59	A/blue-wingedteal/Missouri/15OS6536/2016(H1N1)	99.48
A/turkey/Missouri/160140377/2016	CPF-MO-2016(H5N1)	A/Canadagoose/DelawareBay/601/2016(H5N1)	99.35	A/blue-wingedteal/Ohio/15OS3662/2015(H4N6)	99.73
A/turkey/MB/FAV10/2010	CPF-MB-2010(H5N2)	A/Americanblackduck/Illinois/3854/2009(H11N9)	99.09	A/blue-wingedteal/Texas/AI10-3844/2010(H4N6)	99.41
A/turkey/VA/50547718/2007	CPF-VA-2007(H5N1)	A/green-wingedteal/NewBrunswick/02630/2007(H4N6)	98.68	A/shorebird/Delaware/472/2007(H5N1)	99.74
A/turkey/CA/D0208651C/02	CPF-CA-2002(H5N2)	Genomic sequence not available			
A/duck/NewYork/16-020978-2orig/2016	LBM-NY-2016(H5N2)	No possible progenitor gene detected in wild bird			
A/chicken/NewJersey/150026592/2015	LBM-NJ-2015(H5N1)	A/Americanblackduck/Maryland/13OS2956/2013(H11N9)	98.70	A/mallard/Ohio/14OS3244/2014(mixed)	99.60
A/duck/NewJersey/11-064045-002/2011	LBM-NJ-2011(H5N2)	A/mallard/Ohio/11OS2078/2011(H1N1)	99.82	A/mallard/Ohio/11OS2049/2011(H3N6)	99.87
A/duck/NewYork/08-000759-001/2008	LBM-NY-2007(H5N2)	No possible progenitor gene detected in wild bird			
A/chicken/NewJersey/2514/2008	LBM-NJ-2007(H5N2)	A/mallard/Ohio/1506/2006(H3N6)	98.31	A/mallard/Quebec/11111/2006(H11N9)	99.21
A/turkey/NewYork/465977/2006	LBM-NY-2006(H5N2)	A/mallard/Ohio/468159-4/2006(H5N2)	99.49	A/blue-wingedteal/Ohio/1918/2006(H6N5)	99.80
A/chicken/Pennsylvania/4460807/2006	LBM-NJ-2006(H5N2)a	A/green-wingedteal/Ohio/1747/2005(H11N2)	99.50	A/mallard/Maryland/897/2004(H5N2)	99.61
A/avian/NewYork/448534/2006	LBM-NJ-2006(H5N2)b	A/mallard/Ohio/664/2002(H6N6)	99.05	A/snowgoose/Maryland/364/2005(H6N1)	98.30
A/duck/NJ/1172287/2001	LBM-NJ-2001(H5N2)	A/gull/DelawareBay/18/2000(H6N1)	99.13	A/shorebird/DelawareBay/277/2000(H9N7)	99.03
mallard/Michigan/15-031493-1orig/2015	BYP-MI-2015(H5N2)	A/blue-wingedteal/Texas/AI13-3971/2013(H3N8)	98.86	A/mallard/Maryland/14OS2911/2015(h7n3)	99.41
A/duck/Oregon/4596743/2006	BYP-OR-2006(H5N2)	A/Americanwidgeon/Oregon/467919/2006(H5N2)	99.86	A/Americanwidgeon/Oregon/467919/2006(H5N2)	99.81
A/quail/California/K1400794/2014	GBP-CA-2014(H5N8)	A/northernshoveler/Illinois/12OS4957/2012(H6N2)	99.05	A/mallard/California/1400/2013(H5N5)	99.27
A/pheasant/Idaho/08-002590-63/2008	GBP-ID-2008(H5N8)	A/pintail/Alberta/68/2005(H1N1)	98.70	A/whitefrontgoose/Alaska/477003/2007(H5N2)	98.18

Representative isolate	Introduction	MP		NS	
		Isolate	Identity	Isolate	Identity
A/turkey/Wisconsin/170071461/2017	CPF-WI-2017(H5N2)	A/mallardduck/Ohio/15OS4285/2015(H3N8)	99.40	A/mallard/Ohio/15OS5649/2015(H10N1)	99.88
A/turkey/Missouri/160140377/2016	CPF-MO-2016(H5N1)	A/mallard/Minnesota/UGAI15-6563/2015(H5N9)	100.00	A/green-wingedteal/Ohio/15OS5438/2015(H3N2)	99.88
A/turkey/MB/FAV10/2010	CPF-MB-2010(H5N2)	A/mallard/Missouri/132/2009(H2N3)	99.60	A/Americanwigeon/Missouri/10MO0530/2010 (mixed)	99.77
A/turkey/VA/50547718/2007	CPF-VA-2007(H5N1)	A/ruddyturnstone/Delaware/81/2001(H10N7)	99.70	A/green-wingedteal/Ohio/81/1999(H11N2)	98.47
A/turkey/CA/D0208651C/02	CPF-CA-2002(H5N2)	A/mallard/Minnesota/31/2000(H2N9)	98.99	Genomic sequence not available	
A/duck/NewYork/16-020978-2orig/2016	LBM-NY-2016(H5N2)	No possible progenitor gene detected			
A/chicken/NewJersey/150026592/2015	LBM-NJ-2015(H5N1)	A/blue-wingedteal/Ohio/12OS2154/2012(H3N2)	99.61	A/mallard/Ohio/11OS1982/2011(mixed)	99.28
A/duck/NewJersey/11-064045-002/2011	LBM-NJ-2011(H5N2)	A/mallard/Ohio/11OS1961/2011(H5N2)	99.80	A/mallard/Ohio/793/2004(H11N2)	99.31
A/duck/NewYork/08-000759-001/2008	LBM-NY-2007(H5N2)	A/mallard/Ohio/684/2002(H4N6)	99.20	A/shorebird/DelawareBay/288/1999(Mixed)	98.27
A/chicken/NewJersey/2514/2008	LBM-NJ-2007(H5N2)	A/mallard/Ohio/793/2004(H11N2)	99.60	A/mallard/Ontario/26078/2007(H5N1)	99.30
A/turkey/NewYork/465977/2006	LBM-NY-2006(H5N2)	A/greenwingedteal/Delaware/468157-6/2006(H5N2)	99.80	A/mallard/Kentucky/472048-2/2006(H5N2)	99.88
A/chicken/Pennsylvania/4460807/2006	LBM-NJ-2006(H5N2)a	A/mallard/Quebec/11189/2006(H4N6)	100.00	A/mallard/Maryland/718/2004(H8N4)	99.19
A/avian/NewYork/448534/2006	LBM-NJ-2006(H5N2)b	A/mallard/Ohio/684/2002(H4N6)	98.80	A/mallard/Ohio/667/2002(H4N6)	99.31
A/duck/NJ/1172287/2001	LBM-NJ-2001(H5N2)	A/mallard/Alberta/279/1996(H11N9)	99.09	A/mallard/Minnesota/401/1999(H6N0)	99.65
mallard/Michigan/15-031493-1orig/2015	BYP-MI-2015(H5N2)	A/blue-wingedteal/Louisiana/AI12-4628/2012(mixed)	99.40	A/gadwall/Ohio/15OS5508/2015(mixed)	99.65
A/duck/Oregon/4596743/2006	BYP-OR-2006(H5N2)	A/mallard/BritishColumbia/07594/2005(H5N2)	100.00	A/mallard/BritishColumbia/07594/2005(H5N2)	100.00
A/quail/California/K1400794/2014	GBP-CA-2014(H5N8)	A/Americangreen-wingedteal/Alaska/44493-588/2009(H3N8)	99.40	A/mallard/Mississippi/12OS443/2012(H10N1)	99.06
A/pheasant/Idaho/08-002590-63/2008	GBP-ID-2008(H5N8)	A/lessersnowgoose/Alaska/44301-116/2007(H2N3)	99.20	A/glaucous-wingedgull/Alaska/392/2011(H5N2)	99.42

