"Toward a Sustainable Low Carbon Society"

How are we prepared for emerging zoonoses ?

Ayato Takada

Hokkaido University
Research Center for Zoonosis Control
Sapporo, Japan

Zoonosis is any infectious disease that may be transmitted from other animals, both wild and domestic, to humans or from humans to animals.

The word is derived from the Greek words zoon (animal) (pronounced as zoo-on) and nosos (disease). Many serious diseases fall under this category.

Bacteria, viruses, parasite, protozoa, prion ….

- **Anthrax, Brucellosis, Leptospirosis, Listeriosis, MRSA,**
- **Influenza, Ebola fever, SARS, Rabies,**
- **Echinococcosis, Trypanosomiasis, Toxoplasmosis,**
- **BSE**

Emerging Zoonoses

Year	Disease	Causative agent	Country	Human cases
1977	Ebola hemorrhagic fever	Ebola virus of *Filoviridae*	Zaire (DRC)	318 (279 daeths)
	Hemorrhagic fever with renal syndrome	Hantavirus of *Bunyaviridae*	Korea	388
1982	Bloody diarrhea, Hemolytic uremic syndrome	*Escherichia coli* O157:H7	USA	73,000(61 deaths)
	Lyme disease	*Borreria burgdorferi*	USA	9,000
1983	AIDS	HIV of *Retroviridae*		
1986	BSE	Prion	UK	113(-2001)
1989	Ehrlichiosis	*Ehrlichia chaffensis, E. phagocytophila*	USA	1,200
1991	Venezuelan hemorrhagic fever	Guanarito virus of *Arenaviridae*	Venezuela	105(35 deaths)
1992	Cat scratch disease	*Bartonella hensele*	USA	22,000
1993	Hantavirus pulmonary syndrome	Sin Nombre virus of *Bunyaviridae*	USA	80 (50 deaths)
1994	Brazilian hemorrhagic fever	Sabia virus of *Arenaviridae*	Brazil	26 (10 deaths)
	Morbillivirus infection from horses	Hendra virus of *Paramyxoviridae*	Australia	2 (1 dath)
1995	Hantavirus pulmonary syndrome	*Hantavirus of bunyaviridae*	South American countries	239 (30% deaths)
	Ebola hemorrhagic fever	Ebola virus of *Filoviridae*	Zaire	318 (249 deaths)
1996	Rabies from bat	Lyssavirus type 7 of *Rhabdoviridae*	Australia	2 deaths
1997	Avian influenza (H5N1) virus infection	Highly pathogenic avian influenza virus	Hong Kong	18 (6 deaths)
1998	Pneumonic plague	*Yersinia pestis*	India	16 (4人 deaths)
1999	Nipah virus infection	Morbillivirus of *Paramyxoviridae*	Malaysia	258 (100 deaths)
	Leptospirosis (-present)	*Leptospira interrogans*	Thai, Philippines, Asia	>30,000 (>700 deaths)
2000	Rift Valley fever	Rift Valley fever virus of Bunyaviridae	Saudi Arabia, Yemen	884 (124 death)
2001 - 2007	West Nile fever	West Nile virus of Flaviviridae	USA, Canada, Mexico	17,000 (>600 deaths)
2001 ～2004	Ebola hemorrhagic fever	Ebola virus of *Filoviridae*	Congo	210 (175 deaths)
2003	SARS	Coronavirus	Hong Kong, China, worldwide	8,437 (813 deaths)
	Avian influenza virus (H7N7) infection	Highly pathogenic avian influenza virus	Netherland, Belgium, Germany	86 (1 death)
2004 ～2008	Avian influenza virus (H5N1) infection	Highly pathogenic avian influenza virus	China and 11 countries of Asia, Fareast, and Africa	331 (204 deaths)
2004 ～2005	Marburg hemorrhagic fever	Marburg virus of *Filoviridae*	Angola	424 (363 deaths)
2005	Ebola hemorrhagic fever	Ebola virus of *Filoviridae*	Congo	12 (10 deaths)

Emerging Zoonoses

- **Many of the agents responsible for epidemics throughout human history have their origins in animals.**
- **Nearly all emerging disease episodes of the past 20 years have involved zoonotic infectious agents.**
- **Episodes of zoonoses are increasing around the globe.**

Causative factors resulting in the increase of zoonosis outbreaks

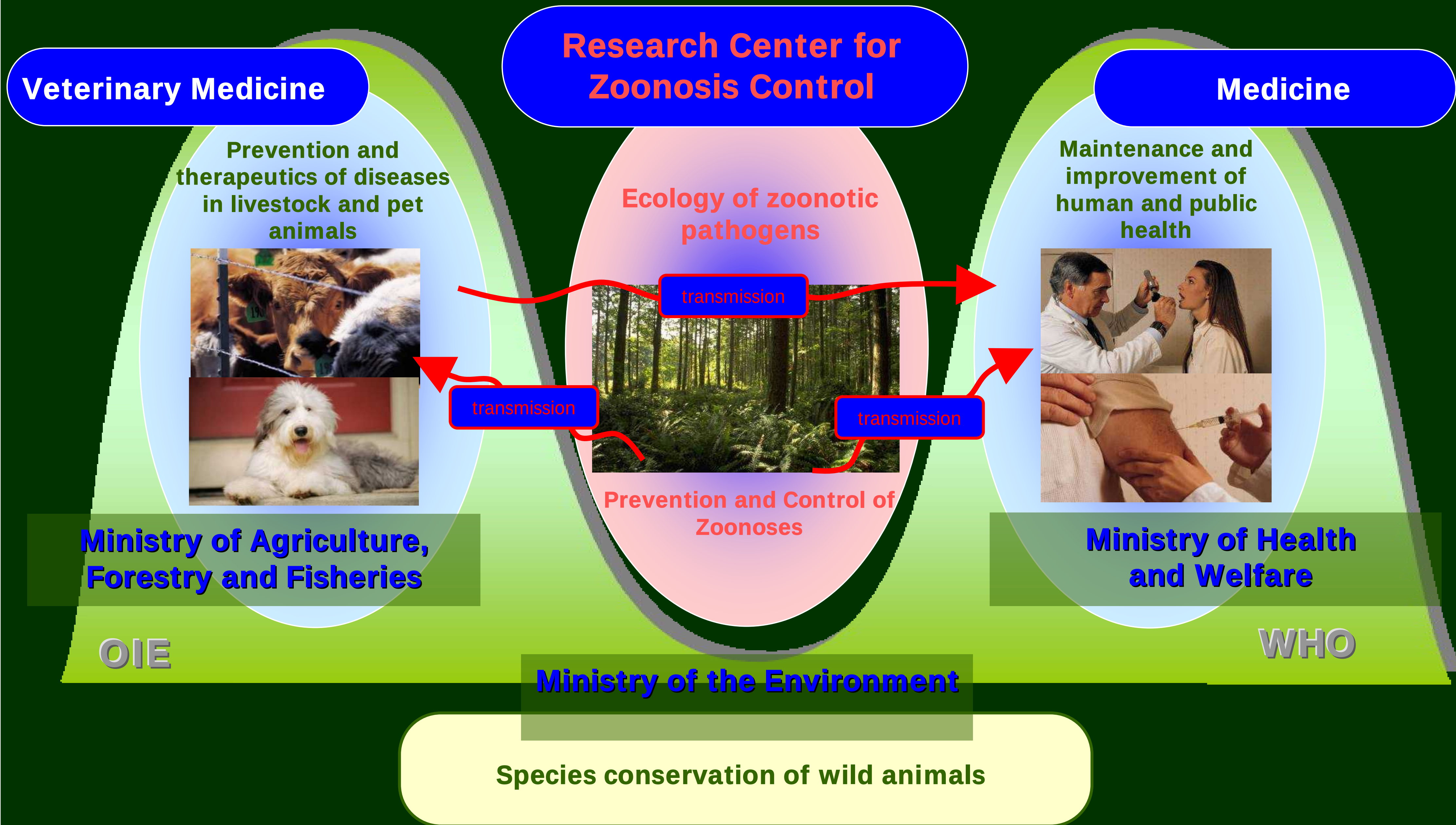
- **Climate, weather, rainfall, temperature (global warming)**
- **Population movements and the intrusion of humans and domestic animals into arthropod habitats**
- **Deforestation and settlement of new tropical forest/farm margins**
- **Expanding primitive irrigation systems**
- **The opening up of isolated ecosystems such as islands**
- **Increased long-distance air travel**
- **Increased long-distance livestock transportation**
- **New routings of long-distance bird migrations**
- **Uncontrolled urbanization and environmental pollution**

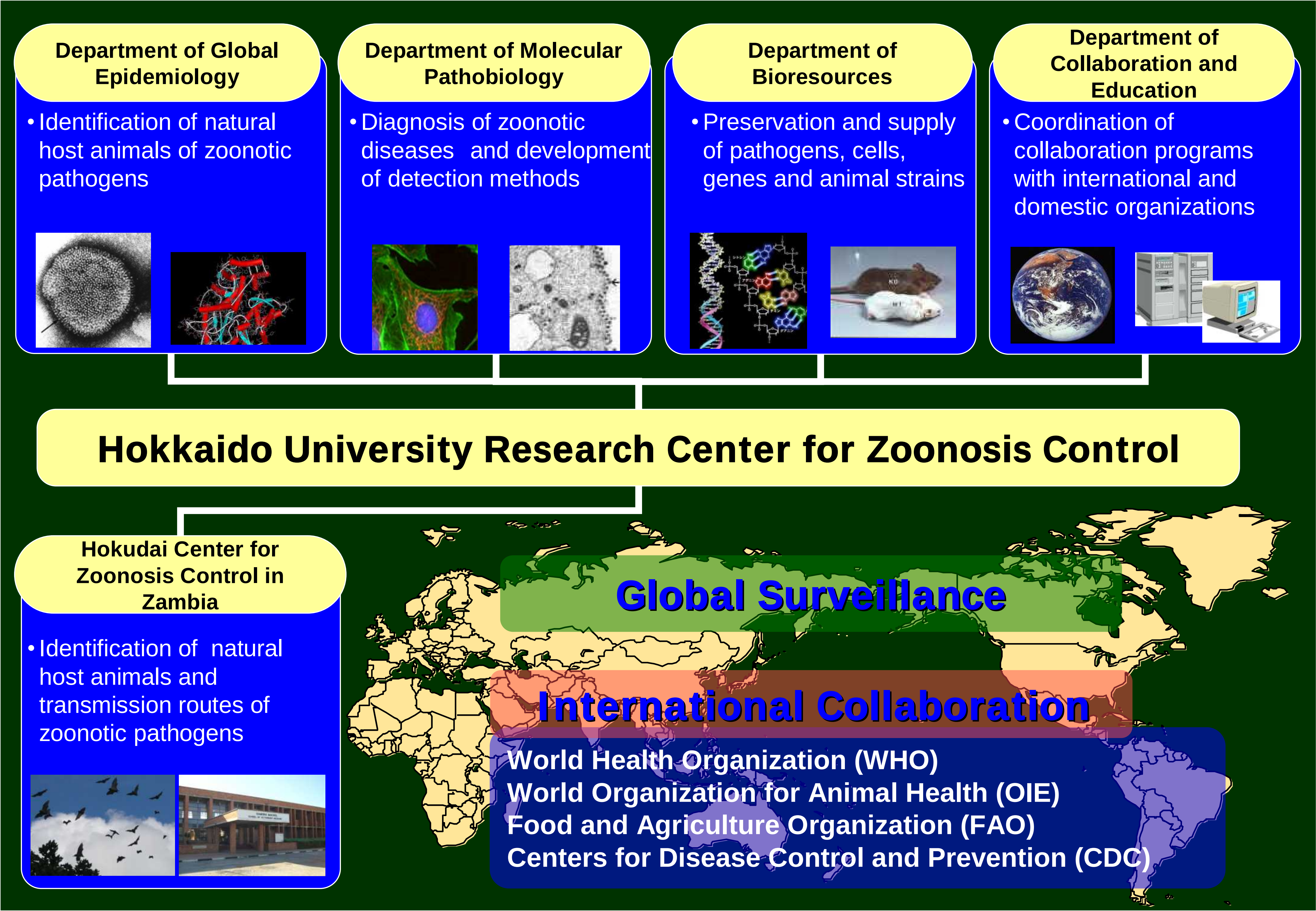
Zoonotic factors favoring new, emerging and re-emerging infections

- **Zoonoses must be dealt with at the interface between medical, veterinary, and environmental sciences.**
- **The research base involves the interface between:**

virology (biologic and molecular biologic), immunology, pathology, ecology, animal biology, wildlife biology, mammology, ornithology, entomology, meteorology, climatology, geography, sciences pertaining to societal and commercial risk factors, economics, government, biodefense, etc., and the medical sciences and veterinary sciences.

Control and Prevention of Zoonoses




Department of Global Epidemiology
• Identification of natural host animals of zoonotic pathogens
Department of Molecular Pathobiology
• Diagnosis of zoonotic diseases and development of detection methods
Department of Bioresources
• Preservation and supply of pathogens, cells, genes and animal strains
Department of Collaboration and Education
• Coordination of collaboration programs with international and domestic organizations
Hokkaido University Research Center for Zoonosis Control
Hokudai Center for Zoonosis Control in Zambia
• Identification of natural host animals and transmission routes of zoonotic pathogens
Global Surveillance
International Collaboration
World Health Organization (WHO)
World Organization for Animal Health (OIE)
Food and Agriculture Organization (FAO)
Centers for Disease Control and Prevention (CDC)

Influenza A virus

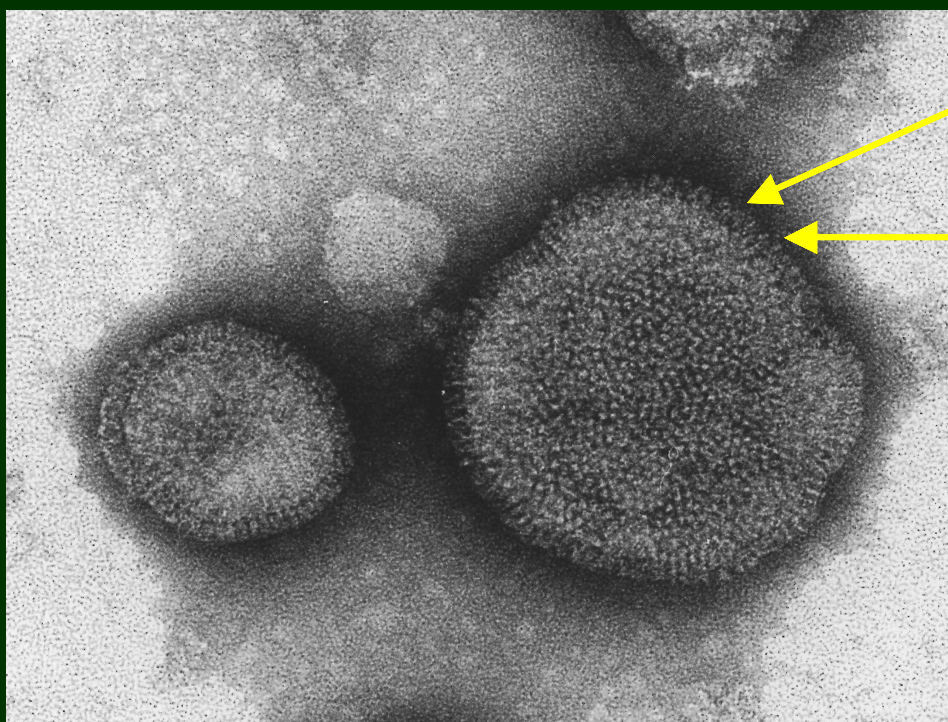
Filovirus

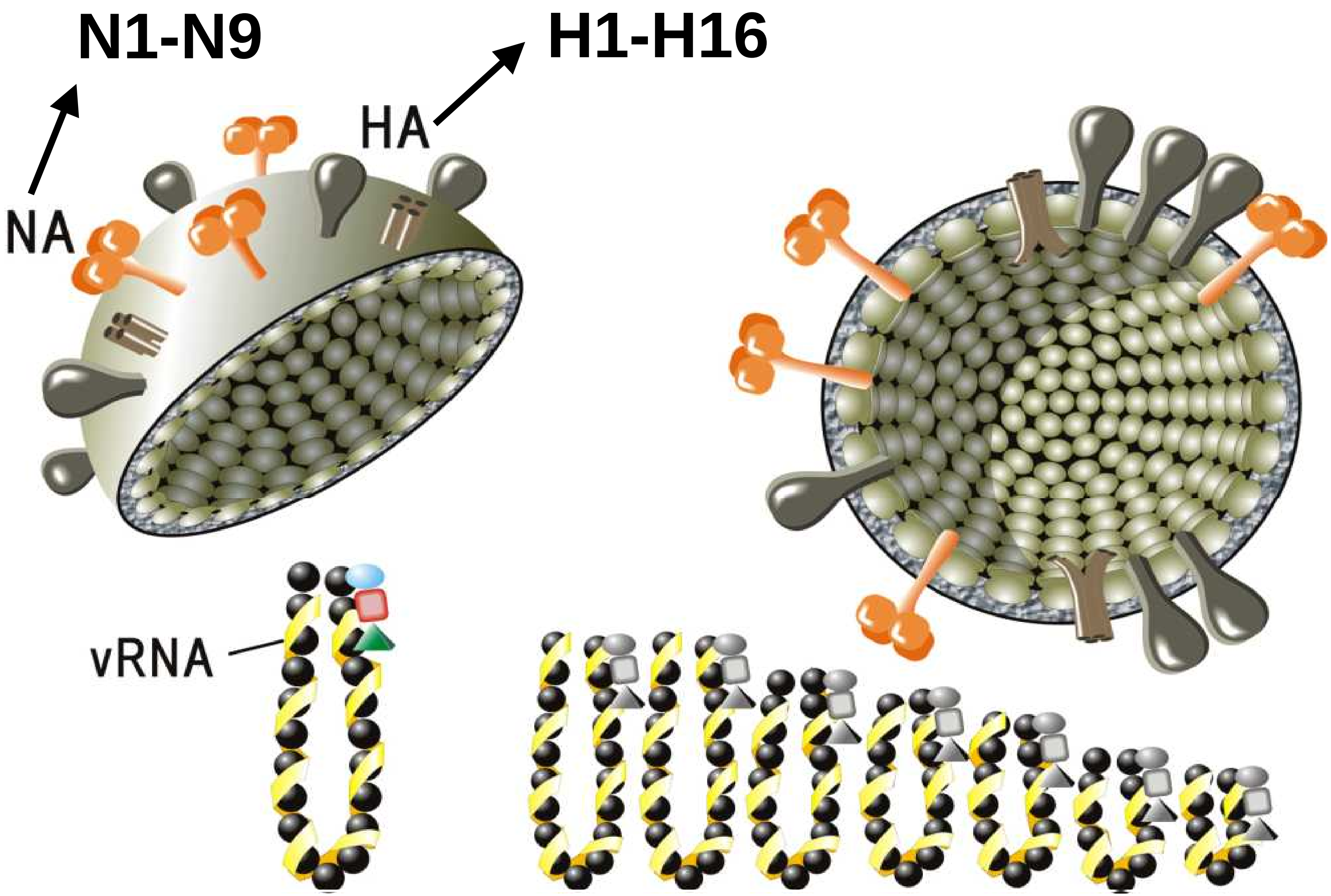
The Ecology of influenza A viruses

Influenza virus

Orthomyxoviridae

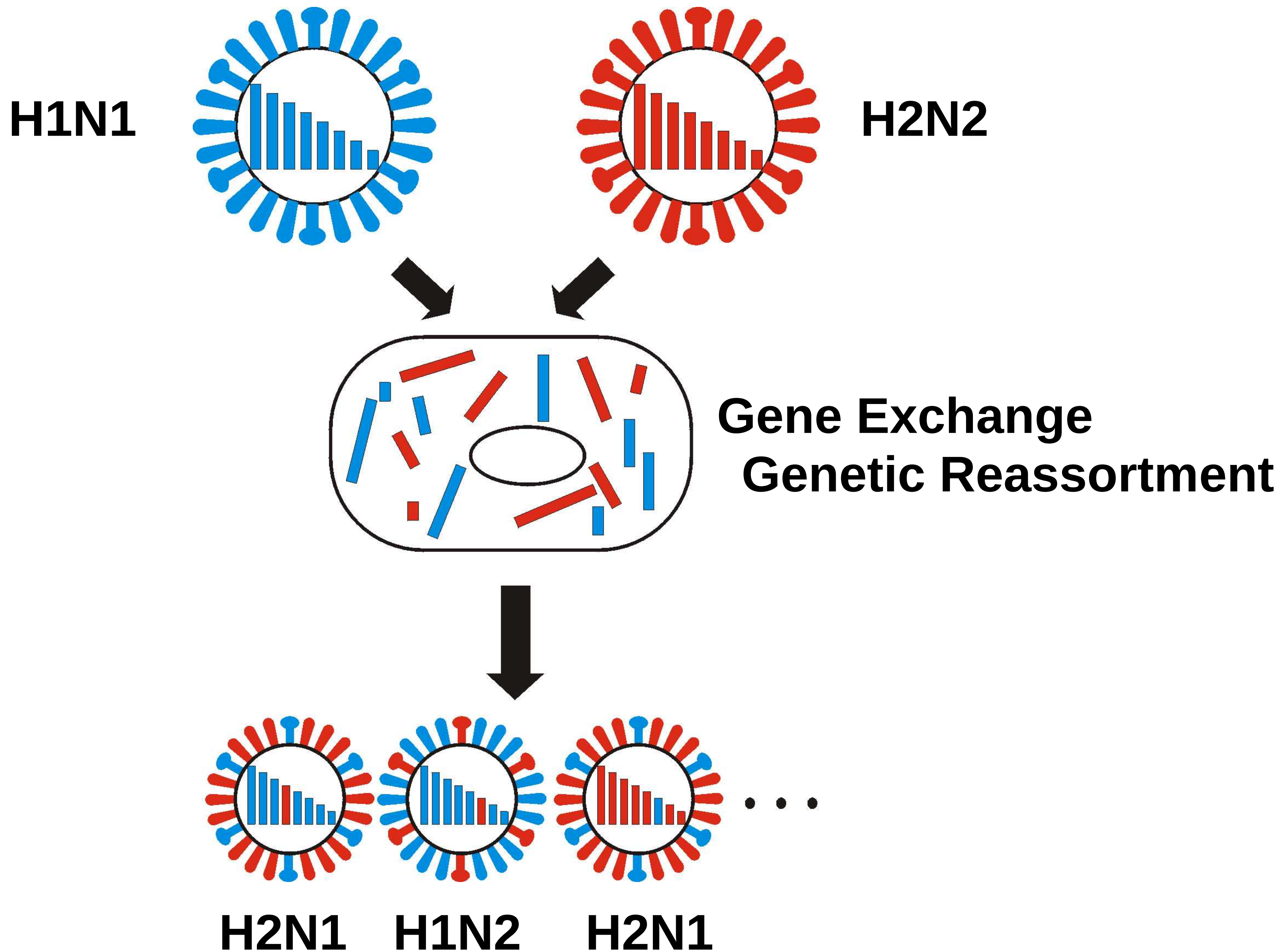
Envepoled, negative-stranded RNA virus
Segmented RNA genome