Table S2. Statistical supports generated from phylogeographic analysis of geographical distribution of four bird migratory flyways associated with sub-lineage 1 and sub-lineage 2 of H5 genes of low pathogenic avian influenza viruses in the United States and Canada.

Flyways		Indicator ^a	Bayes factor ^a	Support level ^b
From	To			
Atlantic	Mississippi	1.00	>10000	Decisive
Atlantic	Central	0.81	9.63	Support
Atlantic	Pacific	No significant transition was observed		
Mississippi	Atlantic	0.84	11.74	Strong support
Mississippi	Central	0.94	36.32	Strong support
Mississippi	Pacific	0.99	1838.37	Decisive
Central	Atlantic	No significant transition was observed		
Central	Mississippi	No significant transition was observed		
Central	Pacific	No significant transition was observed		
Pacific	Atlantic	No significant transition was observed		
Pacific	Central	1.00	>10000	Decisive
Pacific	Mississippi	0.77	7.72	Support

^aOnly indicator ≥ 0.5 and BF ≥ 3 are considered as significant transition; ^b Statistical support levels were interpreted from Bayes factors as follows: Bayes factor <3 indicates no support; $3 \leq$ Bayes factor <10 indicates support; $10 \leq$ Bayes factor <100 indicates strong support; $100 \leq$ Bayes factor <1000 indicates very strong support; and Bayes factor $\geq 1,000$ indicates decisive support.

Table S3. Statistical supports generated from phylogeographic analyses of H5 low pathogenic avian influenza viruses for three recent introductions to the domestic poultry in the United States and Canada.

H5 introduction	Segment	Host group	Indicator^a	Bayes factor^a	Support level^b
CPF-WI-2017(H5N2)	PB2	Dabbling Duck	0.92	35.12	Strong support
	PB1	Dabbling Duck	0.65	19.37	Strong support
	PA	Dabbling Duck	0.74	17.61	Strong support
	HA	Dabbling Duck	0.69	29.87	Strong support
	NP	Dabbling Duck	0.61	8.15	Support
	NA	Dabbling Duck	0.56	6.59	Support
	MP	Dabbling Duck	0.77	20.91	Strong support
	NS	Dabbling Duck	0.81	17.83	Strong support
CPF-MO-2016(H5N1)	PB2	Goose/Swan	0.95	149.91	Very strong support
	PB1	Goose/Swan	0.78	25.49	Strong support
	PA	Goose/Swan	0.9	68.06	Strong support
	HA	Goose/Swan	0.61	20.52	Strong support
	NP		No significant transition observed		
	NA		No significant transition observed		
	MP	Goose/Swan	0.58	15.69	Strong support
	NS	Goose/Swan	0.85	48.47	Strong support
LBM-NJ-2015(H5N1)	PB2	Dabbling Duck	0.88	53.98	Strong support
	PB1		No significant transition observed		
	PA		No significant transition observed		
	HA		No significant transition observed		
	NP	Diving/Sea Duck	0.95	169.25	Very strong support
	NA	Dabbling Duck	0.56	8.12	Support
	MP		No significant transition observed		
	NS	Goose/Swan	0.54	9.55	Support

^aOnly indicator ≥ 0.5 and BF ≥ 3 were considered as significant transmission and all statistical support level were indicated in the last column; ^b Statistical support levels were interpreted from Bayes factors as follows: Bayes factor <3 indicates no support; $3 \leq$ Bayes factor <10 indicates support; $10 \leq$ Bayes factor <100 indicates strong support; $100 \leq$ Bayes factor <1000 indicates very strong support; and Bayes factor $\geq 1,000$ indicates decisive support.

Table S4. Statistical supports generated from phylogeographic analyses of H5 low pathogenic avian influenza viruses introduced to domestic poultry in the United States and Canada (2001-2017).