Segmented RNA genome

Genetic Reassortment



H1N1
H2N2
Gene Exchange
Genetic Reassortment
H2N1
H1N2
H2N1

Wild aquatic bird

Natural reservoir
No disease
Non-pathogenic virus
H1-16、N1-9

The Ecology of Influenza Viruses

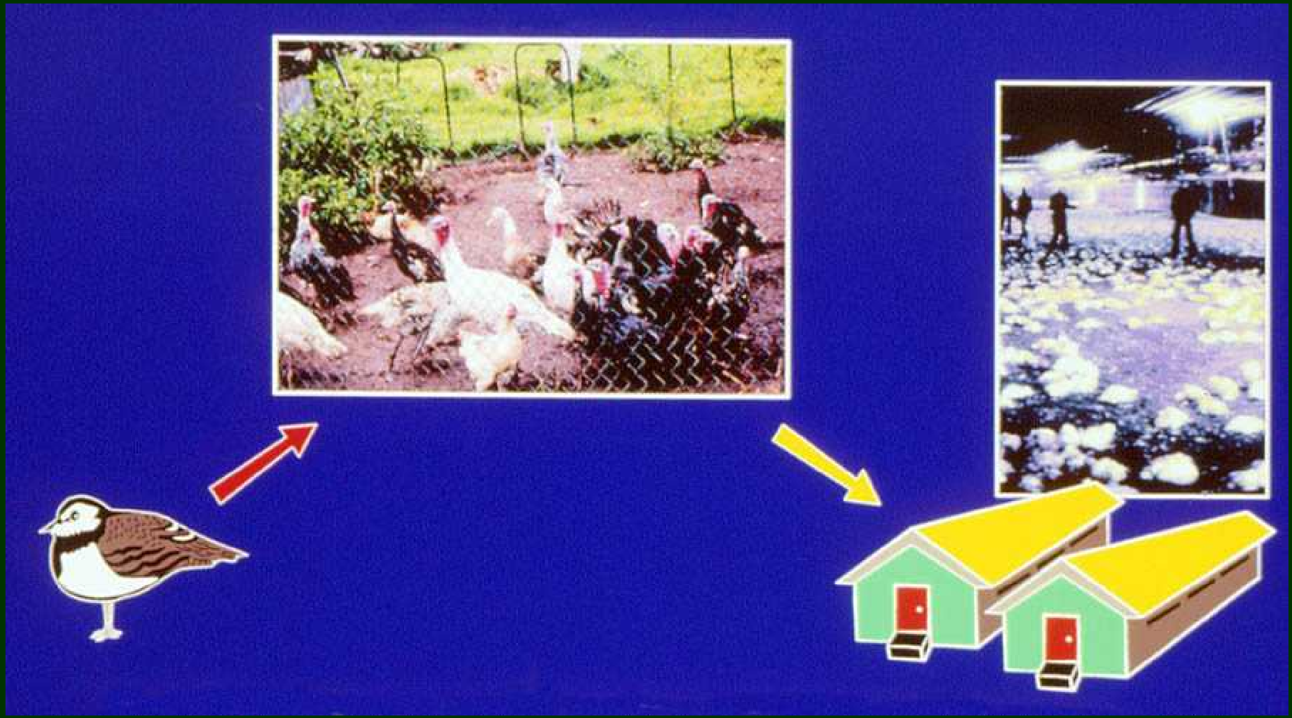
- Wild aquatic birds are the natural reservoirs of all influenza A viruses in other species

- In wild aquatic birds, influenza viruses replicate predominately in the intestinal tract and are shed by fecal oral transmission often through water

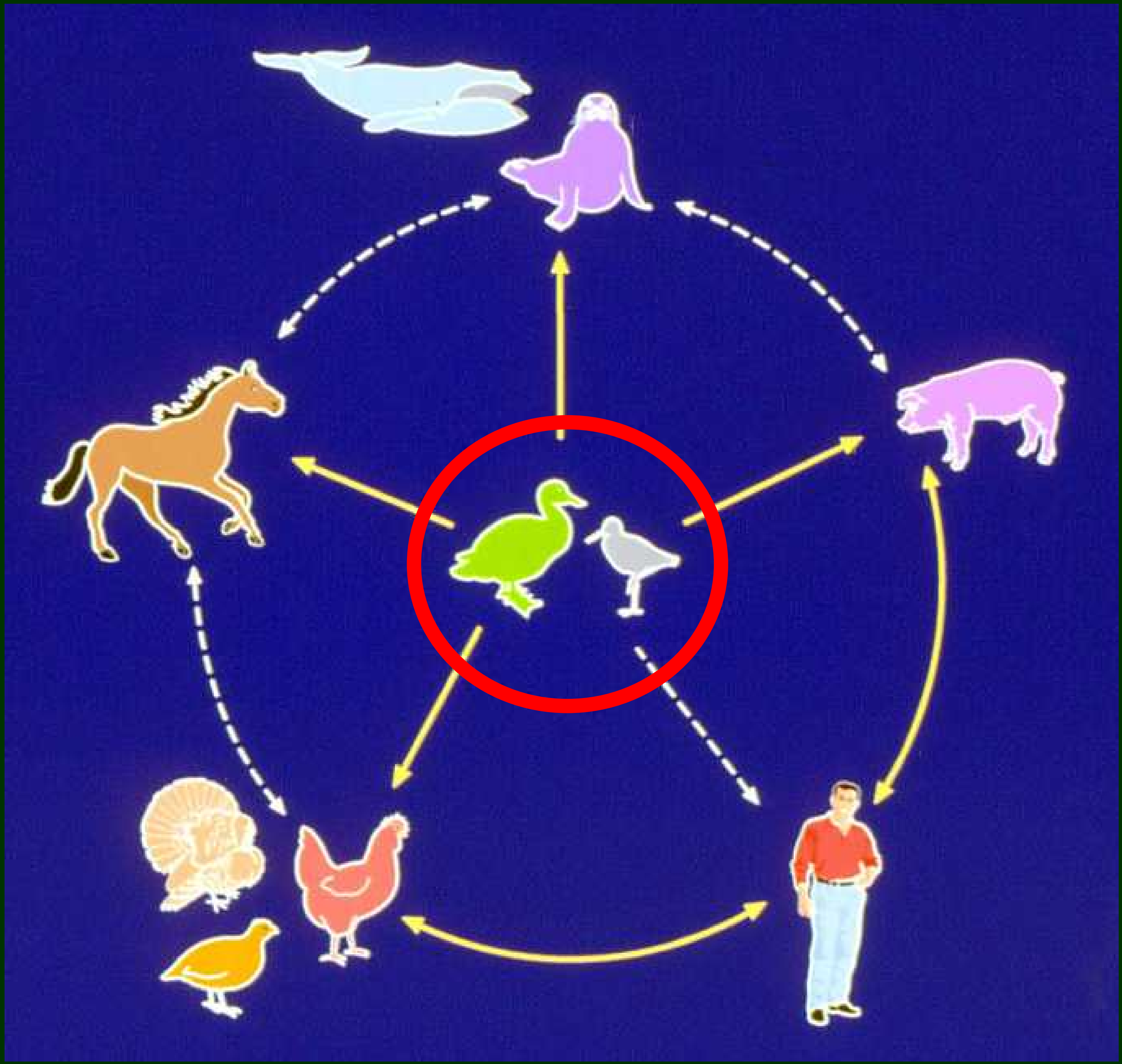
The Ecology of Influenza A Viruses

- Influenza viruses in their natural reservoirs are in evolutionary stasis

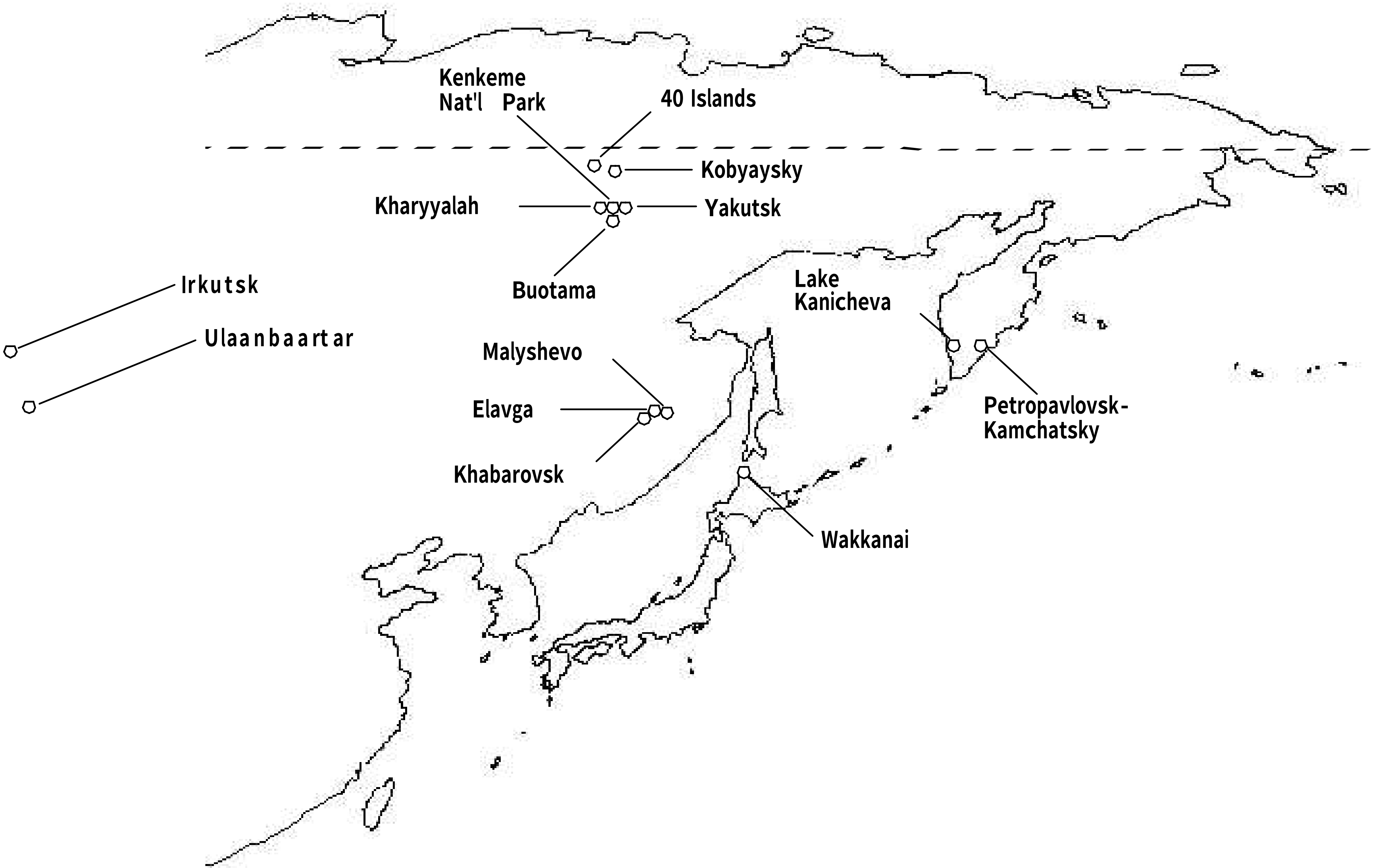
- Rapid evolution occurs after transfer to new hosts



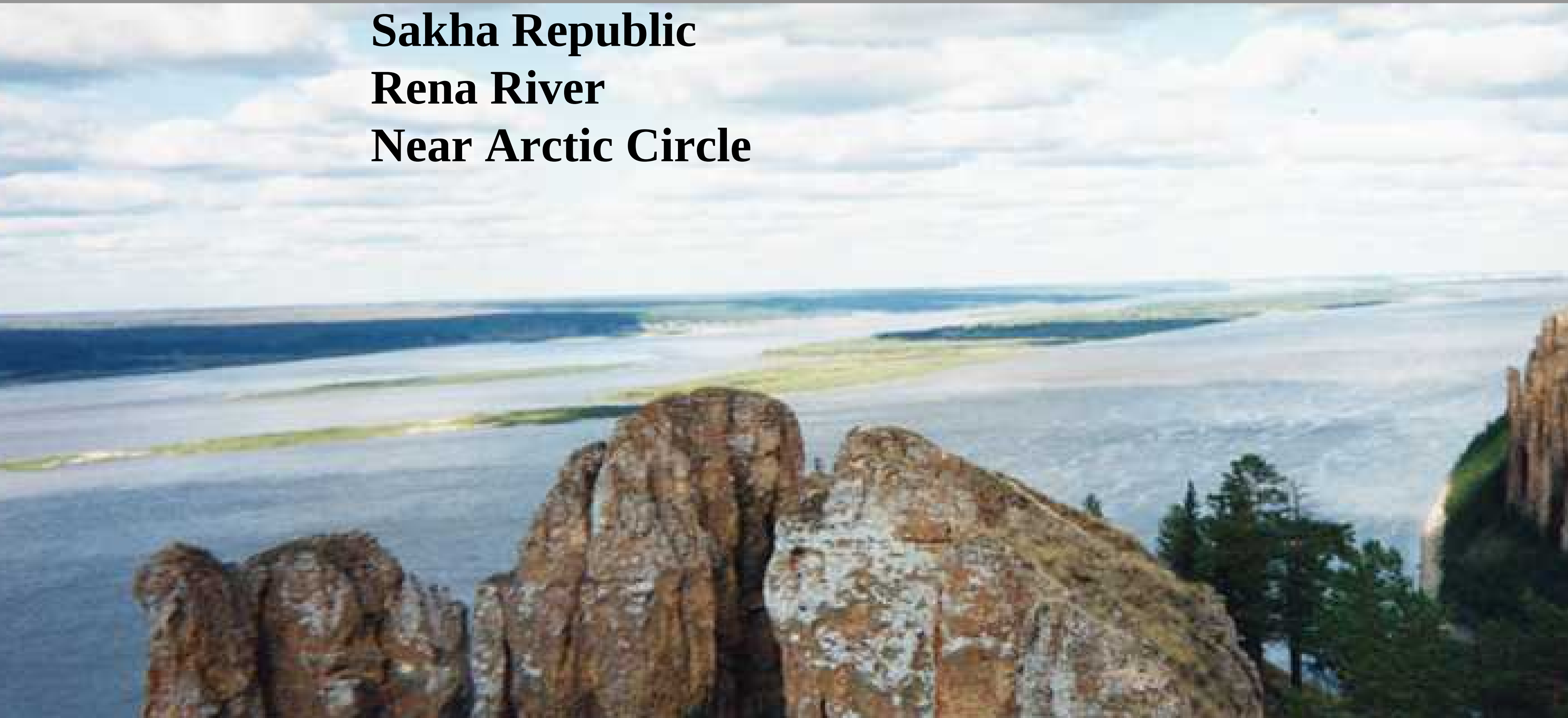
The Ecology of Influenza A Viruses



Surveillance of avian influenza in Japan, Siberia, and Mongolia



Kenkeme
Nat'l Park
40 Islands
Kobyaysky
Kharyyalah
Yakutsk
Buotama
Irkutsk
Ulaanbaartar
Lake
Kanicheva
Malyshevo
Elavga
Khabarovsk
Petropavlovsk-
Kamchatsky
Wakkanai


Sakha Republic
Rena River
Near Arctic Circle

with a bird's-eye view

A lot of lakes and ponds
Nesting area for wild ducks
Viruses are perpetuated in winter

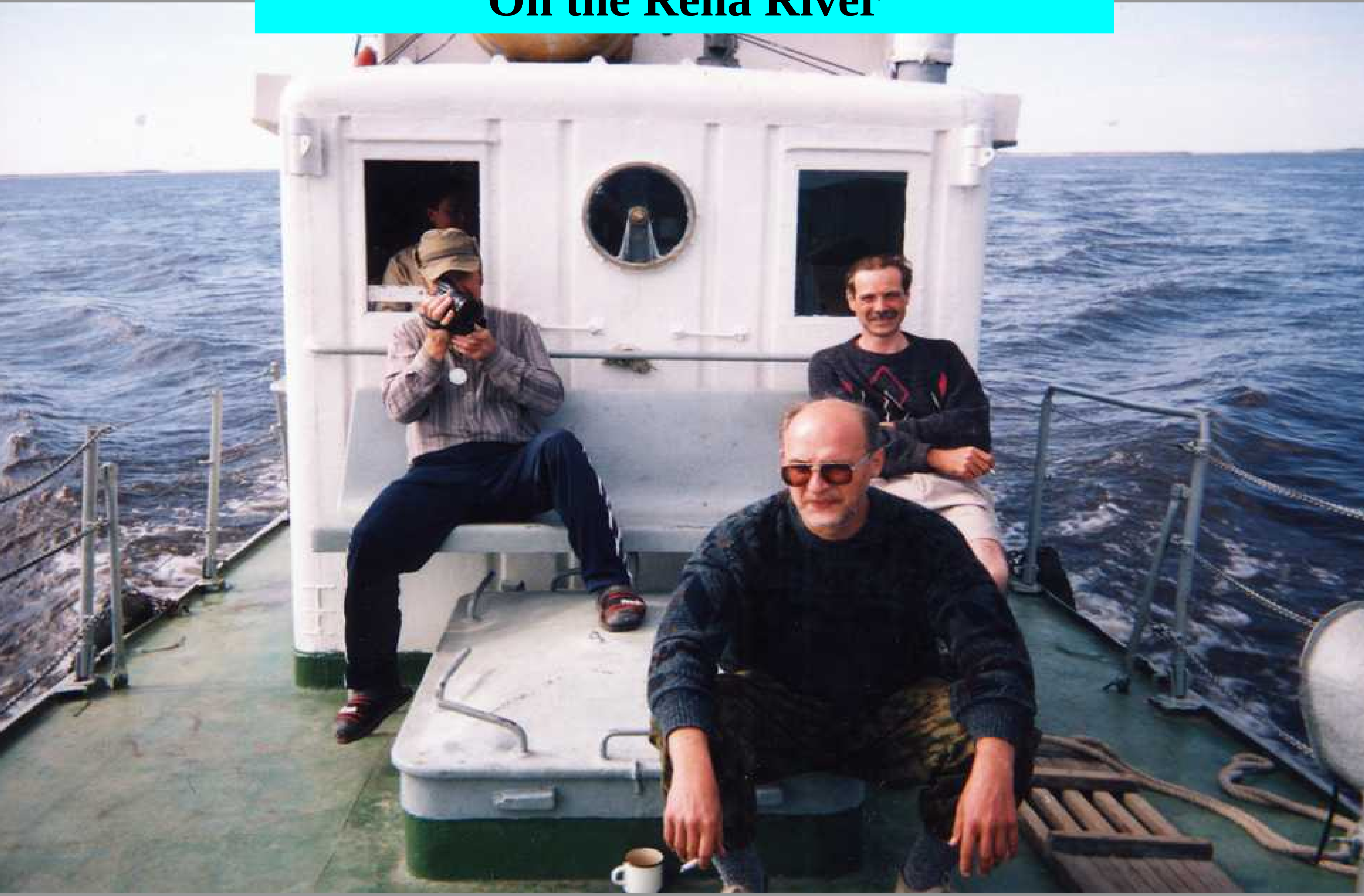
Journal of Virology, December 2006, p. 12229-12235, Vol. 80, No. 24

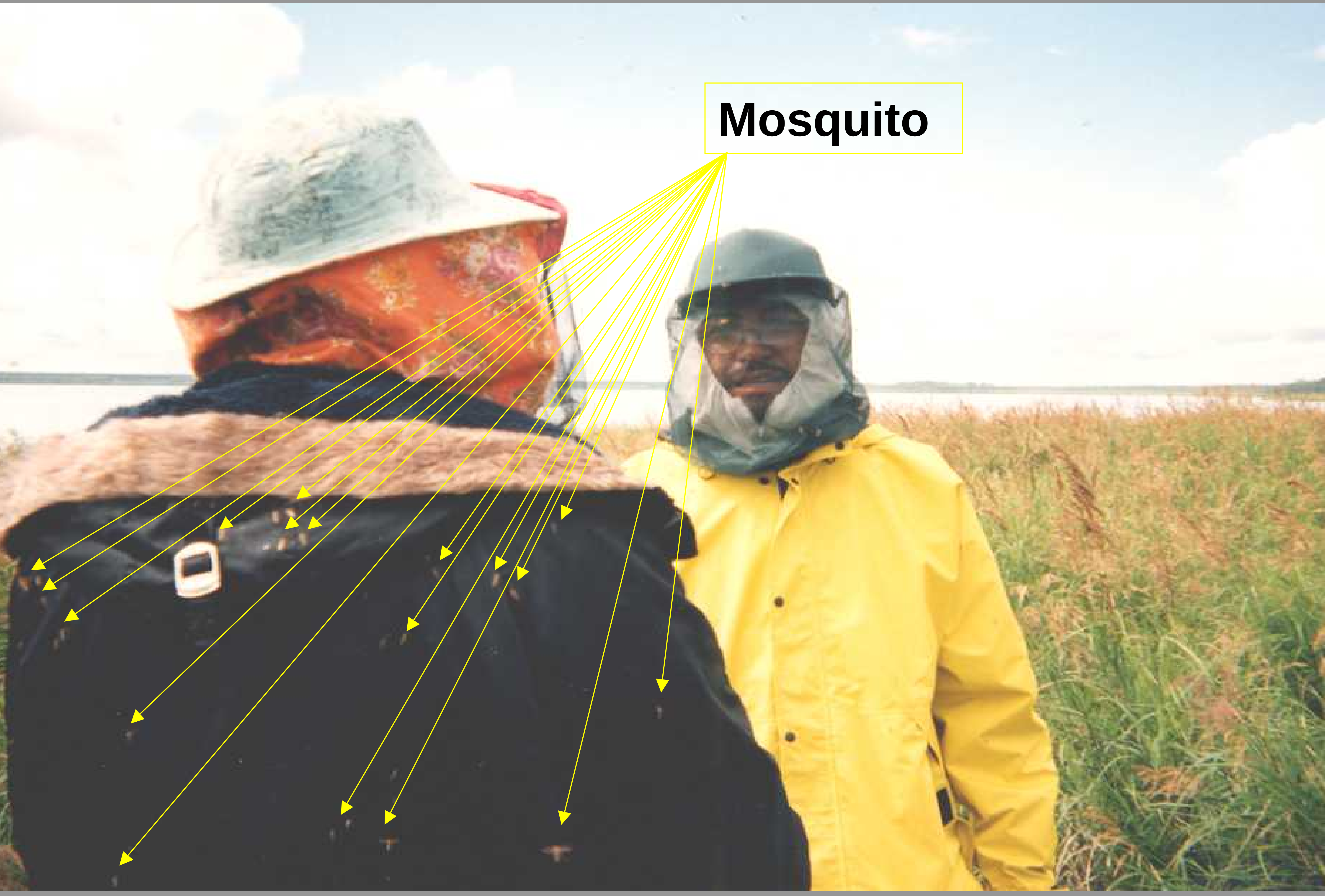
Evidence of Influenza A Virus RNA in Siberian Lake Ice

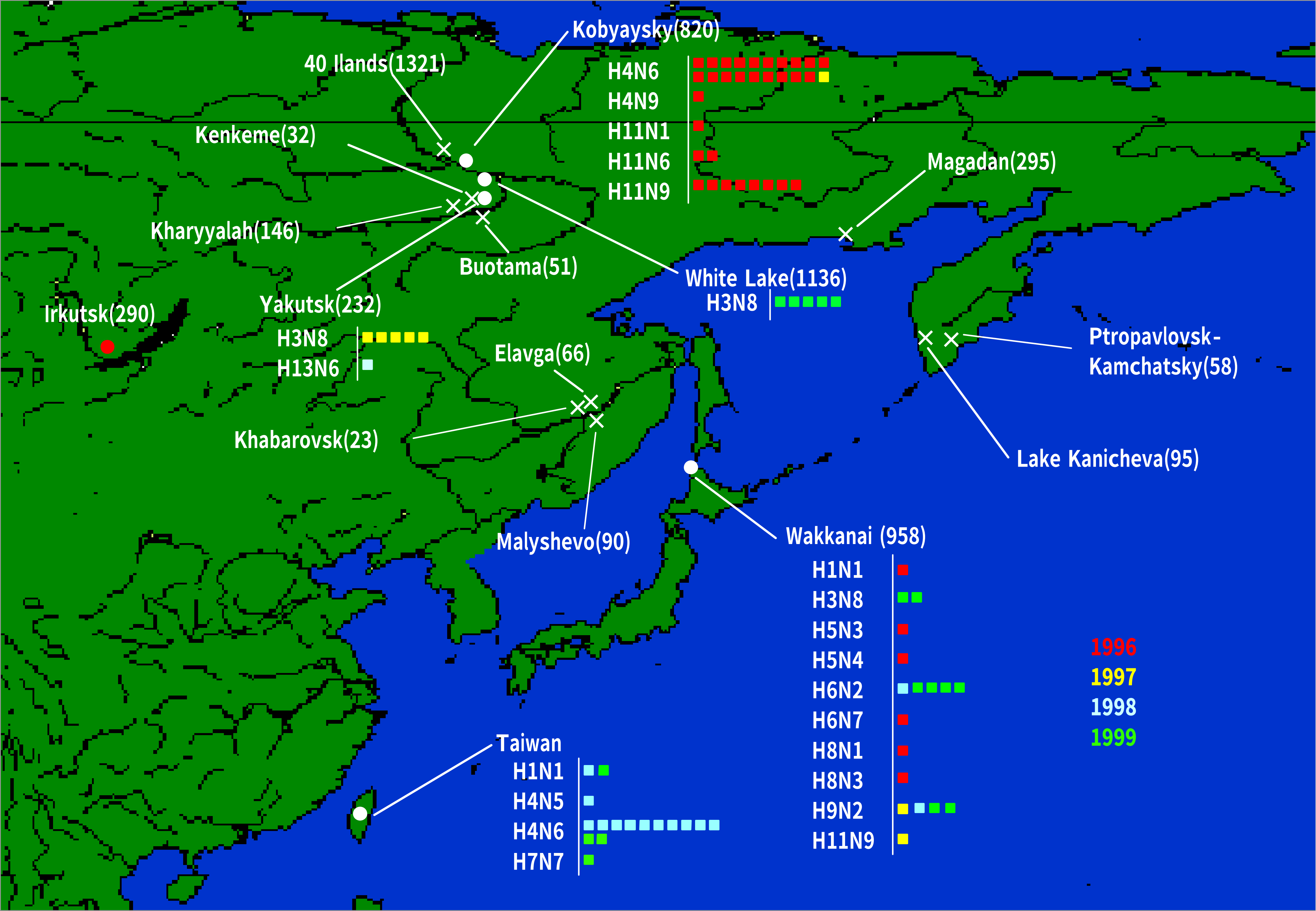
Gang Zhang,1 Dany Shoham,2 David Gilichinsky,3 Sergei Davydov,4 John D. Castello,5 and Scott O. Rogers1*

Influenza A virus infects a large proportion of the human population annually, sometimes leading to the deaths of millions. The biotic cycles of infection are well characterized in the literature, including in studies of populations of humans, poultry, swine, and migratory waterfowl. However, there are few studies of abiotic reservoirs for this virus. Here, we report the preservation of influenza A virus genes in ice and water from high-latitude lakes that are visited by large numbers of migratory birds. The lakes are along the migratory flight paths of birds flying into Asia, North America, Europe, and Africa. The data suggest that influenza A virus, deposited as the birds begin their autumn migration, can be preserved in lake ice. As birds return in the spring, the ice melts, releasing the viruses. Therefore, temporal gene flow is facilitated between the viruses shed during the previous year and the viruses newly acquired by birds during winter months spent in the south. Above the Arctic Circle, the cycles of entrapment in the ice and release by melting can be variable in length, because some ice persists for several years, decades, or longer. This type of temporal gene flow might be a feature common to viruses that can survive entrapment in environmental ice and snow.

On the Rena River

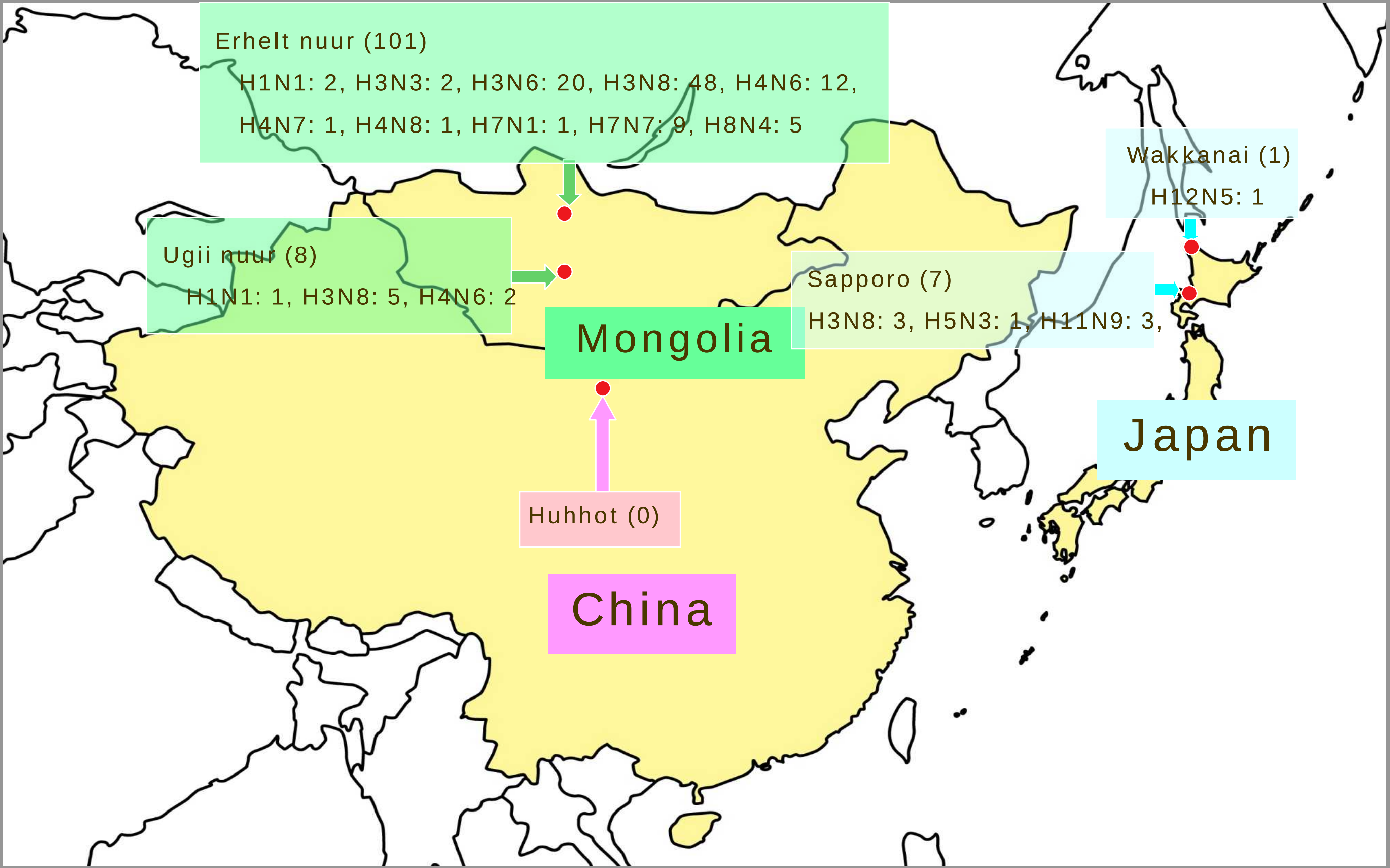




Mosquito



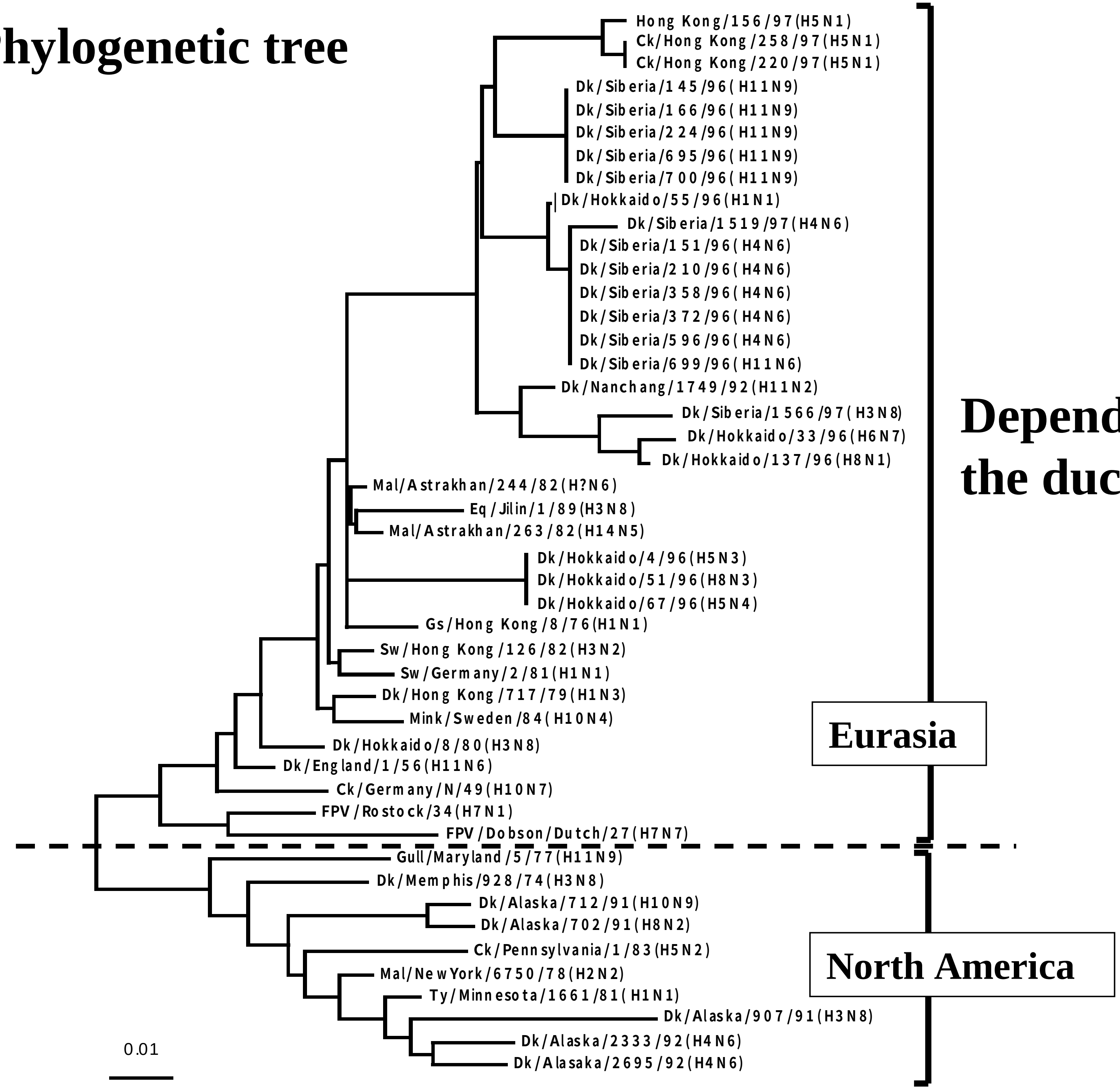
Kobyaysky(820)
40 Ilands(1321)
H4N6
H4N9
H11N1
H11N6
H11N9
Kenkeme(32)
Magadan(295)
Kharyyalah(146)
Buotama(51)
White Lake(1136)
H3N8
Yakutsk(232)
Irkutsk(290)
H3N8
H13N6
Elavga(66)
Ptropavlovsk-
Kamchatsky(58)
Khabarovsk(23)
Lake Kanicheva(95)
Malyshevo(90)
Wakkanai (958)
H1N1
H3N8
H5N3
H5N4
H6N2
H6N7
H8N1
H8N3
H9N2
H11N9
1996
1997
1998
1999
Taiwan
H1N1
H4N5
H4N6
H7N7


Nesting area for some species of birds
Stopover for some migratory birds

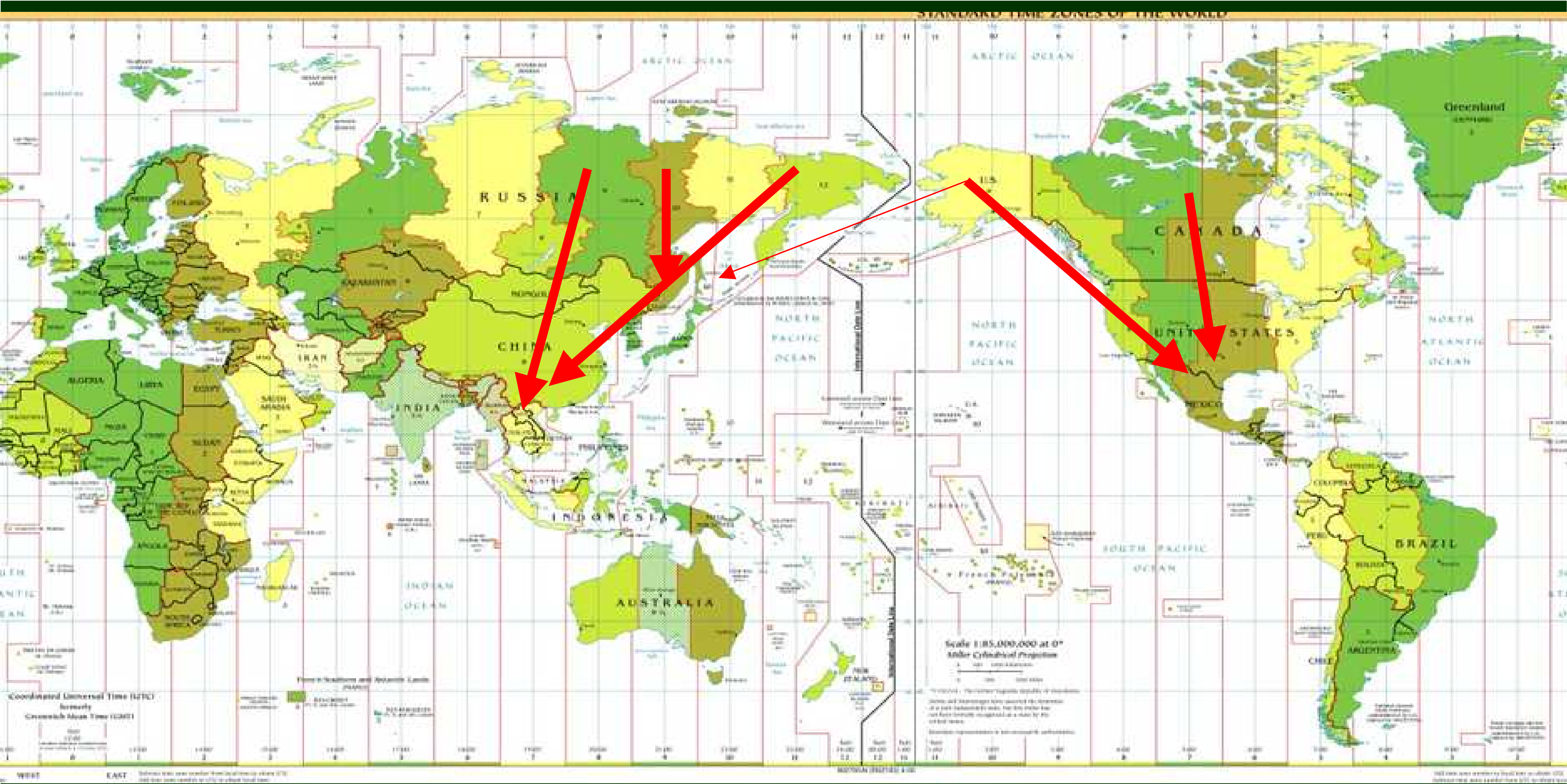


Isolation of influenza virus in 2002 (117 isolates)

Phylogenetic tree



Depending on the flyway of the duck



Global warming may affect the route of migration, and may change the ecology of influenza viruses.

H5N1 influenza virus

A highly pathogenic avian influenza virus

Outbreaks of highly pathogenic avian influenza

Country	Year	Subtype	Species of birds
Italy	1902	H7N7	Chicken
Japan	1924-5	H7N7	Chicken
Netherlands	1927	H7N1	?
Germany	1934	H7N1	?
Egypt	1945	H7N3	?
England	1959	H5N1	Chicken
South Africa	1961	H5N3	Tern
England	1963	H7N3	Turkey
Canada	1966	H5N9	Turkey
Australia	1975-6	H7N7	Chicken
Germany	1979	H7N7	Goose
USA	1983	H5N2	Chicken
Australia	1985	H7N7	Chicken
Ireland	1985	H5N8	Turkey
England	1991	H5N1	Turkey
Australia	1992	H7N3	Chicken
Australia	1994	H7N3	Chicken
Pakistan	1996	H7N2	Chicken
Mexico	1994-5	H5N2	Chicken
Pakistan	1996	H7N3	Chicken
Italy	1997	H5N2	Chicken
Australia	1997	H7N4	Chicken
Hong Kong	1997	H5N1	Chicken
Hong Kong	2003	H5N1	Chicken
Netherlands	2003	H7N7	Chicken
Eurasia	2003-	H5N1	Chicken