H5	Representative isolate	PB2		PB1		PA		HA		NP		NA		MP		NS	
		Host ^a	BF ^b	Host	BF	Host	BF	Host	BF	Host	BF	Host	BF	Host	BF	Host	BF
CPF-WI-2017(H5N2)	A/turkey/Wisconsin/17-007146-1/2017	DaD	35.12	DaD	19.37	DaD	17.61	DaD	29.87	DaD	8.15	DaD	6.59	DaD	20.91	DaD	17.83
CPF-MO-2016(H5N1)	A/turkey/Missouri/16_014037_7/2016	GS	149.91	GS	25.49	GS	68.06	GS	20.52					GS	15.69	GS	48.47
CPF-MB-2010(H5N2)	A/turkey/MB/FAV10/2010			DaD	8.08			DaD	5.82	DaD	3.24	DaD	189.74	DaD	27.07	Unk	17.18
CPF-VA-2007(H5N1)	A/turkey/Virginia/505477-17/2007			DaD	8.28	DiD	15.68	DaD	10.72	Unk	71.55	DaD	3.31	SB	154.54	Unk	31.5
CPF-CA-2002(H5N2)	A/turkey/CA/D0208651-C/02	Complete genome not available															
LBM-NY-2016(H5N2)	A/duck/NewYork/16-020978-2orig/2016	Related wild bird origin samples not available															
LBM-NJ-2015(H5N1)	A/chicken/New_Jersey/15_002659_2/2015	DaD	53.98							DiD	169.25	DaD	8.12			GS	9.55
LBM-NJ-2011(H5N2)	A/duck/NewJersey/11-064045-002/2011	DaD	35.09	DaD	9.84					DaD	48.01	DaD	68.27				
LBM-NY-2007(H5N2)	A/duck/NewYork/08-000759-001/2008	PT	90	PT	318.55	PT	32.64	Unk	9.85	PT	189.29			PT	21.11	PT	32.77
LBM-NJ-2007(H5N2)	A/chicken/NewJersey/251-4/2008			DaD	138.71	DaD	10.01	DaD	19.66	DaD	10.41					DiD	34.96
LBM-NY-2006(H5N2)	A/turkey/NewYork/465977/2006	DaD	38.89	DaD	9.82	Unk	186.65	DaD	6.89	Unk	785.05	DaD	15.74	DaD	43.03	DaD	1244.25
	A/duck/NewYork/492652/2007	DaD	17.25	Unk	33.17	Unk	186.65	DaD	6.89	Unk	785.05	DaD	15.74	DaD	43.03	Unk	197.64
LBM-NJ-2006(H5N2)a	A/chicken/Pennsylvania/446080-7/2006	DaD	>10000	Unk	8.05	GS	6.9					DaD	12.21	DaD	21.71		
LBM-NJ-2006(H5N2)b	A/guineafowl/NewJersey/447114/2006			DaD	8.34					DaD	295.97	DaD	49.46	DaD	17.30		
LBM-NJ-2001(H5N2)	A/duck/ME/151895-7A/2002	Unk	64.98	Unk	86.83	Unk	154.74	Unk	>10000	Unk	311.27	Unk	>10000	Unk	>10000	DaD	7.89
	A/duck/NJ/117228-7/2001			Unk	>10000	Unk	>10000	Unk	>10000			Unk	>10000	Unk	>10000	DaD	7.89
BYP-MI-2015(H5N2)	A/mallard/Michigan/15-031493-1orig/2015	DaD	17.94	DaD	30.86	DiD	6.85			DaD	10.43	DaD	76.97	DaD	41	DaD	42.78
BYP-OR-2006(H5N2)	A/duck/Oregon/459674-3/2006	GS	19.89	DaD	10.38	DaD	90.65	DaD	334.20	DaD	186.65	DaD	2819.74	DaD	36.24	DaD	82.17
GBP-CA-2014(H5N8)	A/quail/California/K1400794/2014	DaD	69.73	DaD	28.42	DaD	73.21	DaD	5.06	DaD	19.51			DaD	8.05	DaD	50.58
GBP-ID-2008(H5N8)	A/pheasant/Idaho/08-002590-63/2008	DaD	43.14					DaD	36.34	DaD	7.69	DaD	8.41	GS	136.51		

^a**DaD:** dabbling duck; **DiD:** diving/sea duck; **GS:** goose/swan; **SB:** shorebird; **GT:** gull/tern/seabird; **Unk:** unknown; **OA:** Other Avian; **PT:** Poultry; ^bOnly indicator ≥ 0.5 and $BF \geq 3$ are considered as significant transmission and shown; only most significant functional groups were shown.

Table S5. Low pathogenic avian influenza viruses newly sequenced and recovered from domestic poultry (2001-2017) and wild bird samples in the United States and Canada in this study.