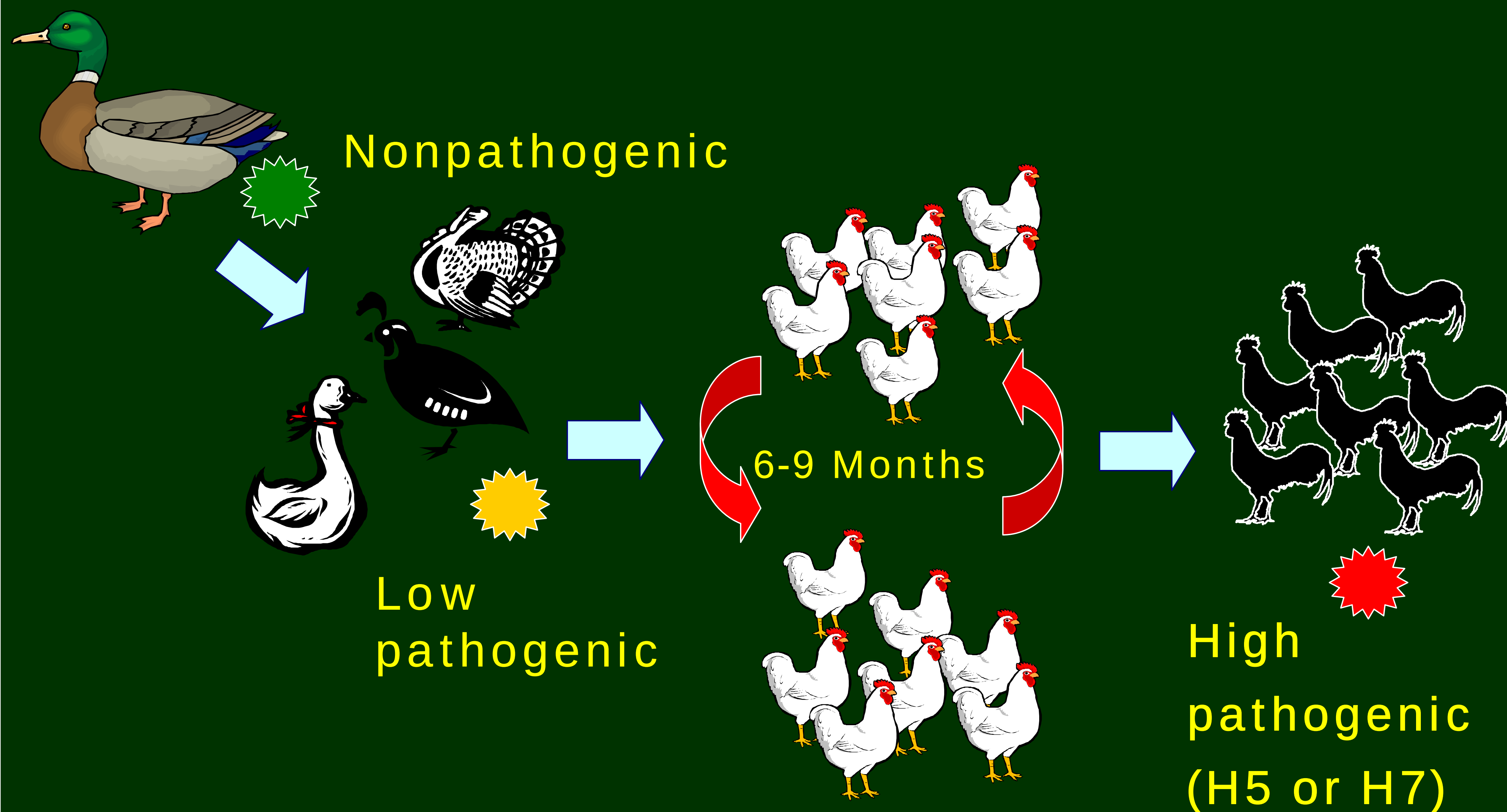
Only H5 and H7 HA subtypes

No report of human disease

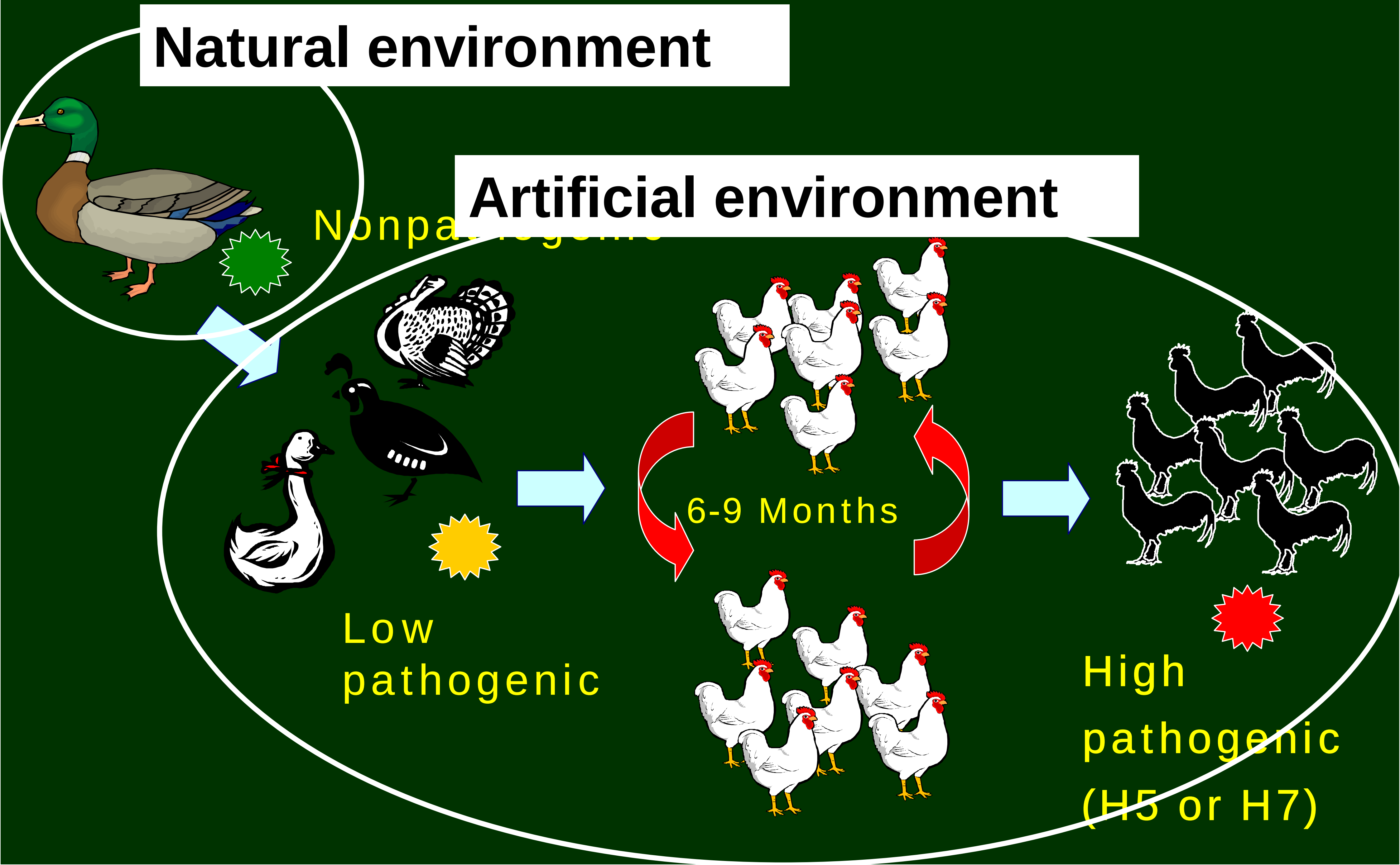
Wild aquatic birds

Natural host（reservoir）
No disease
Nonpathogenic
H1-16、N1-9

Emergence of HPAI virus



Emergence of HPAI virus



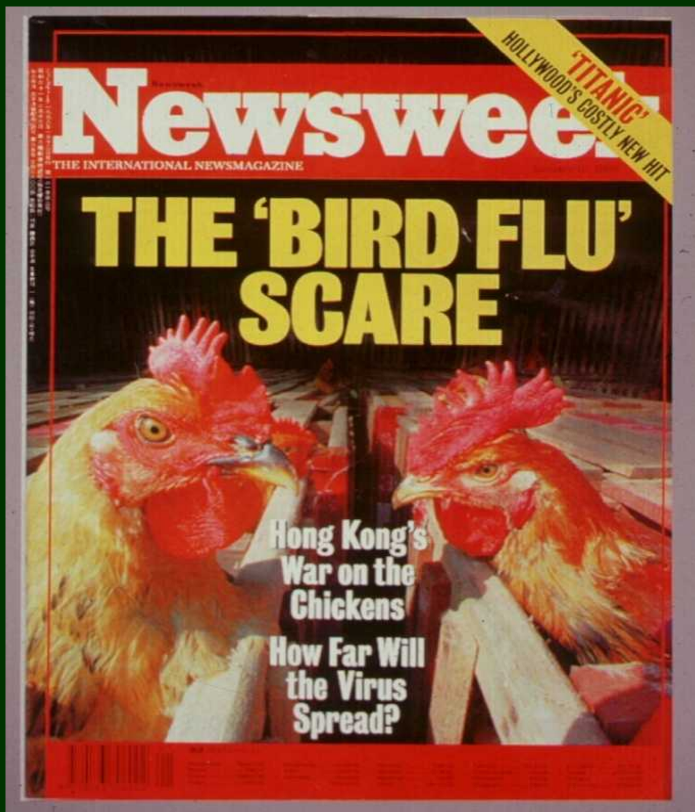
Transmission of HPAI to humans

1997

H5N1 incident in Hong Kong

18 infected, 6 died

The H5N1 incident in 1997

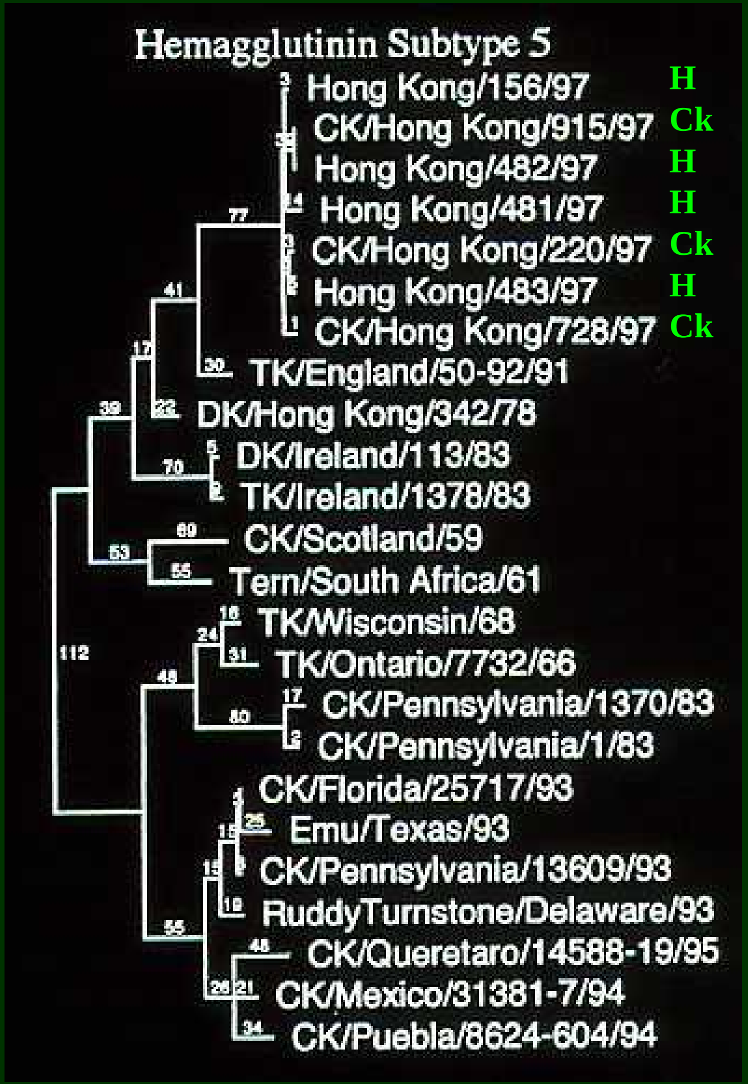


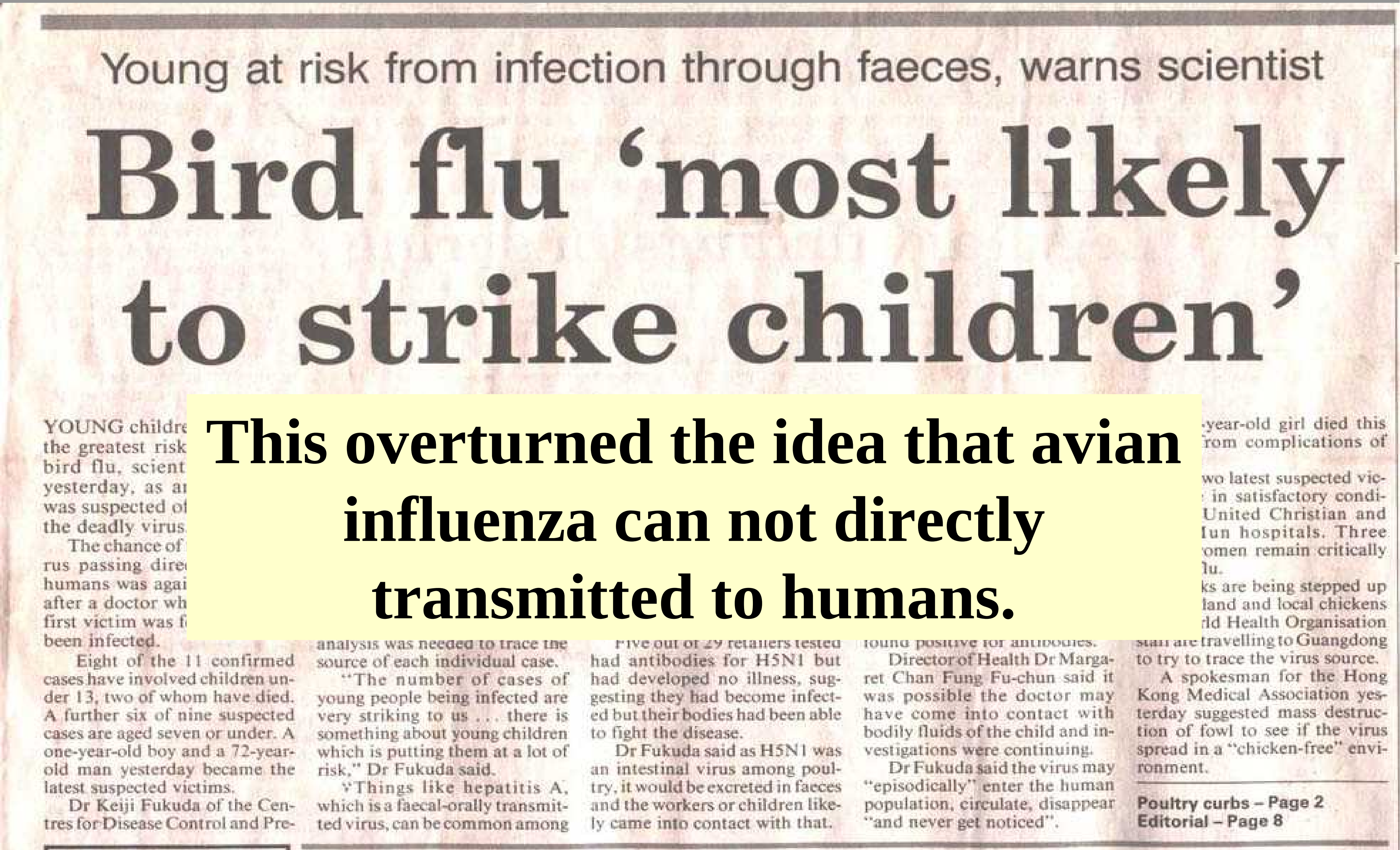
- Outbreaks of avian flu in chicken farms in Hong Kong in March / April 1997
- May 1997: Child with flu like illness
- Died of complications
- Virus was H5N1

The H5N1 incident in 1997

- Human H5N1 viruses were genetically identical to the virus causing disease in the chicken farms

Subbarao et al 1998
Claas et al 1998





Young at risk from infection through faeces, warns scientist

Bird flu 'most likely to strike children'

YOUNG childre
the greatest risk
bird flu, scient
yesterday, as a
was suspected o
the deadly virus.

The chance of
rus passing dire
humans was agai
after a doctor wh
first victim was f
been infected.

Eight of the 11 confirmed cases have involved children under 13, two of whom have died. A further six of nine suspected cases are aged seven or under. A one-year-old boy and a 72-year-old man yesterday became the latest suspected victims.

Dr Keiji Fukuda of the Centres for Disease Control and Pre-

analysis was needed to trace the source of each individual case.

"The number of cases of young people being infected are very striking to us . . . there is something about young children which is putting them at a lot of risk," Dr Fukuda said.

"Things like hepatitis A, which is a faecal-orally transmitted virus, can be common among

Five out of 29 retailers tested had antibodies for H5N1 but had developed no illness, suggesting they had become infected but their bodies had been able to fight the disease.

Dr Fukuda said as H5N1 was an intestinal virus among poultry, it would be excreted in faeces and the workers or children likely came into contact with that.

found positive for antibodies.

Director of Health Dr Margaret Chan Fung Fu-chun said it was possible the doctor may have come into contact with bodily fluids of the child and investigations were continuing.

Dr Fukuda said the virus may "episodically" enter the human population, circulate, disappear "and never get noticed".

-year-old girl died this
from complications of

wo latest suspected vic-
in satisfactory condi-
United Christian and
lun hospitals. Three
omen remain critically
lu.

ks are being stepped up
land and local chickens
rld Health Organisation
staff are travelling to Guangdong to try to trace the virus source.

A spokesman for the Hong Kong Medical Association yesterday suggested mass destruction of fowl to see if the virus spread in a "chicken-free" environment.

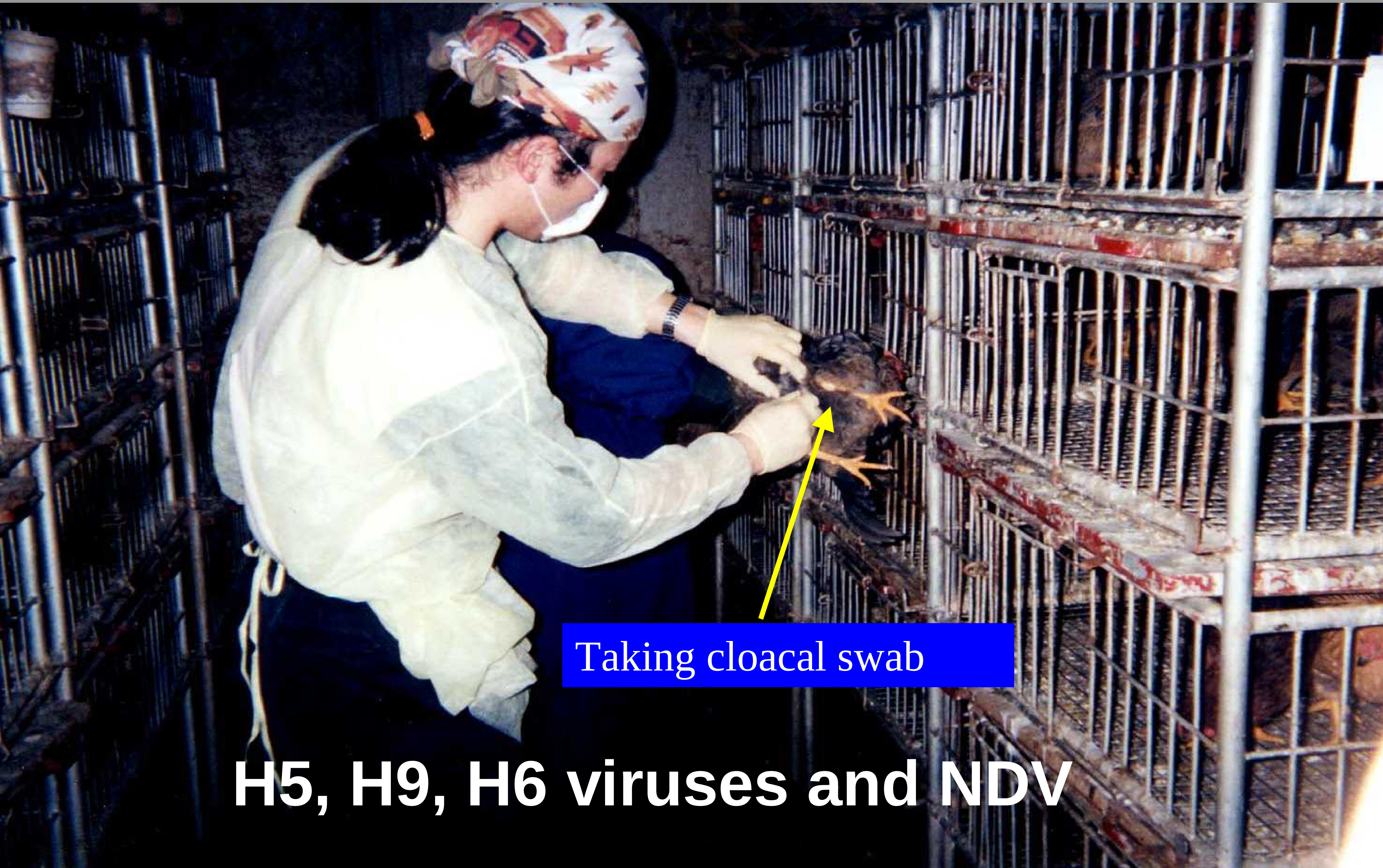
Poultry curbs – Page 2
Editorial – Page 8

This overturned the idea that avian influenza can not directly transmitted to humans.

Where did H5N1 virus come from?

Beginning of AI surveillance in live poultry market in Hong Kong

Sampling from any species of birds


Taking cloacal swab
H5, H9, H6 viruses and NDV

HABIBIE NO. 2? ◆ CHINA'S DOPED SWIMMERS

ASIAWEEK

JANUARY 30, 1998

THE FLU FIGHTERS

On the Frontlines in a World War Against the Bird Virus

AUSTRALIA	A$5.50	CHINA	RMB35.00	INDIA	Rs55	LAOS	US$3.50	NEPAL	Rs70	PORTUGAL	PTE1,200.00 CONT	THAILAND	B95
BANGLADESH	Taka70	DENMARK	DKR27.00	INDONESIA	Rp4,400(inc PPN)	MACAU	HK$35.00	NEW ZEALAND	NZ$7.95	SAUDI ARABIA	SR17	U.K.	£2.95
BHUTAN	NU37	FRANCE	Fr29	ITALY	LIRA10,000	MALAYSIA	RM7.00	NORWAY	NKR42.00	SINGAPORE	S$6.25	U.S.A.	US$5.50
BRUNEI	B$6.25	GERMANY	DM8.50	JAPAN	¥750 (¥714)	MALDIVES	Rf35.00	PAKISTAN	Rs55	SRI LANKA	Rs75	U.A.E.	H.D.13.00
CAMBODIA	US$3.50	GUAM	US$5.50	KOREA	Won3,300	MONGOLIA	US$5.00	PAPUA N.G.	K4.50	SWEDEN	SKR57.00	VIETNAM	US$3.50
CANADA	C$6.00	HONG KONG	HK$35.00	KUWAIT	K.D.1.10	MYANMAR	US$3.50	PHILIPPINES	P65.00	TAIWAN	NT$120	REST OF THE WORLD	US$5.50

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South China Morning Post

General: 2565 2222 News: 2565 2252 Classified: 2565 8822 Subscriptions: 2680 8882 Web Site: http://www.scmp.com

南華早報 Hong Kong Monday December 29 1997 Vol.LIII No. 360 ★★ Price $7.0

Virus fears spark massive 24-hour operation to kill all local chickens

1.2m birds to be slaughtered

STAFF REPORTERS

All Hong Kong's estimated 1.2 million chickens are to be slaughtered in a radical attempt to rid the SAR of the deadly bird flu virus that has killed four people.

Poultry in retail markets – including geese and ducks kept near chickens – will also be destroyed in the massive 24-hour operation beginning today.

Government officials announced the move, sanctioned by Chief Executive Tung Chee-hwa, after a New Territories farm and part of a Kowloon wholesale market were found to be infected with the killer H5N1 virus.

"The Government has decided, in public health interests, to kill birds in local farms," said Director of Health Margaret Chan.

Compensation for farmers may top $40 million and 2,200 government workers will be needed to arrange the slaughter.

Teams of five Agriculture and Fisheries Department staff will visit each of Hong Kong's 160 chicken and 39 mixed poultry farms. They will place groups of birds into plastic containers and then gas them to death with carbon dioxide.

The Environmental Protection Department expects to deal with about 6,500 cubic metres of waste generated by the blitz.

Officials will make a count at each location to help with compensation assessments.

Farmers can expect up to $30 for each bird if provisional legislators approve a finance package outlined by the Government during their sitting on January 9.

Farmers supported the slaughter but called for the rapid payment of compensation claims.

With wholesale prices having fallen from $12 to $2 per catty in recent weeks, a Hong Kong Chicken Farmers' Association spokesman said: "We support any move to restore public confidence. But the Government has to give us compensation quickly so that we can start our business again."

The mass slaughter was a "short-term measure", according to Mr Ip, and another cleaning operation of markets and stalls would follow.