Isolate	Source ^a	Genbank Accession Number							
		PB2	PB1	PA	HA	NP	NA	MP	NS
A/mallard/Michigan/15-031493-1/2015(H5N2)	BYP	MH546608	MH546609	MH546610	MH546611	MH546612	MH546613	MH546614	MH546615
A/turkey/Minnesota/16-009265-3/2016(H1N1)	CPF	MH546984	MH546985	MH546986	MH546987	MH546988	MH546989	MH546990	MH546991
A/turkey/Missouri/16-009707-1/2016(H1N1)	CPF	MH546992	MH546993	MH546994	MH546995	MH546996	MH546997	MH546998	MH546999
A/turkey/Wisconsin/17-007146-1/2017(H5N2)	CPF	MH547000	MH547001	MH547002	MH547003	MH547004	MH547005	MH547006	MH547007
A/turkey/Wisconsin/17-007146-2/2017(H5N2)	CPF	MH547008	MH547009	MH547010	MH547011	MH547012	MH547013	MH547014	MH547015
A/turkey/Wisconsin/17-007319-3/2017(H5N2)	CPF	MH547016	MH547017	MH547018	MH547019	MH547020	MH547021	MH547022	MH547023
A/turkey/Wisconsin/17-007981-6/2017(H5N2)	CPF	MH547024	MH547025	MH547026	MH547027	MH547028	MH547029	MH547030	MH547031
A/pheasant/Idaho/08-002590-63/2008(H5N8)	GBP	MH546944	MH546945	MH546946	MH546947	MH546948	MH546949	MH546950	MH546951
A/chicken/NewJersey/08-000640-006/2008(H5N2)	LBM	MH546336	MH546337	MH546338	MH546339	MH546340	MH546341	MH546342	MH546343
A/chicken/Pennsylvania/16-002590-1/2016(H1N1)	LBM	MH546344	MH546345	MH546346	MH546347	MH546348	MH546349	MH546350	MH546351
A/duck/NewJersey/11-064045-002/2011(H5N2)	LBM	MH546360	MH546361	MH546362	MH546363	MH546364	MH546365	MH546366	MH546367
A/duck/NewYork/07-002127-001/2007(H5N2)	LBM	MH546368	MH546369	MH546370	MH546371	MH546372	MH546373	MH546374	MH546375
A/duck/NewYork/08-000759-001/2008(H5N2)	LBM	MH546376	MH546377	MH546378	MH546379	MH546380	MH546381	MH546382	MH546383
A/duck/NewYork/08-000937-001/2008(H5N2)	LBM	MH546384	MH546385	MH546386	MH546387	MH546388	MH546389	MH546390	MH546391
A/duck/NewYork/09-005059-001/2009(H5N2)	LBM	MH546392	MH546393	MH546394	MH546395	MH546396	MH546397	MH546398	MH546399
A/duck/NewYork/16-020978-2/2016(H5N2)	LBM	MH546400	MH546401	MH546402	MH546403	MH546404	MH546405	MH546406	MH546407
A/duck/NewYork/16-021467-1/2016(H5N2)	LBM	MH546408	MH546409	MH546410	MH546411	MH546412	MH546413	MH546414	MH546415
A/duck/NewYork/16-021916-1/2016(H5N2)	LBM	MH546416	MH546417	MH546418	MH546419	MH546420	MH546421	MH546422	MH546423
A/duck/NewYork/16-021920-1/2016(H5N2)	LBM	MH546424	MH546425	MH546426	MH546427	MH546428	MH546429	MH546430	MH546431
A/duck/Pennsylvania/07-002198-003/2007(H5N2)	LBM	MH546432	MH546433	MH546434	MH546435	MH546436	MH546437	MH546438	MH546439
A/guineafowl/NewJersey/07-002030-001/2007(H5N2)	LBM	MH546480	MH546481	MH546482	MH546483	MH546484	MH546485	MH546486	MH546487
A/guineafowl/NewJersey/08-000640-008/2008(H5N2)	LBM	MH546488	MH546489	MH546490	MH546491	MH546492	MH546493	MH546494	MH546495
A/guineafowl/NewJersey/08-000841-001/2008(H5N2)	LBM	MH546496	MH546497	MH546498	MH546499	MH546500	MH546501	MH546502	MH546503
A/guineafowl/NewYork/08-000170-003/2008(H5N2)	LBM	MH546504	MH546505	MH546506	MH546507	MH546508	MH546509	MH546510	MH546511
A/guineafowl/NewYork/08-000238-001/2008(H5N2)	LBM	MH546512	MH546513	MH546514	MH546515	MH546516	MH546517	MH546518	MH546519
A/Muscovyduck/NewJersey/07-002376-001/2007(H5N2)	LBM	MH546248	MH546249	MH546250	MH546251	MH546252	MH546253	MH546254	MH546255