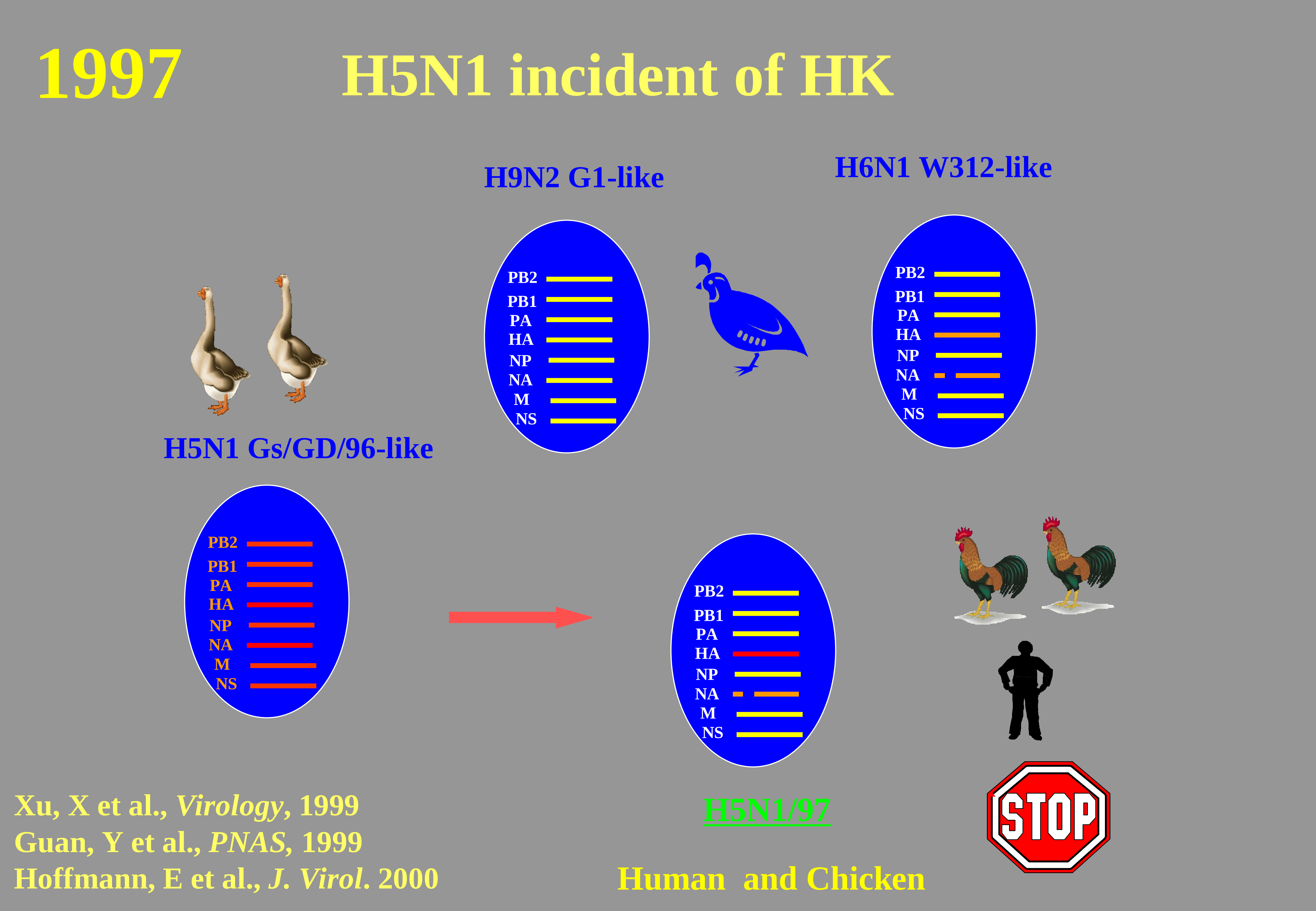
Another factor behind the decision to kill all poultry was the "huge number" of chickens imported before the winter solstice festival, said Agriculture and Fisheries Department assistant

No human case after slaughtering in Hong Kong

The source of human infection was infected poultry

• ~ 20% of chicken in live poultry markets had H5N1 virus -
Shortridge et al 1999

• patients with H5N1 disease had contact with live poultry markets –
Mounts et al 1999


1997
H5N1 incident of HK
H9N2 G1-like
PB2
PB1
PA
HA
NP
NA
M
NS
H6N1 W312-like
PB2
PB1
PA
HA
NP
NA
M
NS
H5N1 Gs/GD/96-like
PB2
PB1
PA
HA
NP
NA
M
NS
PB2
PB1
PA
HA
NP
NA
M
NS
H5N1/97
Human and Chicken
STOP
Xu, X et al., *Virology*, 1999
Guan, Y et al., *PNAS*, 1999
Hoffmann, E et al., *J. Virol*. 2000

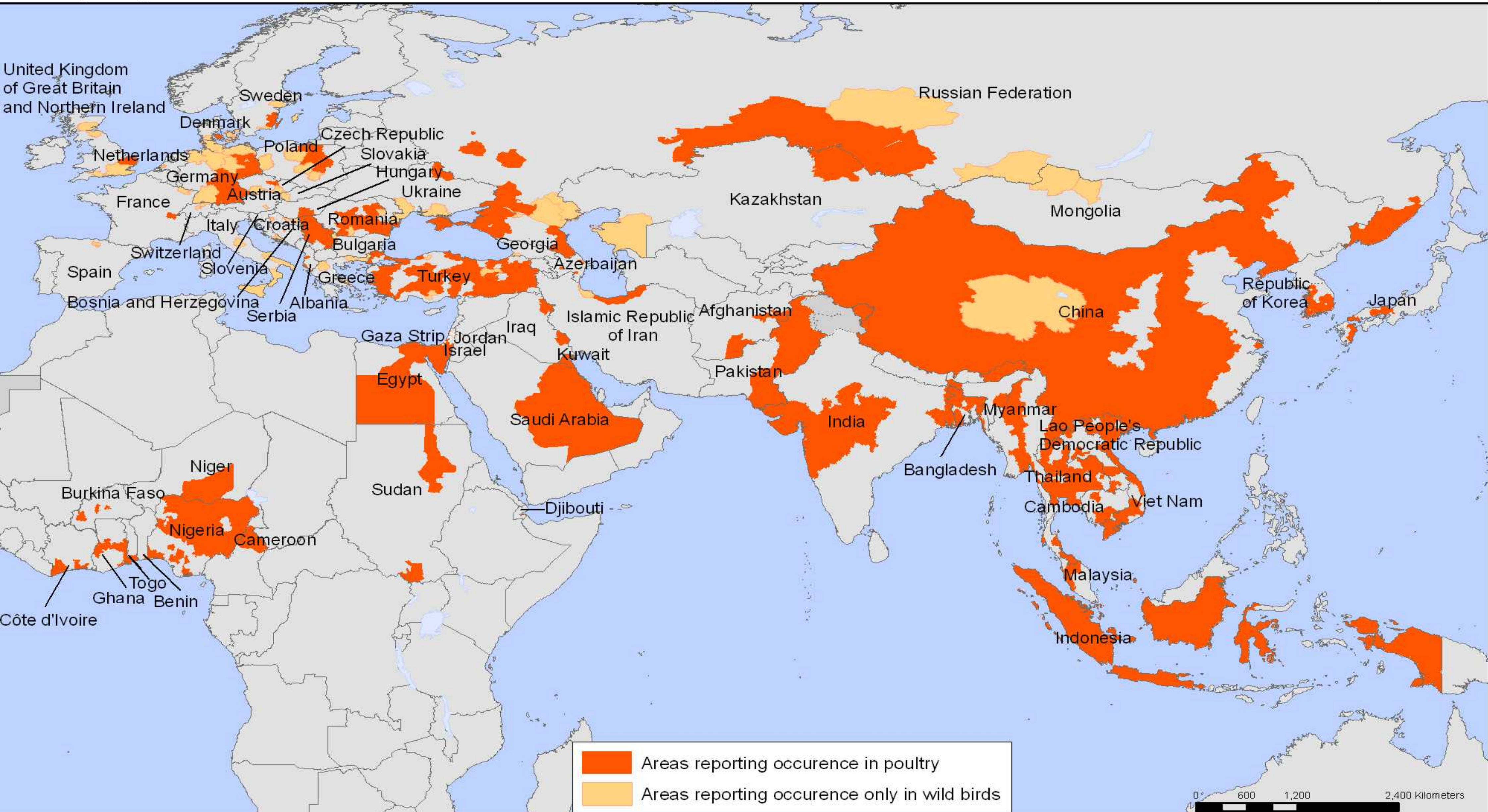
Outbreaks of highly pathogenic avian influenza

Country	Year	Subtype	Species of birds
Italy	1902	H7N7	Chicken
Japan	1924-5	H7N7	Chicken
Netherlands	1927	H7N1	?
Germany	1934	H7N1	?
Egypt	1945	H7N3	?
England	1959	H5N1	Chicken
South Africa	1961	H5N3	Tern
England	1963	H7N3	Turkey
Canada	1966	H5N9	Turkey
Australia	1975-6	H7N7	Chicken
Germany	1979	H7N7	Goose
USA	1983	H5N2	Chicken
Australia	1985	H7N7	Chicken
Ireland	1985	H5N8	Turkey
England	1991	H5N1	Turkey
Australia	1992	H7N3	Chicken
Australia	1994	H7N3	Chicken
Pakistan	1996	H7N2	Chicken
Mexico	1994-5	H5N2	Chicken
Pakistan	1996	H7N3	Chicken
Italy	1997	H5N2	Chicken
Australia	1997	H7N4	Chicken
Hong Kong	1997	H5N1	Chicken

} Humans, cats, tigers, wild birds

Areas reporting confirmed occurrence of H5N1 avian influenza in poultry and wild birds since 2003

Status as of 14 April 2008
Latest available update



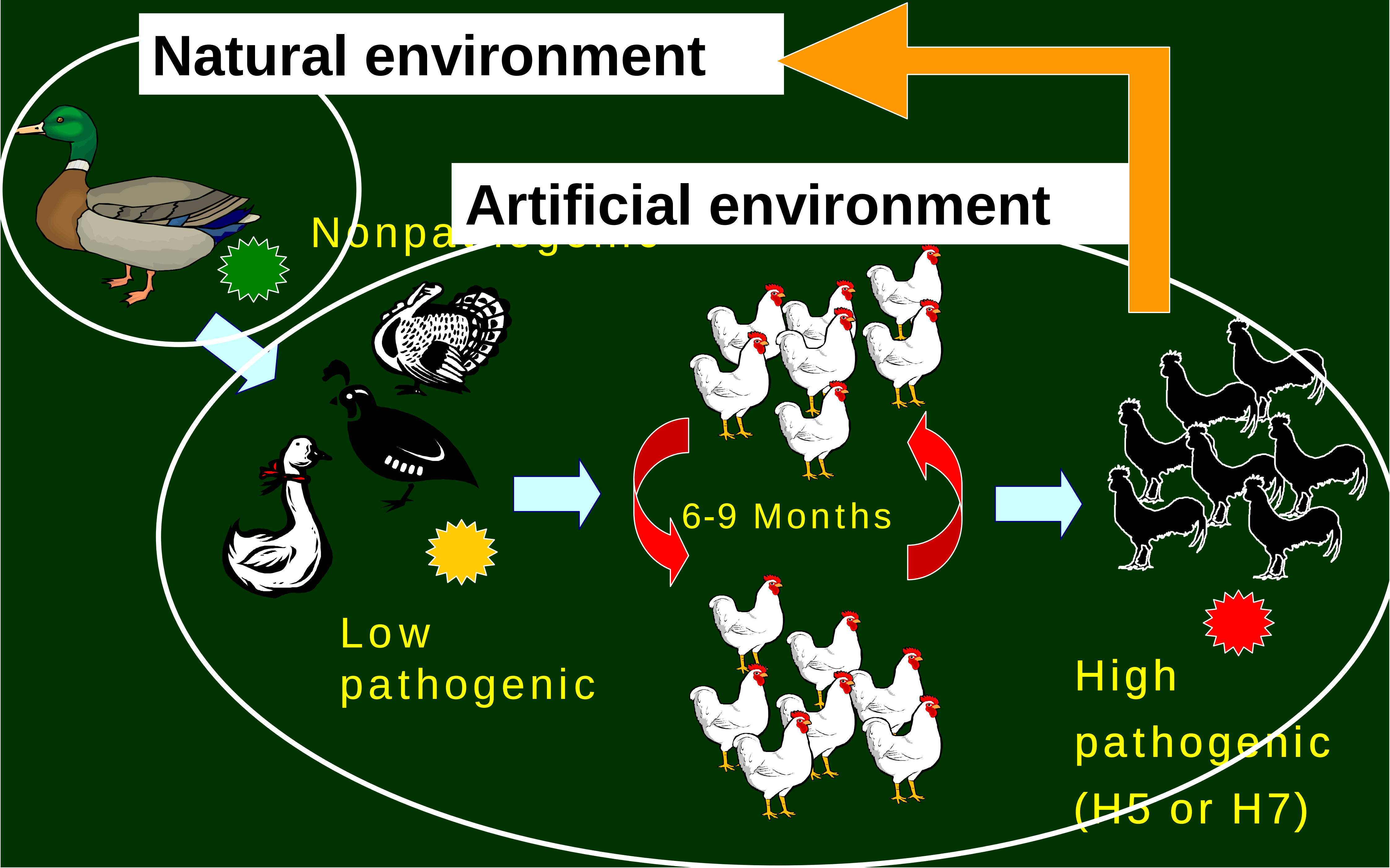
World Health Organization

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Organisation for Animal Health (OIE) and national governments
Map Production: Public Health Mapping and GIS
World Health Organization

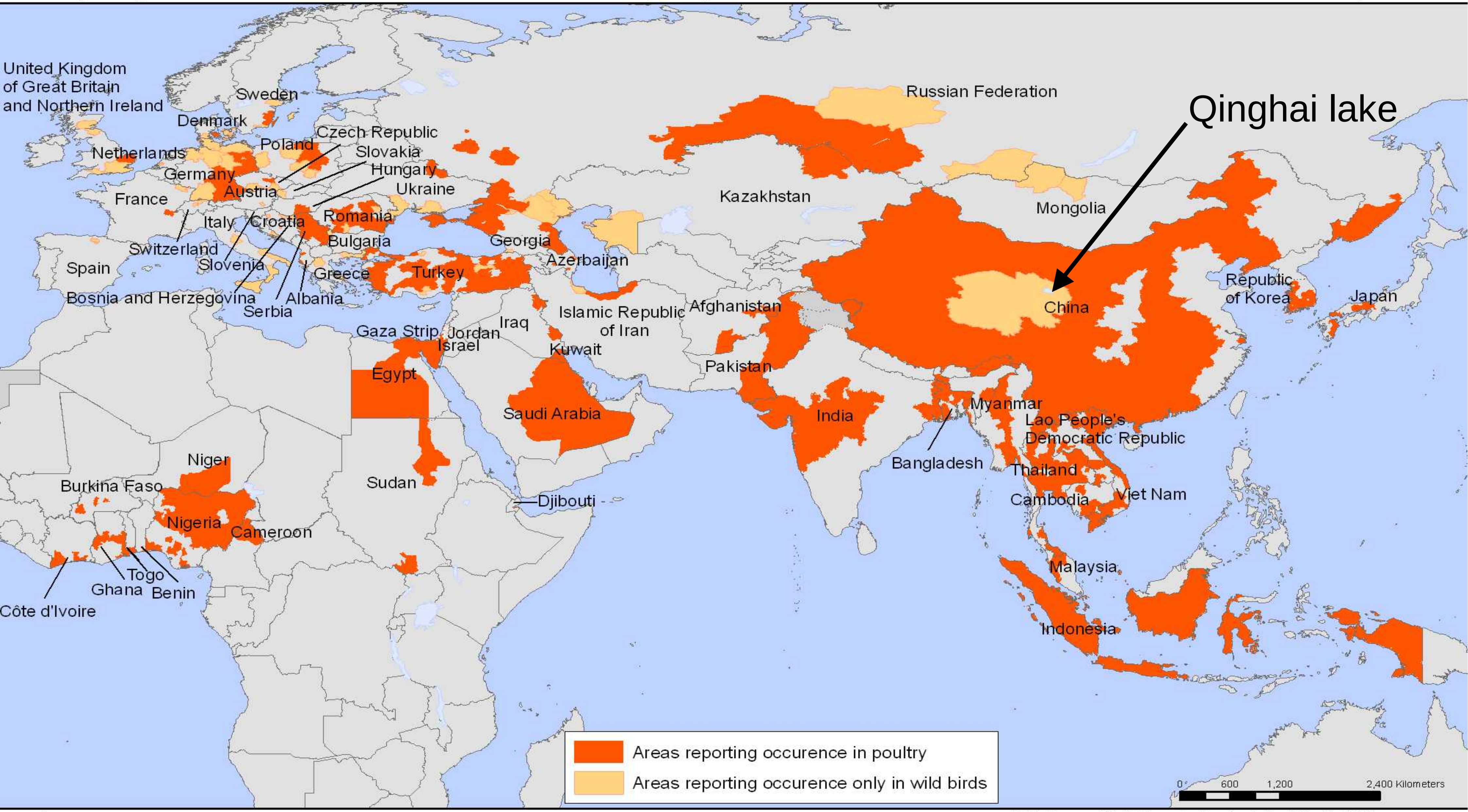
The Spread of H5N1 to wild aquatic bird

Emergence of HPAI virus



Areas reporting confirmed occurrence of H5N1 avian influenza in poultry and wild birds since 2003

Status as of 14 April 2008
Latest available update



World Health Organization

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World Health Organization

Areas reporting confirmed occurrence of H5N1 avian influenza in poultry and wild birds since 2003

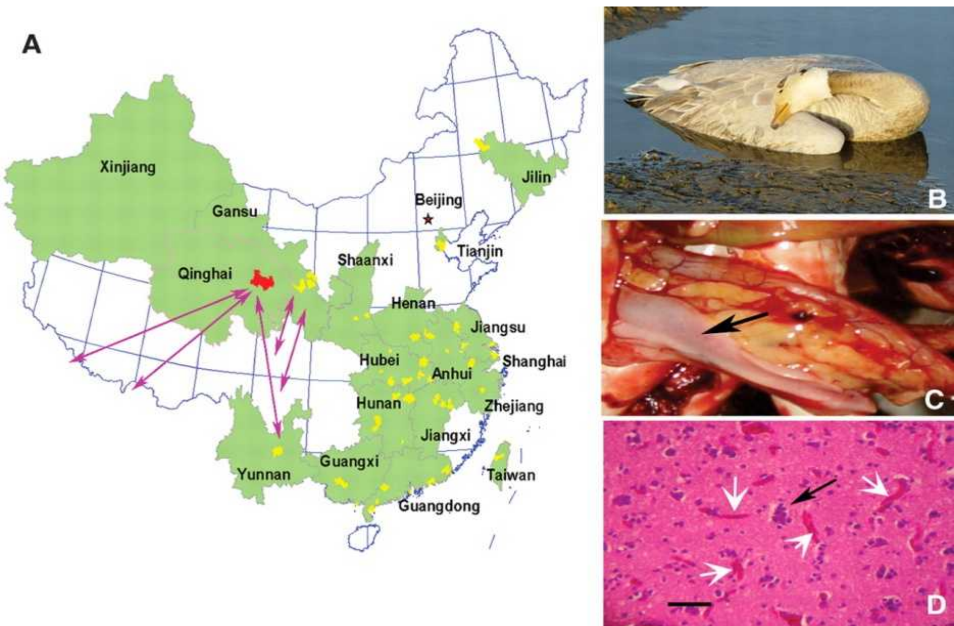
Status as of 14 April 2008
Latest available update

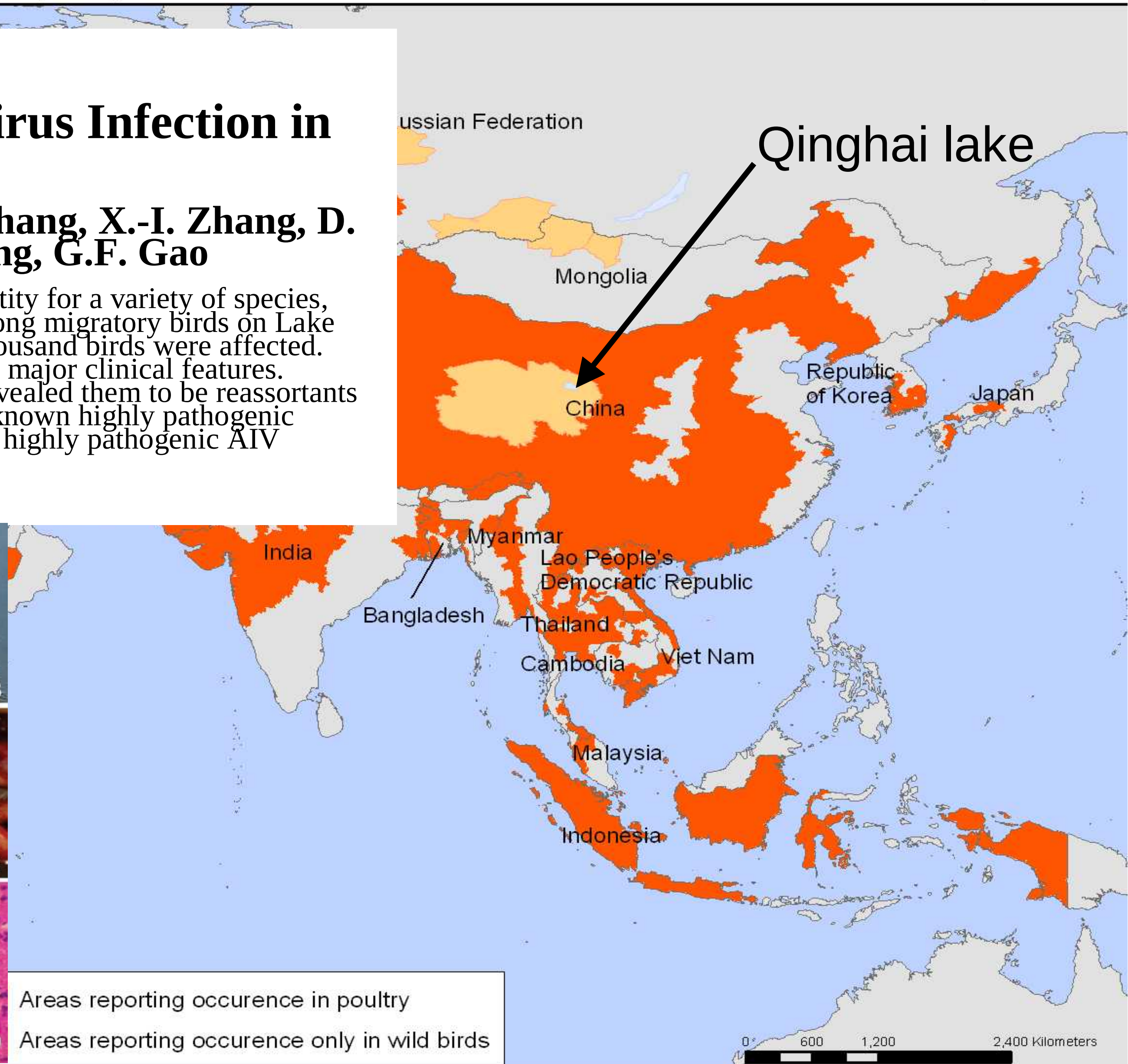
Science 309, 1206 (19 August 2005)

Highly Pathogenic H5N1 Influenza Virus Infection in Migratory Birds

J. Liu, H. Xiao, F. Lei, Q. Zhu, K. Qin, X.-w. Zhang, X.-I. Zhang, D. Zhao, G. Wang, Y. Feng, J. Ma, W. Liu, J. Wang, G.F. Gao

H5N1 avian influenza virus (AIV) has emerged as a pathogenic entity for a variety of species, including humans, in recent years. Here we report an outbreak among migratory birds on Lake Qinghaihu, China, in May and June 2005, in which more than a thousand birds were affected. Pancreatic necrosis and abnormal neurological symptoms were the major clinical features. Sequencing of the complete genomes of four H5N1 AIV strains revealed them to be reassortants related to a peregrine falcon isolate from Hong Kong and to have known highly pathogenic characteristics. Experimental animal infections reproduced typical highly pathogenic AIV infection symptoms and pathology.





World Health Organization

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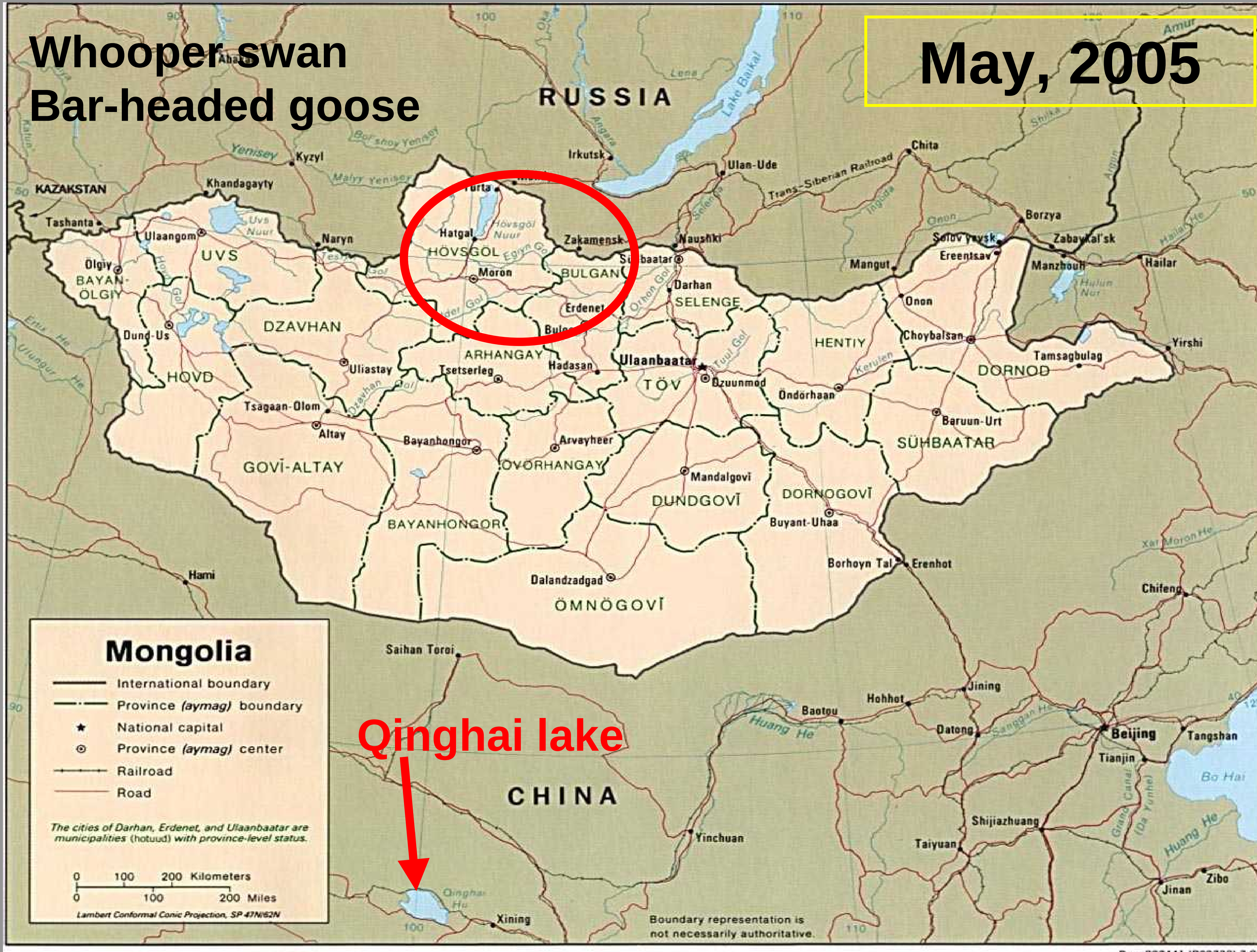
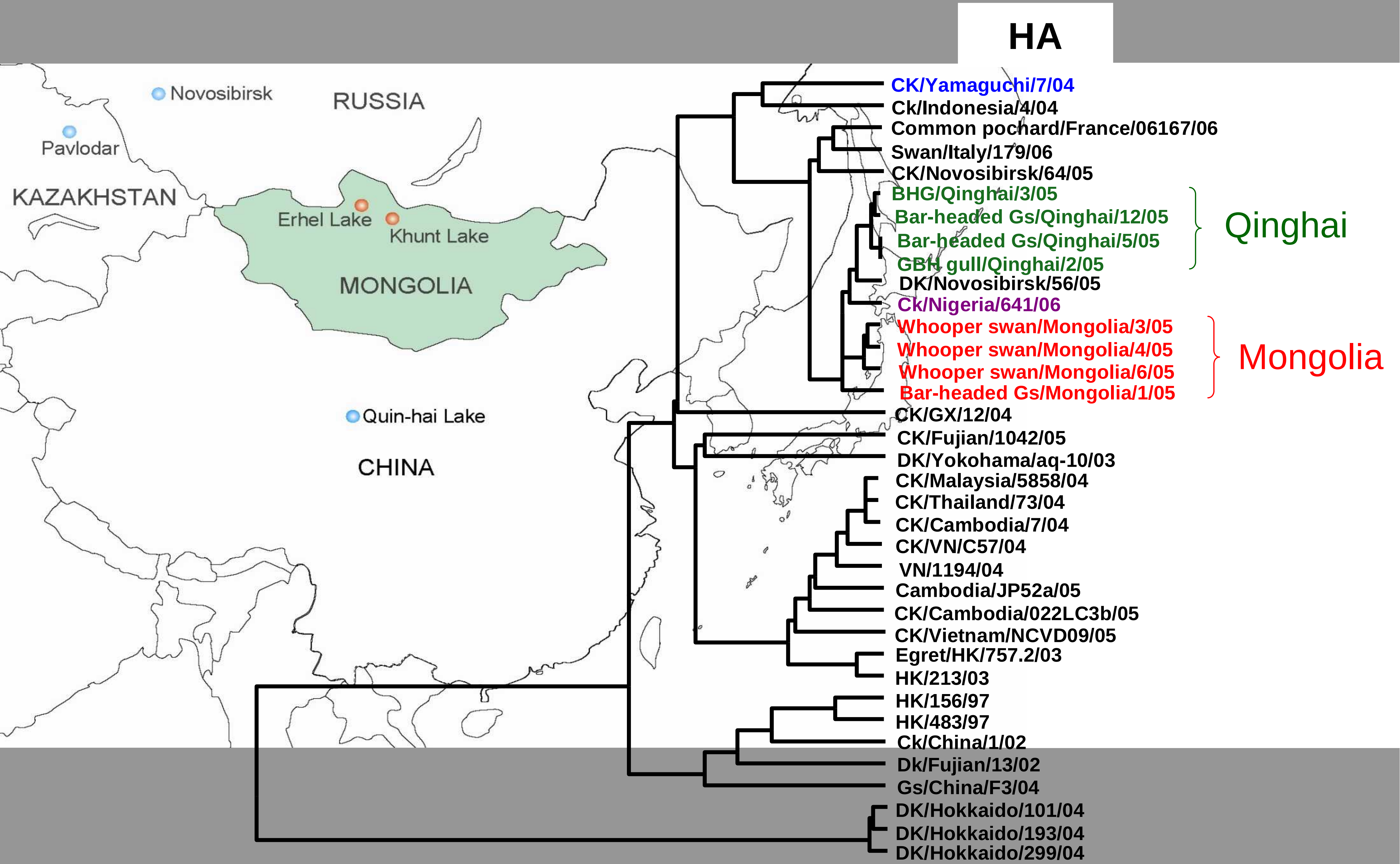
Map Production: Public Health Mapping and GIS
World Health Organization


Whooper swan
Bar-headed goose
May, 2005
Qinghai lake
RUSSIA
CHINA
KAZAKSTAN
Mongolia
International boundary
Province (aymag) boundary
National capital
Province (aymag) center
Railroad
Road
The cities of Darhan, Erdenet, and Ulaanbaatar are municipalities (hotuud) with province-level status.
0 100 200 Kilometers
0 100 200 Miles
Lambert Conformal Conic Projection, SP 47N/62N
Boundary representation is not necessarily authoritative.
Base 802441 (B00730) 3-96
HÖVSGÖL
Hatgal
Hövsgöl Nuur
Mörön
BULGAN
SELENGE
Darhan
Erdenet
UVS
Ulaangom
BAYAN-ÖLGIY
Ölgiy
DZAVHAN
Uliastay
HOVD
Dund-Us
ARHANGAY
Tsetserleg
TÖV
Ulaanbaatar
Dzuunmod
HENTIY
Öndörhaan
DORNOD
Choybalsan
SÜHBAATAR
Baruun-Urt
GOVĬ-ALTAY
Altay
BAYANHONGOR
Bayanhongor
ÖVÖRHANGAY
Arvayheer
DUNDGOVĬ
Mandalgovĭ
DORNOGOVĬ
Buyant-Uhaa
ÖMNÖGOVĬ
Dalandzadgad
Irkutsk
Ulan-Ude
Chita
Lake Baikal
Trans-Siberian Railroad
Kyzyl
Beijing
Tianjin
Baotou
Hohhot
Datong
Yinchuan
Xining
Qinghai Hu
Taiyuan
Shijiazhuang
Jinan
Zibo
Tangshan
Bo Hai
Huang He
Hami
Erenhot
Chifeng

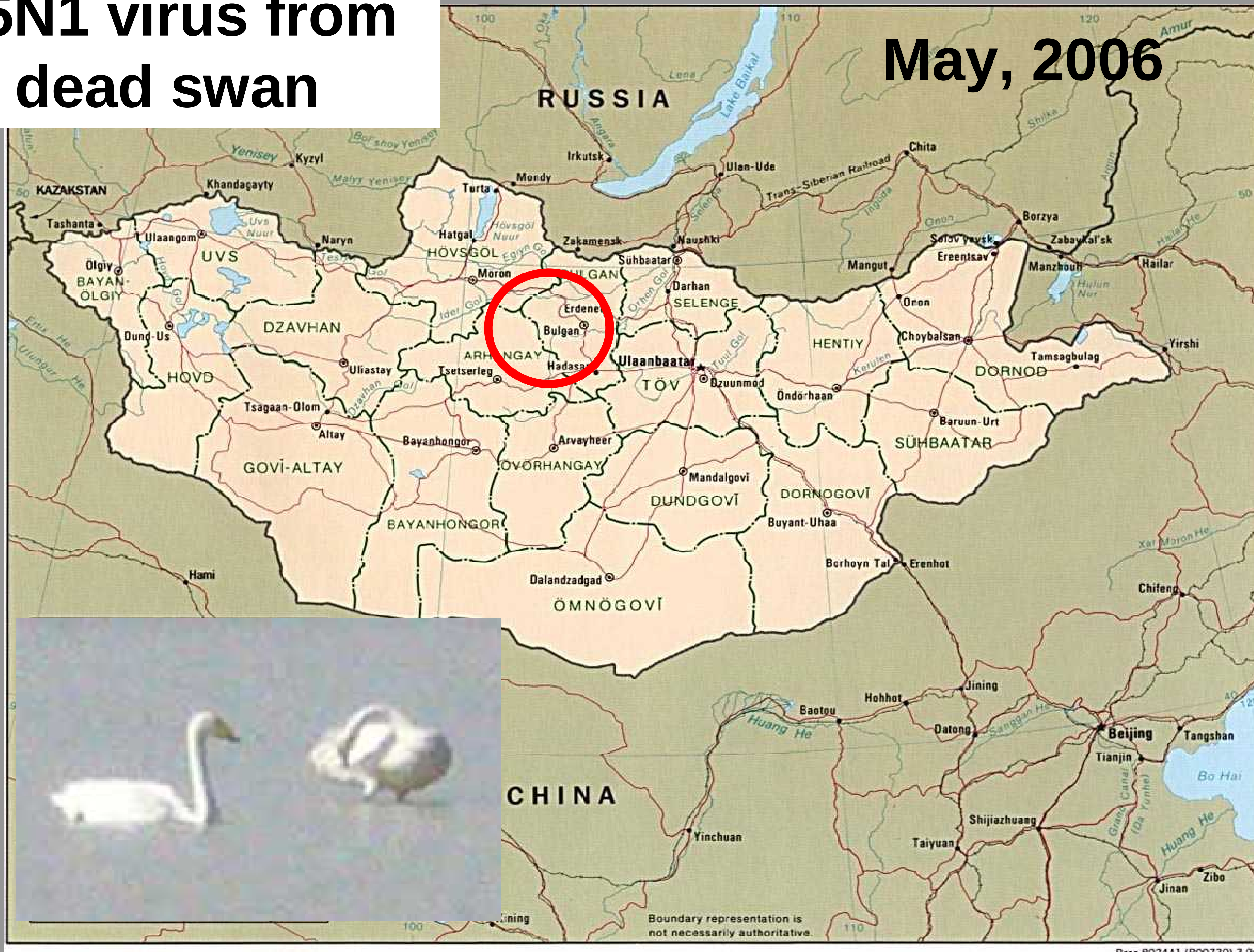
A：Bar-headed goose
B：Whooper swan

H5N1 virus was isolated


HA
Novosibirsk
RUSSIA
Pavlodar
KAZAKHSTAN
Erhel Lake
Khunt Lake
MONGOLIA
Quin-hai Lake
CHINA
CK/Yamaguchi/7/04
Ck/Indonesia/4/04
Common pochard/France/06167/06
Swan/Italy/179/06
CK/Novosibirsk/64/05
BHG/Qinghai/3/05
Bar-headed Gs/Qinghai/12/05
Bar-headed Gs/Qinghai/5/05
GBH gull/Qinghai/2/05
DK/Novosibirsk/56/05
Ck/Nigeria/641/06
Whooper swan/Mongolia/3/05
Whooper swan/Mongolia/4/05
Whooper swan/Mongolia/6/05
Bar-headed Gs/Mongolia/1/05
CK/GX/12/04
CK/Fujian/1042/05
DK/Yokohama/aq-10/03
CK/Malaysia/5858/04
CK/Thailand/73/04
CK/Cambodia/7/04
CK/VN/C57/04
VN/1194/04
Cambodia/JP52a/05
CK/Cambodia/022LC3b/05
CK/Vietnam/NCVD09/05
Egret/HK/757.2/03
HK/213/03
HK/156/97
HK/483/97
Ck/China/1/02
Dk/Fujian/13/02
Gs/China/F3/04
DK/Hokkaido/101/04
DK/Hokkaido/193/04
DK/Hokkaido/299/04
Qinghai
Mongolia

H5N1 virus from dead swan

May, 2006



H5N1 virus from dead crested grebe

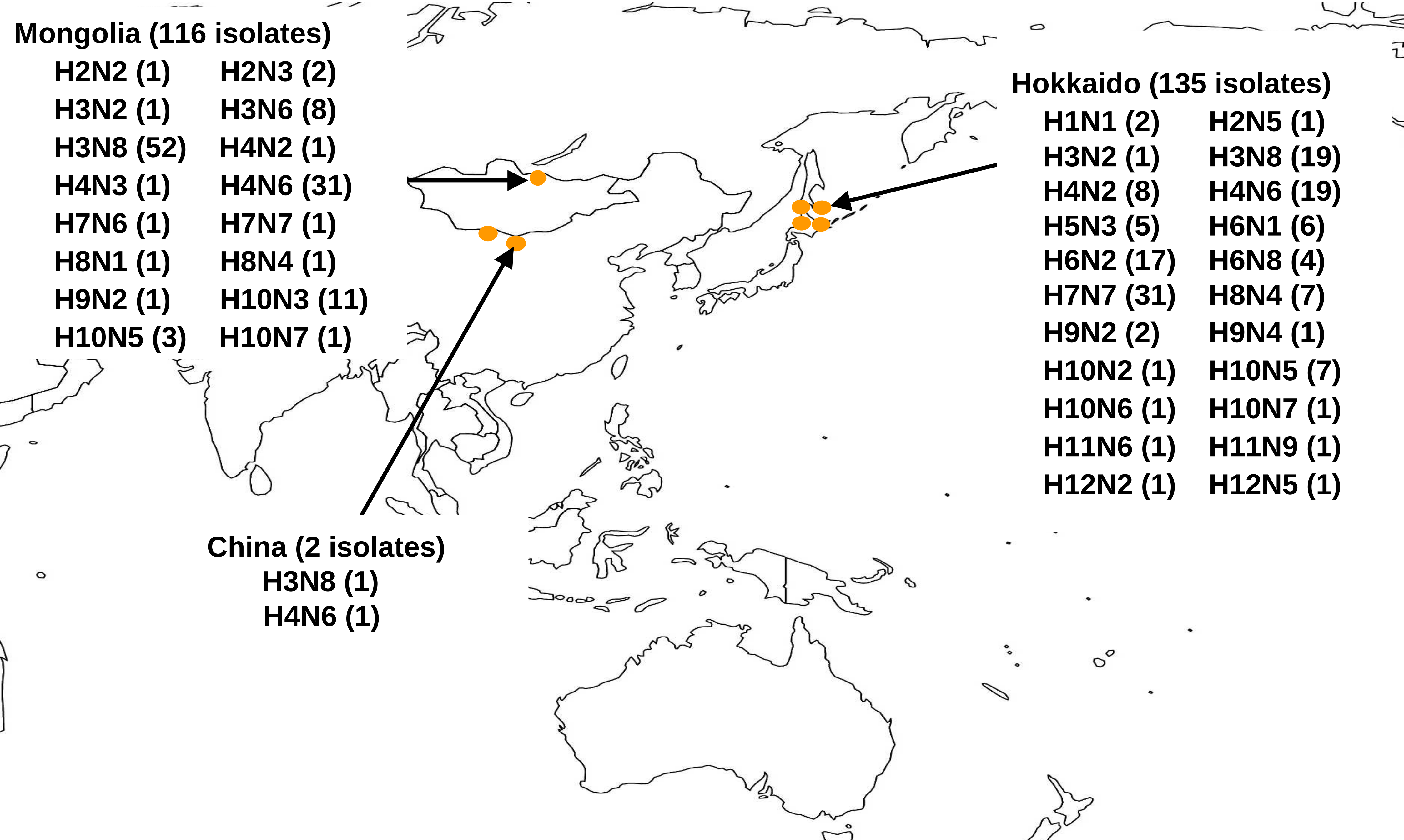
June, 2006

In May and June, birds are coming from China

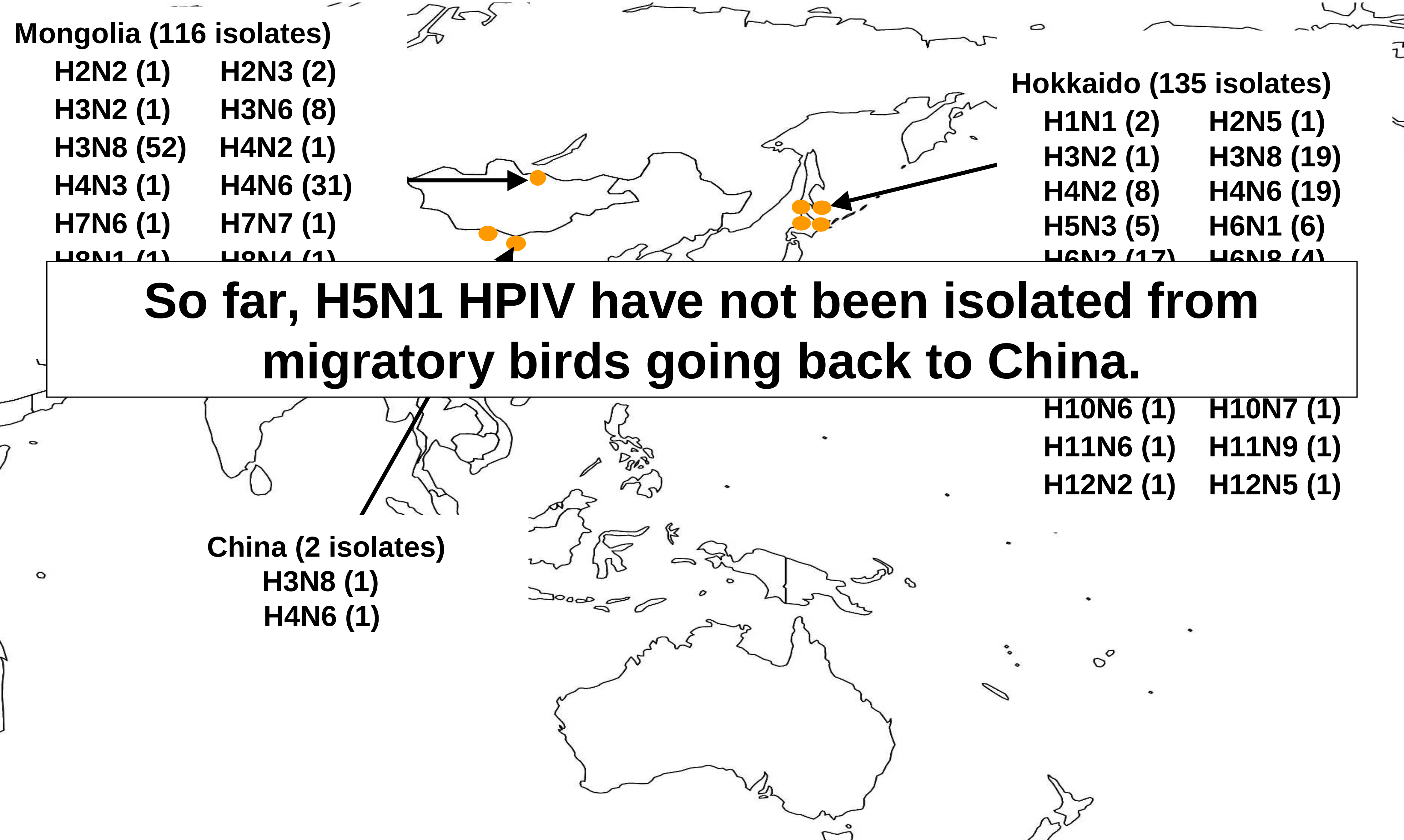
In August and September, birds are going to China