A/Muscovyduck/NewJersey/08-000912-001/2008(H5N2)	LBM	MH546256	MH546257	MH546258	MH546259	MH546260	MH546261	MH546262	MH546263
A/Muscovyduck/NewJersey/16-021456-4/2016(H5N2)	LBM	MH546272	MH546273	MH546274	MH546275	MH546276	MH546277	MH546278	MH546279
A/Muscovyduck/NewJersey/16-021457-2/2016(H5N2)	LBM	MH546280	MH546281	MH546282	MH546283	MH546284	MH546285	MH546286	MH546287
A/Muscovyduck/NewYork/08-000560-002/2008(H5N2)	LBM	MH546288	MH546289	MH546290	MH546291	MH546292	MH546293	MH546294	MH546295
A/Muscovyduck/NewYork/09-002670-002/2009(H5N2)	LBM	MH546296	MH546297	MH546298	MH546299	MH546300	MH546301	MH546302	MH546303
A/Muscovyduck/NewYork/09-005059-002/2009(H5N2)	LBM	MH546304	MH546305	MH546306	MH546307	MH546308	MH546309	MH546310	MH546311
A/pheasant/NewYork/08-000170-002/2008(H5N2)	LBM	MH546952	MH546953	MH546954	MH546955	MH546956	MH546957	MH546958	MH546959
A/quail/NewYork/07-501360-001/2007(H5N2)	LBM	MH546960	MH546961	MH546962	MH546963	MH546964	MH546965	MH546966	MH546967
A/American black duck/Alberta/238/2016(H1N1)	Wild birds	MF046490	MF613777	MF046211	MF046523	MF046299	MF613869	MF613809	MF046434
A/Americangreen-wingedteal/Alaska/16-039026-3/2016(H5N2)	Wild birds	MH546152	MH546153	MH546154	MH546155	MH546156	MH546157	MH546158	MH546159
A/Americangreen-wingedteal/Alaska/16-039026-4/2016(H5N2)	Wild birds	MH546160	MH546161	MH546162	MH546163	MH546164	MH546165	MH546166	MH546167
A/Americangreen-wingedteal/California/16-035443-2/2016(H5N2)	Wild birds	MH546168	MH546169	MH546170	MH546171	MH546172	MH546173	MH546174	MH546175
A/Americangreen-wingedteal/Idaho/16-028809-5/2016(H5N9)	Wild birds	MH546176	MH546177	MH546178	MH546179	MH546180	MH546181	MH546182	MH546183
A/Americangreen-wingedteal/Idaho/16-028809-8/2016(H5N9)	Wild birds	MH546184	MH546185	MH546186	MH546187	MH546188	MH546189	MH546190	MH546191
A/Americangreen-wingedteal/Idaho/16-028809-9/2016(H5N9)	Wild birds	MH546192	MH546193	MH546194	MH546195	MH546196	MH546197	MH546198	MH546199
A/Americangreen-wingedteal/Nevada/16-033700-1/2016(H5N2)	Wild birds	MH546200	MH546201	MH546202	MH546203	MH546204	MH546205	MH546206	MH546207
A/Americangreen-wingedteal/Oregon/17-000383-3/2016(H5N2)	Wild birds	MH546208	MH546209	MH546210	MH546211	MH546212	MH546213	MH546214	MH546215
A/Americanwigeon/California/15-039075-7/2015(H5N2)	Wild birds	MH546216	MH546217	MH546218	MH546219	MH546220	MH546221	MH546222	MH546223
A/Americanwigeon/Colorado/15-038180-1/2015(H5N2)	Wild birds	MH546224	MH546225	MH546226	MH546227	MH546228	MH546229	MH546230	MH546231
A/Americanwigeon/Oregon/17-000383-2/2016(H5N2)	Wild birds	MH546232	MH546233	MH546234	MH546235	MH546236	MH546237	MH546238	MH546239
A/Americanwigeon/Utah/15-038912-1/2015(H5N2)	Wild birds	MH546240	MH546241	MH546242	MH546243	MH546244	MH546245	MH546246	MH546247
A/Blue-winged Teal/Louisiana/UGA114-282/2014(H1N1)	Wild birds	MH341739	MH341740	MH341741	MH341742	MH341743	MH341744	MH341745	MH341746
A/Blue-winged Teal/Texas/UGA115-5632/2015(H1N1)	Wild birds	MH341859	MH341860	MH341861	MH341862	MH341863	MH341864	MH341865	MH341866
A/Blue-winged Teal/Texas/UGA115-6706/2015(H1N1)	Wild birds	MH341891	MH341892	MH341893	MH341894	MH341895	MH341896	MH341897	MH341898
A/blue-wingedteal/SouthCarolina/16-042570-1/2016(H7N1)	Wild birds	MH546320	MH546321	MH546322	MH546323	MH546324	MH546325	MH546326	MH546327
A/blue-wingedteal/Texas/16-031241-1/2016(H5N1)	Wild birds	MH546328	MH546329	MH546330	MH546331	MH546332	MH546333	MH546334	MH546335
A/Cackling Goose/Alaska/UGA115-3902/2015(H6N1)	Wild birds	KU310460	KU310461	KU310462	KU310463	KU310464	KU310465	KU310466	KU310467
A/Canada goose/Delaware Bay/601/2016(H5N1)	Wild birds	MF613753	MF046330	MF046237	MF046544	MF046412	MF046448	MF613747	MF046406
A/commonmurre/Alaska/16-000949-1/2016(H5N9)	Wild birds	MH546352	MH546353	MH546354	MH546355	MH546356	MH546357	MH546358	MH546359
A/duck/Florida/16-004497-1/2016(H5N2)	Wild birds	MH546144	MH546145	MH546146	MH546147	MH546148	MH546149	MH546150	MH546151
A/Emperor Goose/Alaska/UGA115-8456/2015(H1N1)	Wild birds	MH341899	MH341900	MH341901	MH341902	MH341903	MH341904	MH341905	MH341906