Mongolia, August,
2005 and 2006

Surveillance of avian influenza in migratory ducks in 2004-2007

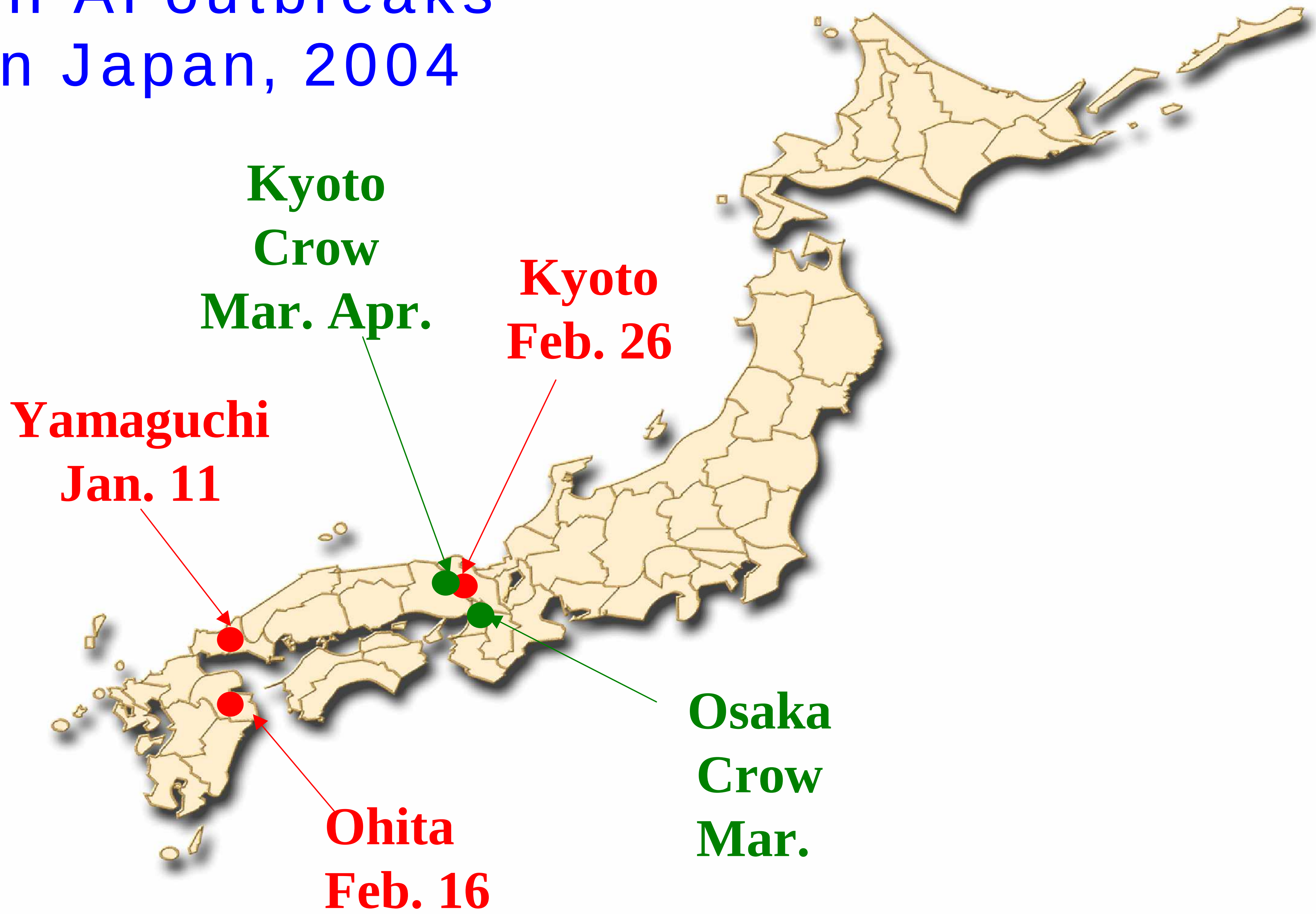


Surveillance of avian influenza in migratory ducks in 2004-2007



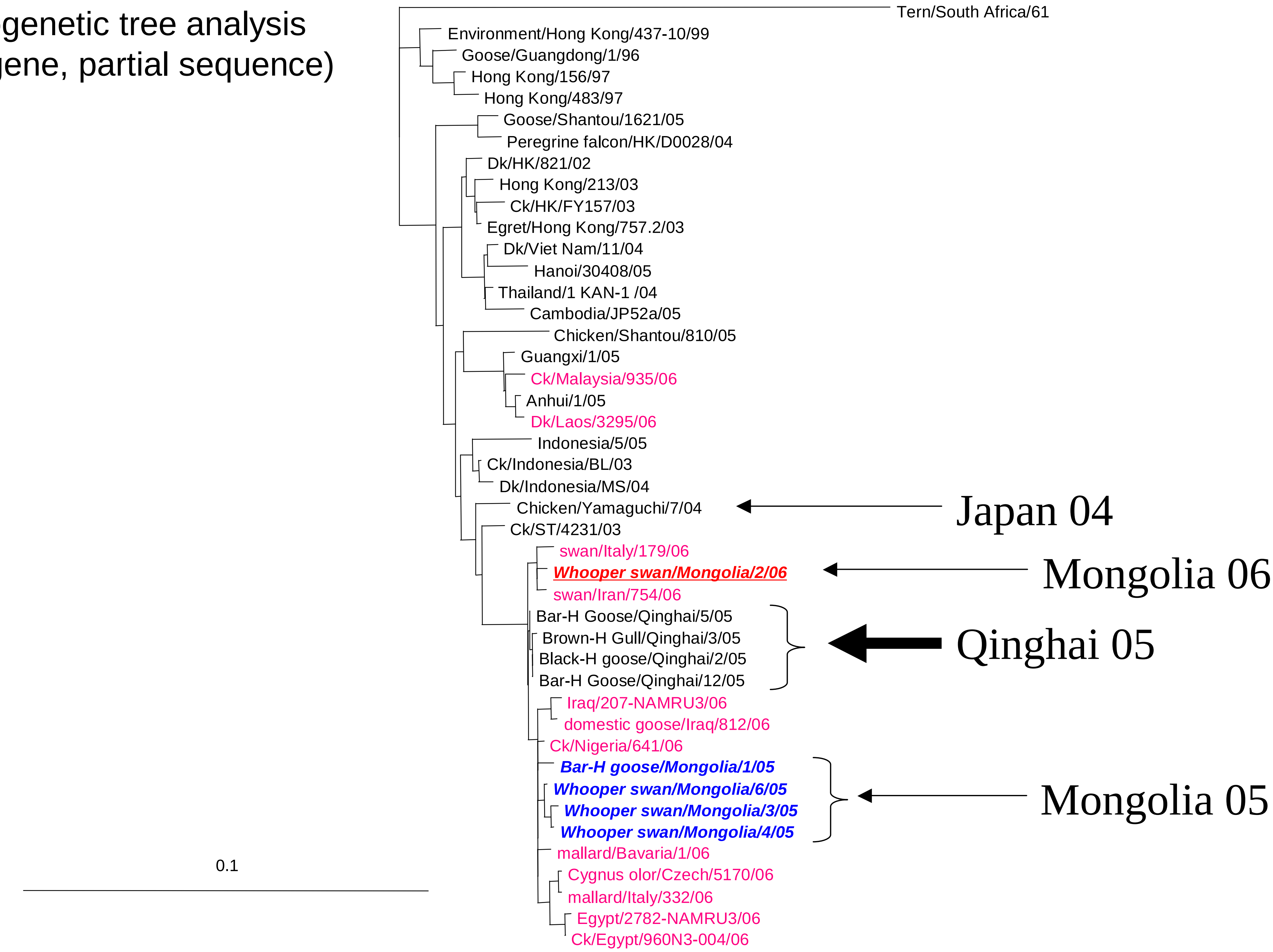
So far, H5N1 HPIV have not been isolated from migratory birds going back to China.

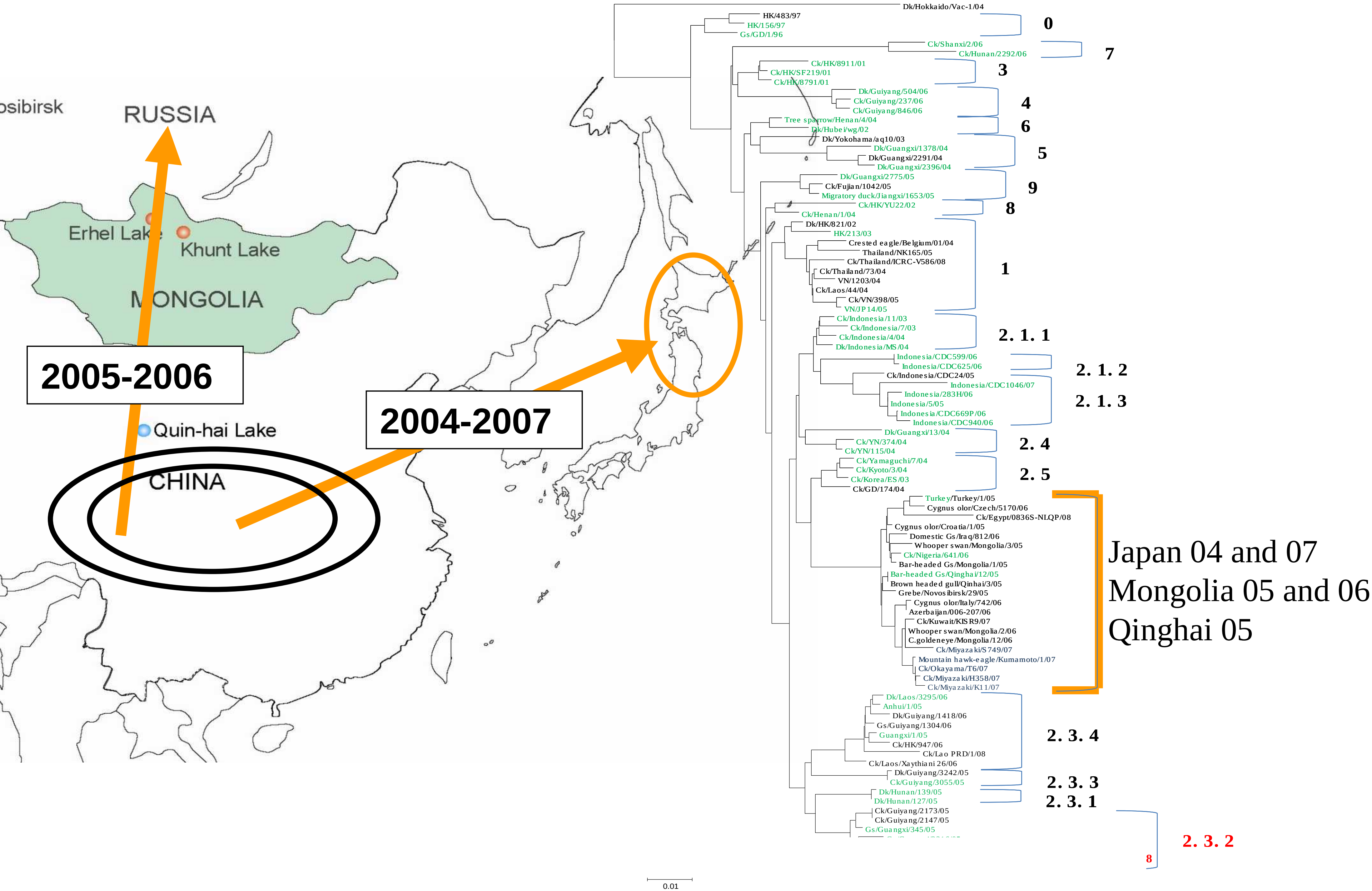
HPAI outbreaks in Japan, 2004



HPAI outbreaks in Japan, 2007

Phylogenetic tree analysis (HA gene, partial sequence)



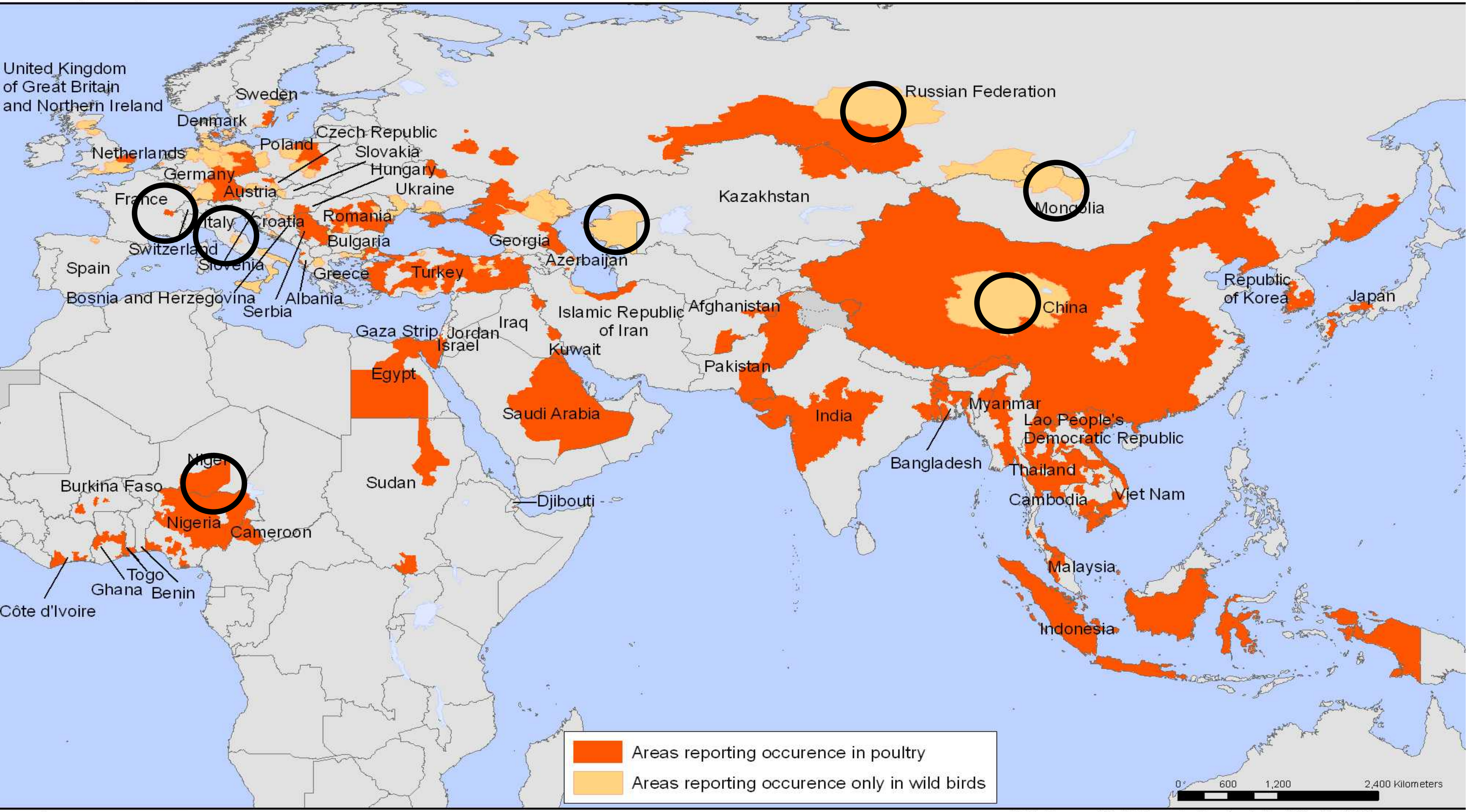


RUSSIA
osibirsk
Erhel Lake
Khunt Lake
MONGOLIA
2005-2006
2004-2007
Quin-hai Lake
CHINA
Dk/Hokkaido/Vac-1/04
HK/483/97
HK/156/97
Gs/GD/1/96
0
Ck/Shanxi/2/06
Ck/Hunan/2292/06
7
Ck/HK/8911/01
Ck/HK/SF219/01
Ck/HK/8791/01
3
Dk/Guiyang/504/06
Ck/Guiyang/237/06
Ck/Guiyang/846/06
4
Tree sparrow/Henan/4/04
Dk/Hubei/wg/02
6
Dk/Yokohama/aq10/03
Dk/Guangxi/1378/04
Dk/Guangxi/2291/04
Dk/Guangxi/2396/04
5
Dk/Guangxi/2775/05
Ck/Fujian/1042/05
Migratory duck/Jiangxi/1653/05
9
Ck/HK/YU22/02
8
Ck/Henan/1/04
Dk/HK/821/02
HK/213/03
Crested eagle/Belgium/01/04
Thailand/NK165/05
Ck/Thailand/ICRC-V586/08
Ck/Thailand/73/04
VN/1203/04
Ck/Laos/44/04
Ck/VN/398/05
VN/JP14/05
1
Ck/Indonesia/11/03
Ck/Indonesia/7/03
Ck/Indonesia/4/04
Dk/Indonesia/MS/04
2. 1. 1
Indonesia/CDC599/06
Indonesia/CDC625/06
Ck/Indonesia/CDC24/05
2. 1. 2
Indonesia/CDC1046/07
Indonesia/283H/06
Indonesia/5/05
Indonesia/CDC669P/06
Indonesia/CDC940/06
2. 1. 3
Dk/Guangxi/13/04
Ck/YN/374/04
Ck/YN/115/04
2. 4
Ck/Yamaguchi/7/04
Ck/Kyoto/3/04
Ck/Korea/ES/03
Ck/GD/174/04
2. 5
Turkey/Turkey/1/05
Cygnus olor/Czech/5170/06
Ck/Egypt/0836S-NLQP/08
Cygnus olor/Croatia/1/05
Domestic Gs/Iraq/812/06
Whooper swan/Mongolia/3/05
Ck/Nigeria/641/06
Bar-headed Gs/Mongolia/1/05
Bar-headed Gs/Qinghai/12/05
Brown headed gull/Qinhai/3/05
Grebe/Novosibirsk/29/05
Cygnus olor/Italy/742/06
Azerbaijan/006-207/06
Ck/Kuwait/KISR9/07
Whooper swan/Mongolia/2/06
C.goldeneye/Mongolia/12/06
Ck/Miyazaki/S749/07
Mountain hawk-eagle/Kumamoto/1/07
Ck/Okayama/T6/07
Ck/Miyazaki/H358/07
Ck/Miyazaki/K11/07
Japan 04 and 07
Mongolia 05 and 06
Qinghai 05
Dk/Laos/3295/06
Anhui/1/05
Dk/Guiyang/1418/06
Gs/Guiyang/1304/06
Guangxi/1/05
Ck/HK/947/06
Ck/Lao PRD/1/08
Ck/Laos/Xaythiani 26/06
2. 3. 4
Dk/Guiyang/3242/05
Ck/Guiyang/3055/05
2. 3. 3
Dk/Hunan/139/05
Dk/Hunan/127/05
2. 3. 1
Ck/Guiyang/2173/05
Ck/Guiyang/2147/05
Gs/Guangxi/345/05
2. 3. 2
8
0.01

HA

Areas reporting confirmed occurrence of H5N1 avian influenza in poultry and wild birds since 2003