A/emperorgoose/Alaska/16-041335-20/2016(H5N2)	Wild birds	MH546440	MH546441	MH546442	MH546443	MH546444	MH546445	MH546446	MH546447
A/emperorgoose/Alaska/17-004479-1/2016(H5N2)	Wild birds	MH546448	MH546449	MH546450	MH546451	MH546452	MH546453	MH546454	MH546455
A/emperorgoose/Alaska/17-004479-2/2016(H5N2)	Wild birds	MH546456	MH546457	MH546458	MH546459	MH546460	MH546461	MH546462	MH546463
A/gadwall/NorthCarolina/15-037410-2/2015(H5N2)	Wild birds	MH546464	MH546465	MH546466	MH546467	MH546468	MH546469	MH546470	MH546471
A/glaucous-wingedgull/Alaska/16-041335-19/2016(H5N2)	Wild birds	MH546472	MH546473	MH546474	MH546475	MH546476	MH546477	MH546478	MH546479
A/Greater White-fronted Goose/Alaska/UGAI15-3903/2015(H6N1)	Wild birds	KU310468	KU310469	KU310470	KU310471	KU310472	KU310473	KU310474	KU310475
A/LAUGHING GULL/DE/341/2011 (H5N3)	Wild birds	MF359875	MF359889	MF359864	MF359833	MF359871	MF359826	MF359836	MF359866
A/lessersnowgoose/Arkansas/16-005566-3/2016(H5N2)	Wild birds	MH546520	MH546521	MH546522	MH546523	MH546524	MH546525	MH546526	MH546527
A/lessersnowgoose/Oregon/16-006224-1/2016(H5N3)	Wild birds	MH546528	MH546529	MH546530	MH546531	MH546532	MH546533	MH546534	MH546535
A/Mallard Duck/Minnesota/UGAI15-6021/2015(H1N1)	Wild birds	MH341867	MH341868	MH341869	MH341870	MH341871	MH341872	MH341873	MH341874
A/Mallard Duck/Minnesota/UGAI15-6522/2015(H1N1)	Wild birds	MH341875	MH341876	MH341877	MH341878	MH341879	MH341880	MH341881	MH341882
A/Mallard Duck/Minnesota/UGAI15-6540/2015(H4N1)	Wild birds	MH341883	MH341884	MH341885	MH341886	MH341887	MH341888	MH341889	MH341890
A/Mallard Duck/Pennsylvania/UGAI15-4737/2015(H3N1)	Wild birds	MH341843	MH341844	MH341845	MH341846	MH341847	MH341848	MH341849	MH341850
A/Mallard Duck/Pennsylvania/UGAI15-4892/2015(H1N1)	Wild birds	MH341851	MH341852	MH341853	MH341854	MH341855	MH341856	MH341857	MH341858
A/mallard/Alaska/16-029597-2/2016(H5N2)	Wild birds	MH546139	MH546140	n/a	MH546141	n/a	MH546142	n/a	MH546143
A/mallard/Alaska/16-039026-5/2016(H5N2)	Wild birds	MH546536	MH546537	MH546538	MH546539	MH546540	MH546541	MH546542	MH546543
A/mallard/Alaska/16-041335-1/2016(H5N2)	Wild birds	MH546544	MH546545	MH546546	MH546547	MH546548	MH546549	MH546550	MH546551
A/mallard/Alaska/16-041335-2/2016(H5N2)	Wild birds	MH546552	MH546553	MH546554	MH546555	MH546556	MH546557	MH546558	MH546559
A/mallard/Alberta/195/2016(H1N1)	Wild birds	MF613903	MF613823	MF046376	MF613817	MF046190	MF046227	MF613937	MF046389
A/MALLARD/ALBERTA/21/2014(H1N1)	Wild birds	MF359862	MF359823	MF359856	MF359832	MF359860	MF359869	MF359887	MF359841
A/mallard/Alberta/233/2015(H1N1)	Wild birds	MF613685	MF046567	MF046452	MF613674	MF613755	MF613940	MF613812	MF613776
A/mallard/Alberta/260/2016(H1N1)	Wild birds	MF613918	MF613905	MF613772	MF046276	MF046547	MF046507	MF613928	MF046361
A/MALLARD/ALBERTA/383/2009 (H5N5)	Wild birds	MF359852	MF359870	MF359842	MF359890	MF359882	MF359872	MF359876	MF359861
A/mallard/Alberta/603/2015(H1N1)	Wild birds	MF613713	MF613716	MF046416	MF046481	MF613745	MF046222	MF046366	MF046509
A/mallard/Alberta/606/2015(H5N1)	Wild birds	MF046556	MF046415	MF046275	MF613792	MF046280	MF046531	MF046442	MF046496
A/MALLARD/ALBERTA/616/2015(H1N1)	Wild birds	MF359840	MF359855	MF359851	MF359843	MF359879	MF359865	MF359868	MF359857
A/MALLARD/ALBERTA/678/2015(H1N1)	Wild birds	MF359859	MF359820	MF359837	MF359883	MF359888	MF359828	MF359835	MF359854
A/MALLARD/ALBERTA/759/2015(H1N1)	Wild birds	MF359819	MF359822	MF359873	MF359848	MF359825	MF359829	MF359853	MF359877
A/mallard/California/16-033701-7/2016(H5N2)	Wild birds	MH546560	MH546561	MH546562	MH546563	MH546564	MH546565	MH546566	MH546567
A/mallard/California/16-038989-4/2016(H5N2)	Wild birds	MH546568	MH546569	MH546570	MH546571	MH546572	MH546573	MH546574	MH546575
A/mallard/Idaho/16-034834-1/2016(H5N2)	Wild birds	MH546576	MH546577	MH546578	MH546579	MH546580	MH546581	MH546582	MH546583

A/mallard/Idaho/UGA116-1964/2016(H5N9)	Wild birds	CY235322	CY235321	CY235320	CY235315	CY235318	CY235317	CY235316	CY235319
A/mallard/Illinois/15-039376-1/2015(H5N6)	Wild birds	MH546584	MH546585	MH546586	MH546587	MH546588	MH546589	MH546590	MH546591
A/mallard/Indiana/16-035911-3/2016(H5N2)	Wild birds	MH546592	MH546593	MH546594	MH546595	MH546596	MH546597	MH546598	MH546599
A/mallard/Maryland/16-042534-2/2016(H5N2)	Wild birds	MH546600	MH546601	MH546602	MH546603	MH546604	MH546605	MH546606	MH546607
A/mallard/Minnesota/15-037267-1/2015(H1N1)	Wild birds	MH546616	MH546617	MH546618	MH546619	MH546620	MH546621	MH546622	MH546623
A/mallard/Minnesota/15-040386-1/2015(H5N9)	Wild birds	MH546624	MH546625	MH546626	MH546627	MH546628	MH546629	MH546630	MH546631
A/mallard/Minnesota/15-040386-2/2015(H1N1)	Wild birds	MH546632	MH546633	MH546634	MH546635	MH546636	MH546637	MH546638	MH546639
A/mallard/Minnesota/15-041504-5/2015(H5N2)	Wild birds	MH546640	MH546641	MH546642	MH546643	MH546644	MH546645	MH546646	MH546647
A/mallard/Minnesota/16-039026-1/2016(H5N2)	Wild birds	MH546648	MH546649	MH546650	MH546651	MH546652	MH546653	MH546654	MH546655
A/mallard/Minnesota/16-041335-3/2016(H5N2)	Wild birds	MH546656	MH546657	MH546658	MH546659	MH546660	MH546661	MH546662	MH546663
A/mallard/Minnesota/16-041335-4/2016(H5N5)	Wild birds	MH546664	MH546665	MH546666	MH546667	MH546668	MH546669	MH546670	MH546671
A/mallard/Nevada/16-035274-2/2016(H5N2)	Wild birds	MH546672	MH546673	MH546674	MH546675	MH546676	MH546677	MH546678	MH546679
A/mallard/NewHampshire/16-029391-25/2016(H5N3)	Wild birds	MH546680	MH546681	MH546682	MH546683	MH546684	MH546685	MH546686	MH546687
A/mallard/NewJersey/16-000670-2/2015(H6N1)	Wild birds	MH546688	MH546689	MH546690	MH546691	MH546692	MH546693	MH546694	MH546695
A/mallard/NorthDakota/16-036222-1/2016(H5N1)	Wild birds	MH546696	MH546697	MH546698	MH546699	MH546700	MH546701	MH546702	MH546703
A/mallard/Oregon/15-036812-2/2015(H5N2)	Wild birds	MH546704	MH546705	MH546706	MH546707	MH546708	MH546709	MH546710	MH546711
A/mallard/Oregon/16-028808-2/2016(H5N2)	Wild birds	MH546712	MH546713	MH546714	MH546715	MH546716	MH546717	MH546718	MH546719
A/mallard/Oregon/17-000383-4/2016(H5N2)	Wild birds	MH546720	MH546721	MH546722	MH546723	MH546724	MH546725	MH546726	MH546727
A/mallard/Pennsylvania/16-035727-1/2016(H5N6)	Wild birds	MH546728	MH546729	MH546730	MH546731	MH546732	MH546733	MH546734	MH546735
A/mallard/SouthDakota/16-001430-2/2016(H7N1)	Wild birds	MH546736	MH546737	MH546738	MH546739	MH546740	MH546741	MH546742	MH546743
A/mallard/Tennessee/AH0039713/2016(H7N1)	Wild birds	KY550909	KY550910	KY550911	KY550912	KY550913	KY550914	KY550915	KY550916
A/mallard/Utah/15-037258-1/2015(H1N1)	Wild birds	MH546744	MH546745	MH546746	MH546747	MH546748	MH546749	MH546750	MH546751
A/mallard/Utah/16-025311-2/2016(H5N9)	Wild birds	MH546752	MH546753	MH546754	MH546755	MH546756	MH546757	MH546758	MH546759
A/mallard/Washington/16-027073-21/2016(H5N2)	Wild birds	MH546760	MH546761	MH546762	MH546763	MH546764	MH546765	MH546766	MH546767
A/mallard/Washington/16-027073-22/2016(H5N2)	Wild birds	MH546768	MH546769	MH546770	MH546771	MH546772	MH546773	MH546774	MH546775
A/mallard/Washington/16-027073-45/2016(H5N2)	Wild birds	MH546776	MH546777	MH546778	MH546779	MH546780	MH546781	MH546782	MH546783
A/mallard/Washington/16-027073-46/2016(H5N2)	Wild birds	MH546784	MH546785	MH546786	MH546787	MH546788	MH546789	MH546790	MH546791
A/mallard/Washington/16-027073-48/2016(H5N2)	Wild birds	MH546792	MH546793	MH546794	MH546795	MH546796	MH546797	MH546798	MH546799
A/mallard/Washington/16-027073-5/2016(H5N2)	Wild birds	MH546800	MH546801	MH546802	MH546803	MH546804	MH546805	MH546806	MH546807
A/mallard/Washington/16-028147-4/2016(H5N2)	Wild birds	MH546808	MH546809	MH546810	MH546811	MH546812	MH546813	MH546814	MH546815
A/Muscovyduck/NewJersey/16-002384-6/2016(H1N1)	Wild birds	MH546264	MH546265	MH546266	MH546267	MH546268	MH546269	MH546270	MH546271

A/Muscovyduck/Pennsylvania/16-003000-1/2016(H1N1)	Wild birds	MH546312	MH546313	MH546314	MH546315	MH546316	MH546317	MH546318	MH546319
A/Northern Pintail Duck/Alaska/UGA115-6978/2015(H6N1)	Wild birds	KY131302	KY131303	KY131304	KY131305	KY131306	KY131307	KY131308	KY131309
A/Northern Pintail Duck/Alaska/UGA115-6985/2015(H6N1)	Wild birds	KY131310	KY131311	KY131312	KY131313	KY131314	KY131315	KY131316	KY131317
A/Northern Pintail Duck/Alaska/UGA115-6993/2015(H6N1)	Wild birds	KY131318	KY131319	KY131320	KY131321	KY131322	KY131323	KY131324	KY131325
A/Northern Pintail Duck/Alaska/UGA115-6994/2015(H6N1)	Wild birds	KY131326	KY131327	KY131328	KY131329	KY131330	KY131331	KY131332	KY131333
A/northern pintail/Alaska/UGA115-7300/2015(H6N1)	Wild birds	KY131357	KY131358	KY131359	KY131360	KY131361	KY131362	KY131363	KY131364
A/northernpintail/Alaska/16-041335-10/2016(H5N2)	Wild birds	MH546816	MH546817	MH546818	MH546819	MH546820	MH546821	MH546822	MH546823
A/northernpintail/Alaska/16-041335-11/2016(H5N2)	Wild birds	MH546824	MH546825	MH546826	MH546827	MH546828	MH546829	MH546830	MH546831
A/northernpintail/Alaska/16-041335-12/2016(H5N2)	Wild birds	MH546832	MH546833	MH546834	MH546835	MH546836	MH546837	MH546838	MH546839
A/northernpintail/Alaska/16-041335-13/2016(H5N2)	Wild birds	MH546840	MH546841	MH546842	MH546843	MH546844	MH546845	MH546846	MH546847
A/northernpintail/Alaska/16-041335-15/2016(H5N2)	Wild birds	MH546848	MH546849	MH546850	MH546851	MH546852	MH546853	MH546854	MH546855
A/northernpintail/Alaska/16-041335-16/2016(H5N2)	Wild birds	MH546856	MH546857	MH546858	MH546859	MH546860	MH546861	MH546862	MH546863
A/northernpintail/Alaska/16-041335-17/2016(H5N2)	Wild birds	MH546864	MH546865	MH546866	MH546867	MH546868	MH546869	MH546870	MH546871
A/northernpintail/Alaska/16-041335-18/2016(H5N2)	Wild birds	MH546872	MH546873	MH546874	MH546875	MH546876	MH546877	MH546878	MH546879
A/northernpintail/Alaska/16-041335-5/2016(H5N2)	Wild birds	MH546880	MH546881	MH546882	MH546883	MH546884	MH546885	MH546886	MH546887
A/northernpintail/Alaska/16-041335-6/2016(H5N2)	Wild birds	MH546888	MH546889	MH546890	MH546891	MH546892	MH546893	MH546894	MH546895
A/northernpintail/Alaska/16-041335-7/2016(H5N2)	Wild birds	MH546896	MH546897	MH546898	MH546899	MH546900	MH546901	MH546902	MH546903
A/northernpintail/Alaska/16-041335-8/2016(H5N2)	Wild birds	MH546904	MH546905	MH546906	MH546907	MH546908	MH546909	MH546910	MH546911
A/northernpintail/Alaska/16-041335-9/2016(H5N2)	Wild birds	MH546912	MH546913	MH546914	MH546915	MH546916	MH546917	MH546918	MH546919
A/northernshoveler/Alaska/17-004479-3/2016(H5N2)	Wild birds	MH546920	MH546921	MH546922	MH546923	MH546924	MH546925	MH546926	MH546927
A/northernshoveler/California/15-039075-4/2015(H5N3)	Wild birds	MH546928	MH546929	MH546930	MH546931	MH546932	MH546933	MH546934	MH546935
A/northernshoveler/Oregon/16-000283-1/2015(H5N3)	Wild birds	MH546936	MH546937	MH546938	MH546939	MH546940	MH546941	MH546942	MH546943
A/ring-neckedduck/California/16-004032-1/2016(H5N2)	Wild birds	MH546968	MH546969	MH546970	MH546971	MH546972	MH546973	MH546974	MH546975
A/Ruddy Turnstone /New Jersey/UGA114-1322/2014(H6N1)	Wild birds	MH341747	MH341748	MH341749	MH341750	MH341751	MH341752	MH341753	MH341754
A/Ruddy Turnstone /New Jersey/UGA114-1399/2014(H6N1)	Wild birds	MH341755	MH341756	MH341757	MH341758	MH341759	MH341760	MH341761	MH341762
A/Ruddy Turnstone /New Jersey/UGA114-1478/2014(H6N1)	Wild birds	MH341763	MH341764	MH341765	MH341766	MH341767	MH341768	MH341769	MH341770
A/Ruddy Turnstone /New Jersey/UGA114-1857/2014(H12N1)	Wild birds	MH341771	MH341772	MH341773	MH341774	MH341775	MH341776	MH341777	MH341778
A/RUDDY TURNSTONE/DE/117/2011 (H5N9)	Wild birds	MF359831	MF359874	MF359821	MF359846	MF359878	MF359884	MF359834	MF359867
A/RUDDY TURNSTONE/DE/431/2011 (H5N2)	Wild birds	MF359885	MF359847	MF359881	MF359838	MF359850	MF359839	MF359849	MF359880
A/ruddy turnstone/Delaware Bay/317/2016(Mixed)	Wild birds	MF613762	MF613881	MF613924	MF613724	MF046298	MF613766	MF613731	MF046472
A/Ruddy Turnstone/New Jersey/UGA115-3003/2015(H1N1)	Wild birds	MH341779	MH341780	MH341781	MH341782	MH341783	MH341784	MH341785	MH341786

A/Ruddy Turnstone/New Jersey/UGAI15-3172/2015(H7N1)	Wild birds	MH341787	MH341788	MH341789	MH341790	MH341791	MH341792	MH341793	MH341794
A/Ruddy Turnstone/New Jersey/UGAI15-3256/2015(H1N1)	Wild birds	MH341795	MH341796	MH341797	MH341798	MH341799	MH341800	MH341801	MH341802
A/Ruddy Turnstone/New Jersey/UGAI15-3295/2015(H1N1)	Wild birds	MH341803	MH341804	MH341805	MH341806	MH341807	MH341808	MH341809	MH341810
A/Ruddy Turnstone/New Jersey/UGAI15-3685/2015(H7N1)	Wild birds	MH341811	MH341812	MH341813	MH341814	MH341815	MH341816	MH341817	MH341818
A/Ruddy Turnstone/New Jersey/UGAI15-3980/2015(H7N1)	Wild birds	MH341819	MH341820	MH341821	MH341822	MH341823	MH341824	MH341825	MH341826
A/Ruddy Turnstone/New Jersey/UGAI15-4065/2015(H1N1)	Wild birds	MH341827	MH341828	MH341829	MH341830	MH341831	MH341832	MH341833	MH341834
A/Ruddy Turnstone/New Jersey/UGAI15-4243/2015(H1N1)	Wild birds	MH341835	MH341836	MH341837	MH341838	MH341839	MH341840	MH341841	MH341842
A/SHOREBIRD/DE/318/2011 (H5N2)	Wild birds	MF359844	MF359827	MF359863	MF359824	MF359830	MF359845	MF359858	MF359886
A/spot-billed duck/Alberta/264/2016(H1N1)	Wild birds	MF046570	MF046514	MF046351	MF046306	MF046504	MF046403	MF046536	MF046468
A/swan/Wyoming/16-026450-2/2016(H1N1)	Wild birds	MH546976	MH546977	MH546978	MH546979	MH546980	MH546981	MH546982	MH546983

^aCommercial poultry farms (CPFs), backyard poultry (BYPs), game bird poultry (GBPs,) and in live bird markets (LBMs); n/a, not available.

Table S6. Number of genomic sequences of avian influenza A viruses included in data analyses, which were downloaded from public databases.

Segment	World Wide	North America
PB2	19292	8844
PB1	19370	8971
PA	19232	8932
HA	29210	9395
NP	19129	8666
NA	22290	8883
MP	20288	9140
NS	19677	8890