Status as of 14 April 2008
Latest available update



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Map Production: Public Health Mapping and GIS
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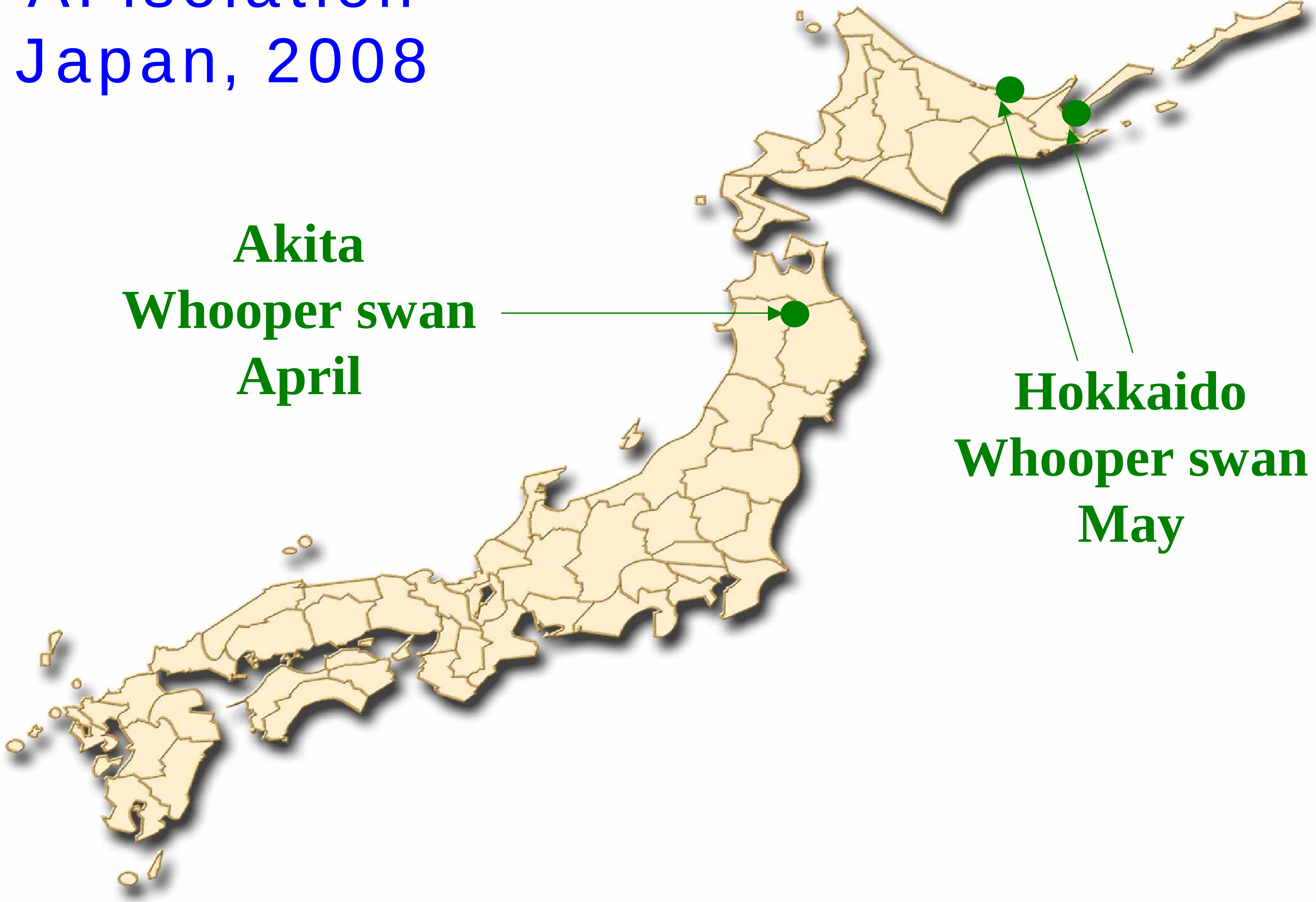
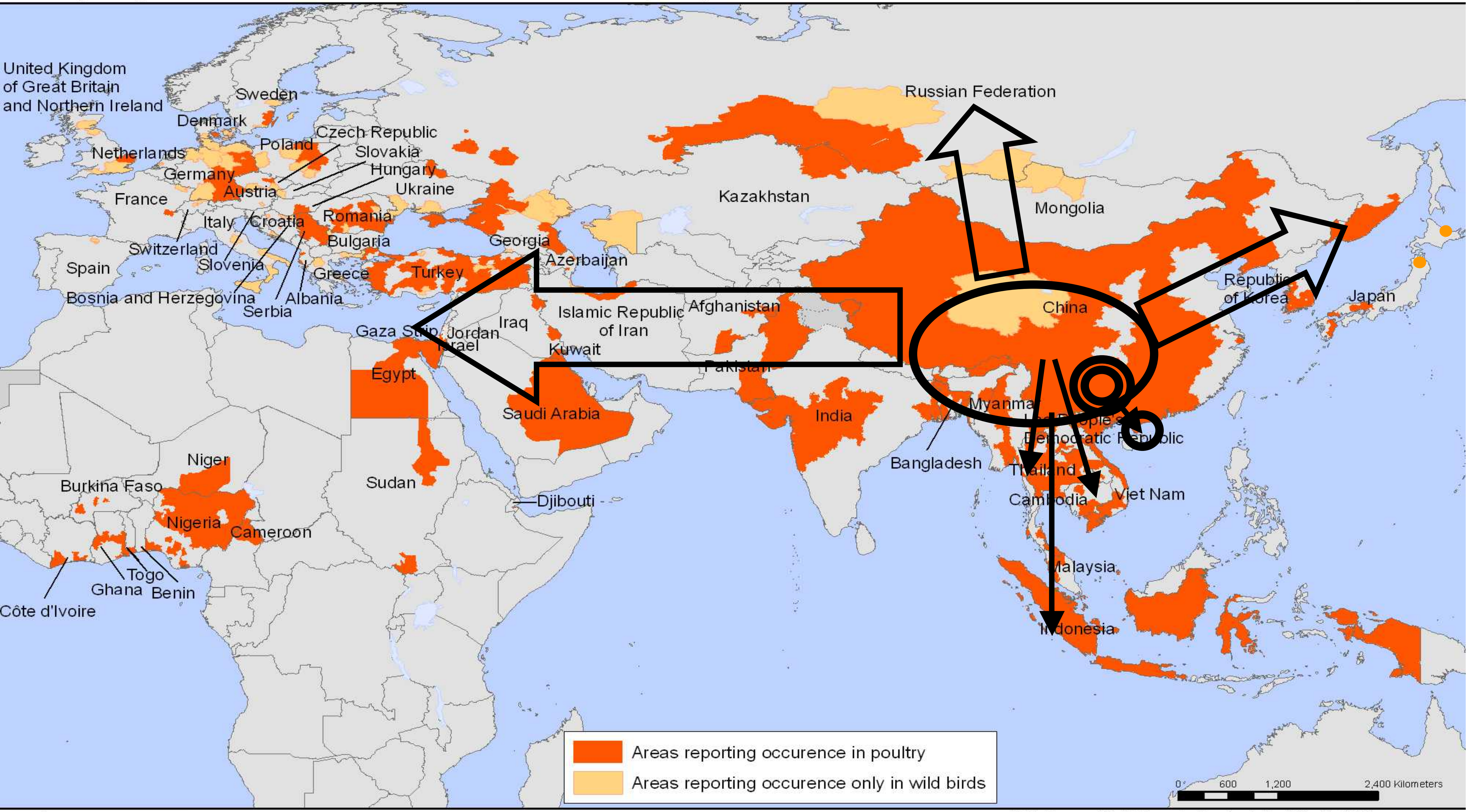
HPAI isolation in Japan, 2008



Areas reporting confirmed occurrence of H5N1 avian influenza in poultry and wild birds since 2003

Status as of 14 April 2008
Latest available update



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Map Production: Public Health Mapping and GIS
World Health Organization

Changing Patterns of Asian HP H5N1?

- Transmission to humans -- 1997
- Inapparent infection of ducks (HPAI) -------------------- 1997
- Lethality for waterfowl -- 2002
- Introduction of distinguishable lineages to Thailand/Vietnam versus Indonesia -------------------- 2003
- Emergence of Qinghai H5N1 strain -------------------- 2005
- HPAI endemic of H5N1 viruses in migratory birds -- 2005
- Inapparent infection of vaccinated chickens (HPAI) -- 2006-?
- Frequent (multiple) introduction of H5N1 viruses into wild birds? -- 2008-?

Generation of pandemic influenza virus

Pandemic Flu – Worldwide Outbreak

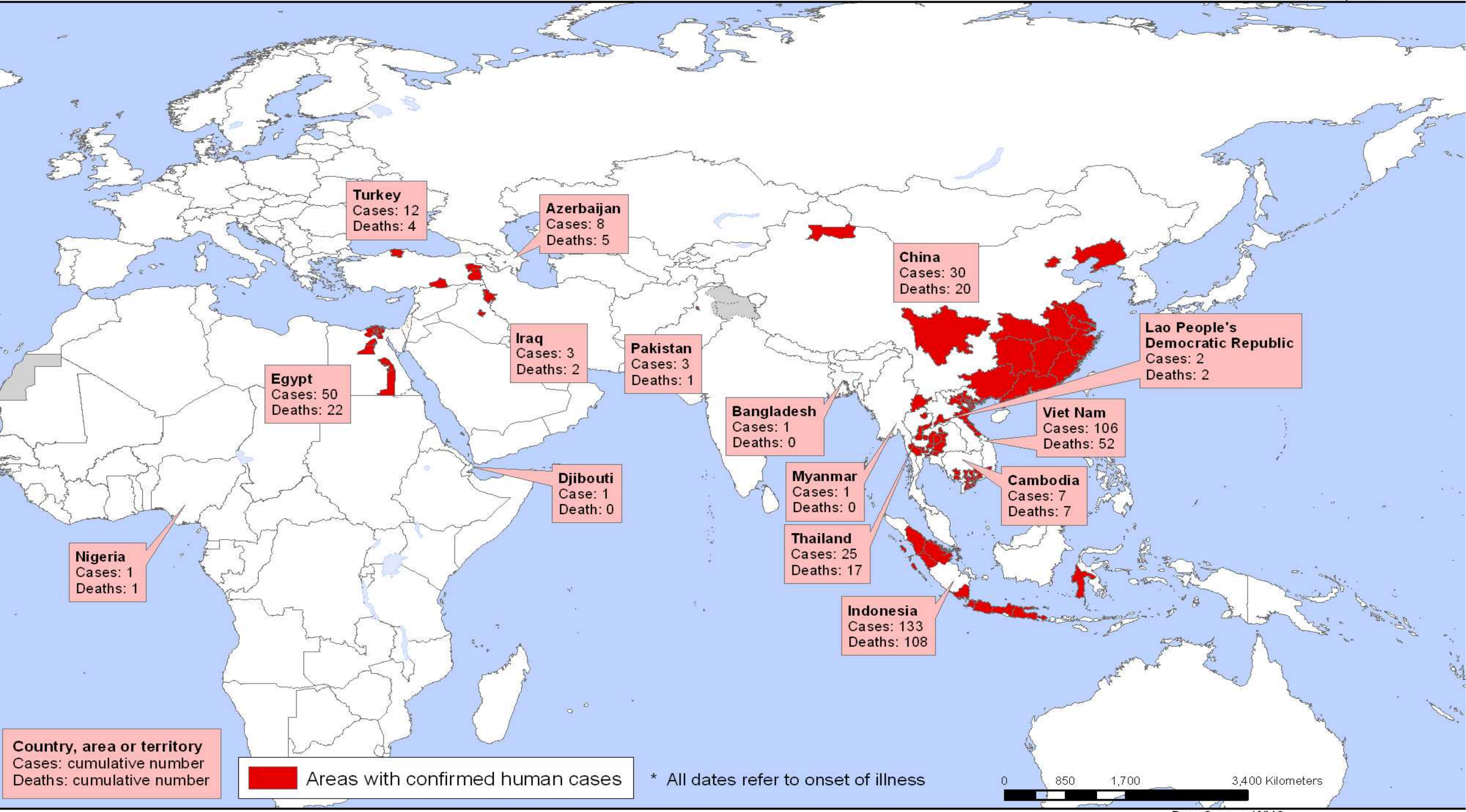
- **1918 H1N1**
- **1957 H2N2**
- **1968 H3N2**

Pandemic Flu – Worldwide Outbreak

- Emergence of influenza virus with NEW subtype of HA
- Infect all age-group people
- Worldwide outbreak within one year

Areas with confirmed human cases of H5N1 avian influenza since 2003 *

Status as of 28 May 2008
Latest available update



* All dates refer to onset of illness

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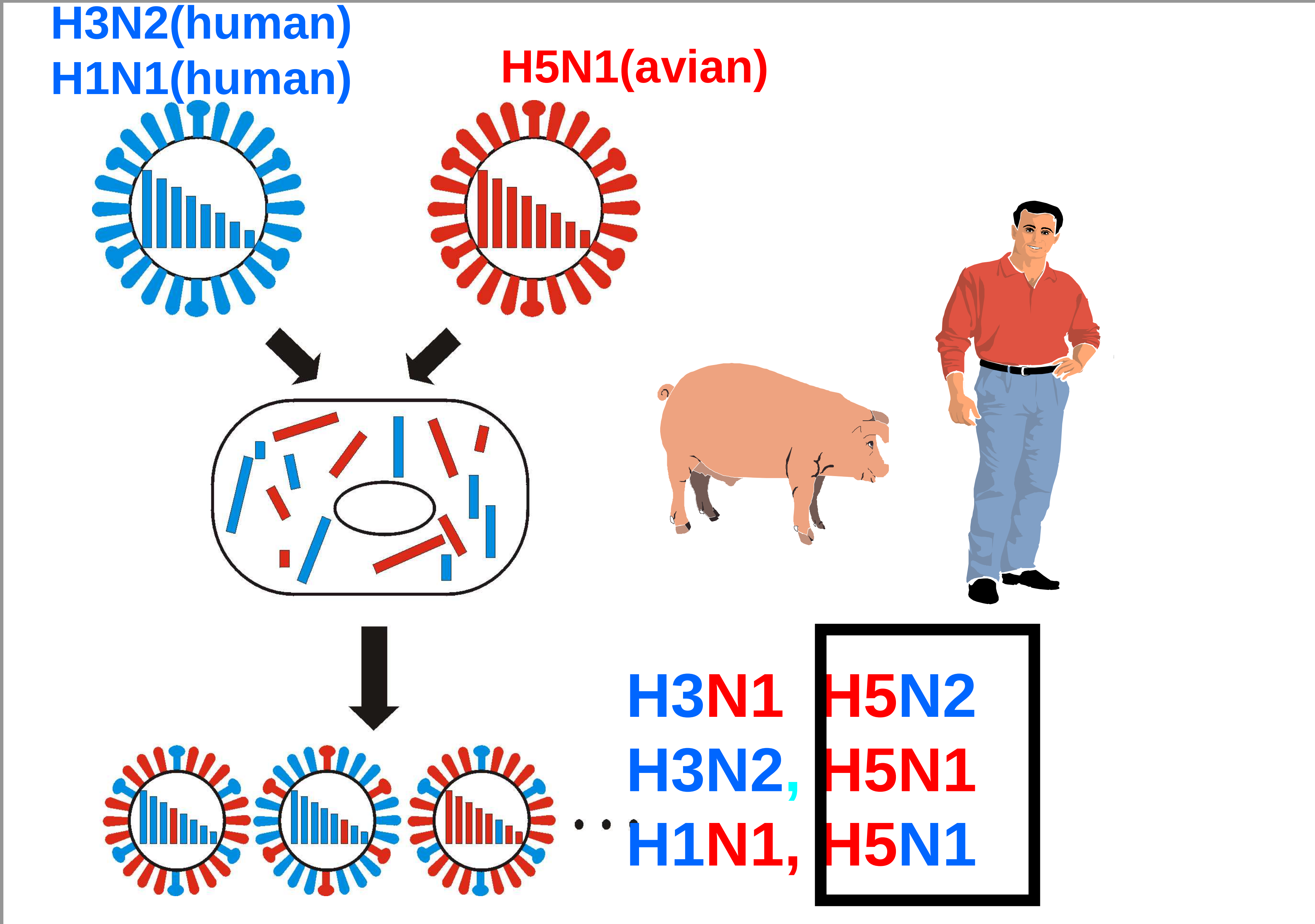
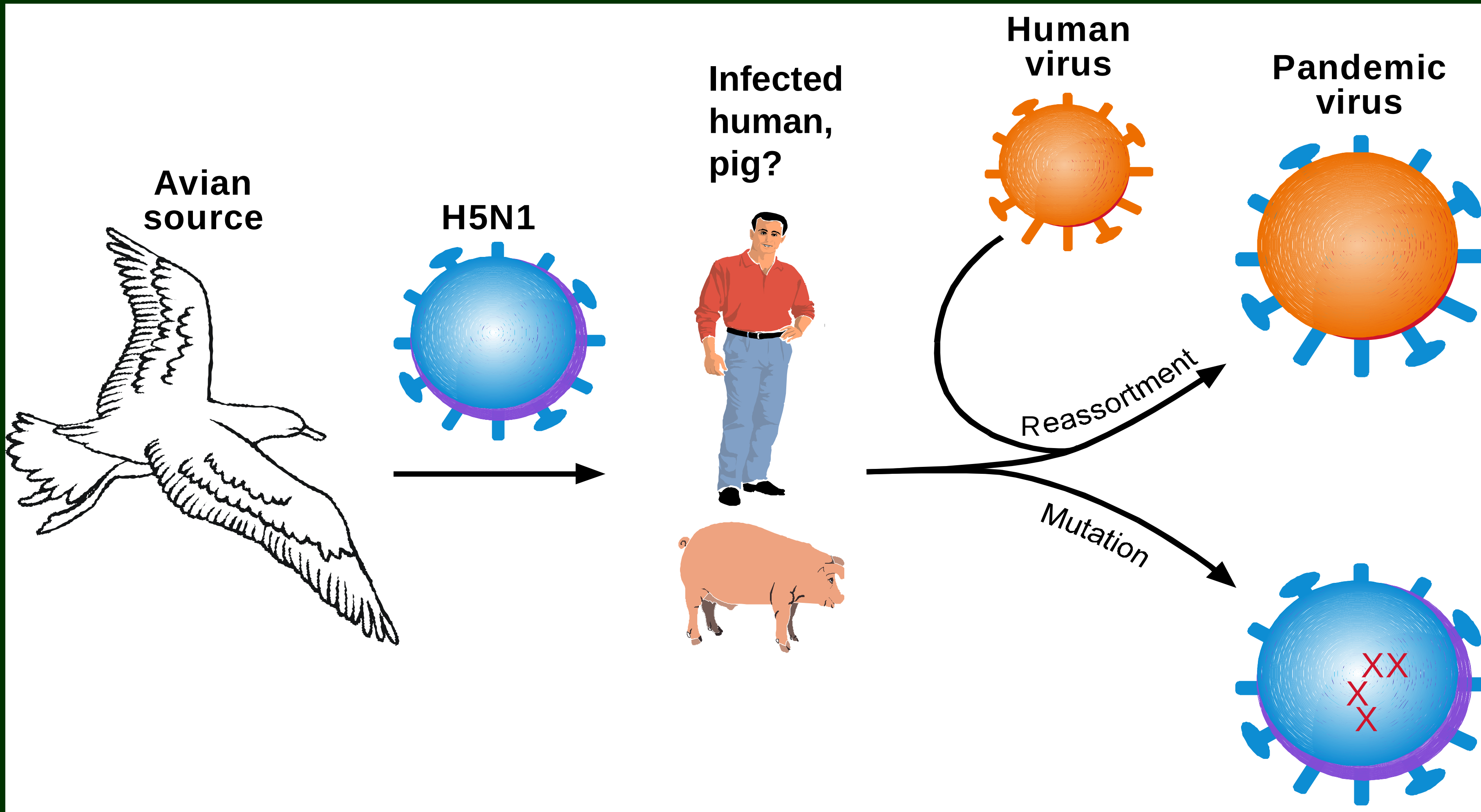
Data Source: WHO
Map Production: Public Health Mapping and GIS
World Health Organization


H3N2(human)
H1N1(human)
H5N1(avian)
H3N1 H5N2
H3N2, H5N1
H1N1, H5N1

Will H5N1 Acquire Transmissibility?



Many factors required.
Ten years have already passed since the first H5N1 case of chicken to human transmission was reported.

Recent Human Infections by Avian Influenza

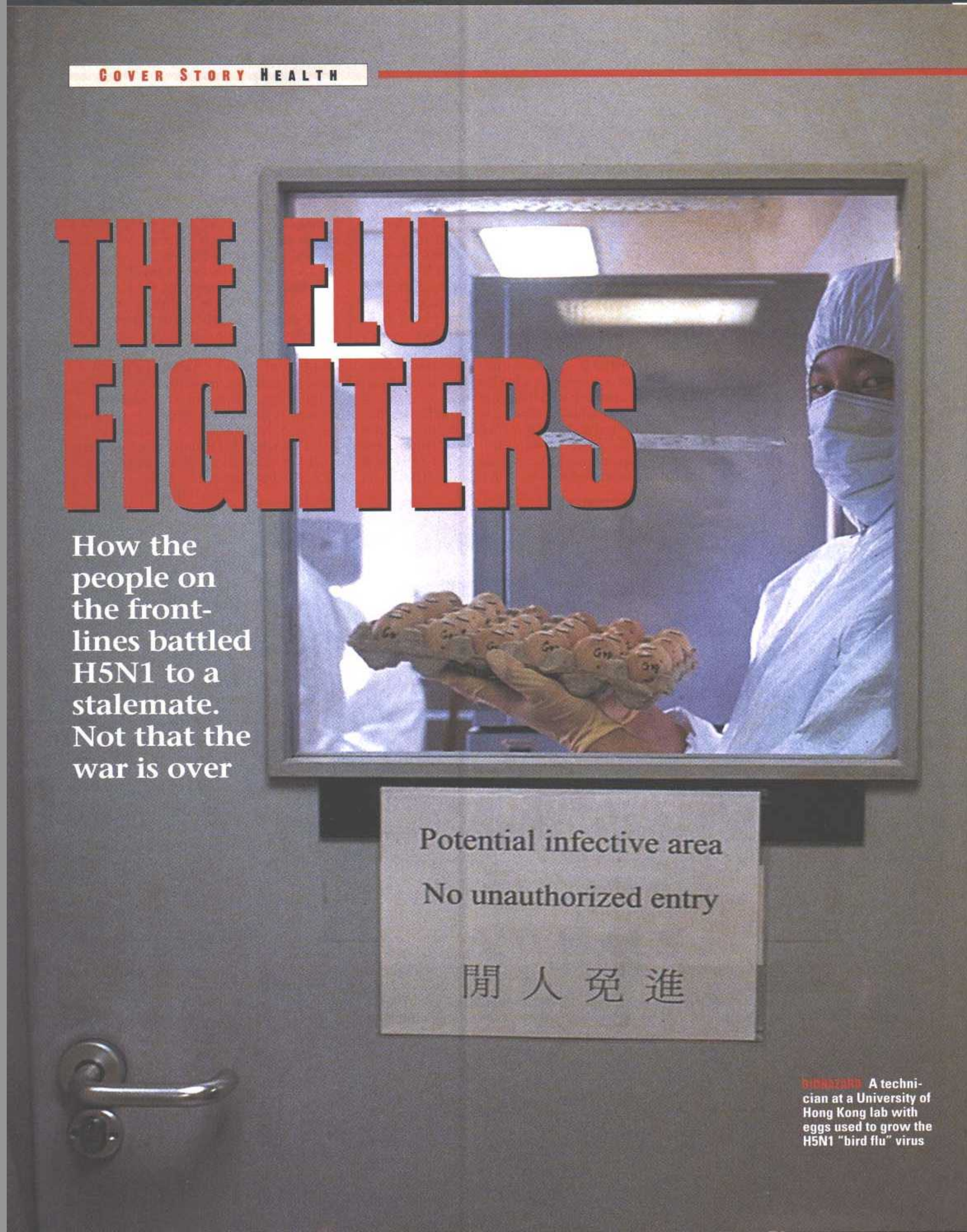
Year	Place	Subtype	Cases	Deaths	H to H
1997	Hong Kong	H5N1	18	6	Limited
1999	Hong Kong	H9N2	2	0	No
2003	Netherlands	H7N7	83	1	Limited
2003	Hong Kong	H9N2	1	0	No
2003-	Eurasia and Africa	H5N1	244	143	Limited

Adaptation to humans?

New Pandemic?

THE FLU FIGHTERS

How the people on the frontlines battled H5N1 to a stalemate. Not that the war is over



BIOHAZARD A technician at a University of Hong Kong lab with eggs used to grow the H5N1 "bird flu" virus

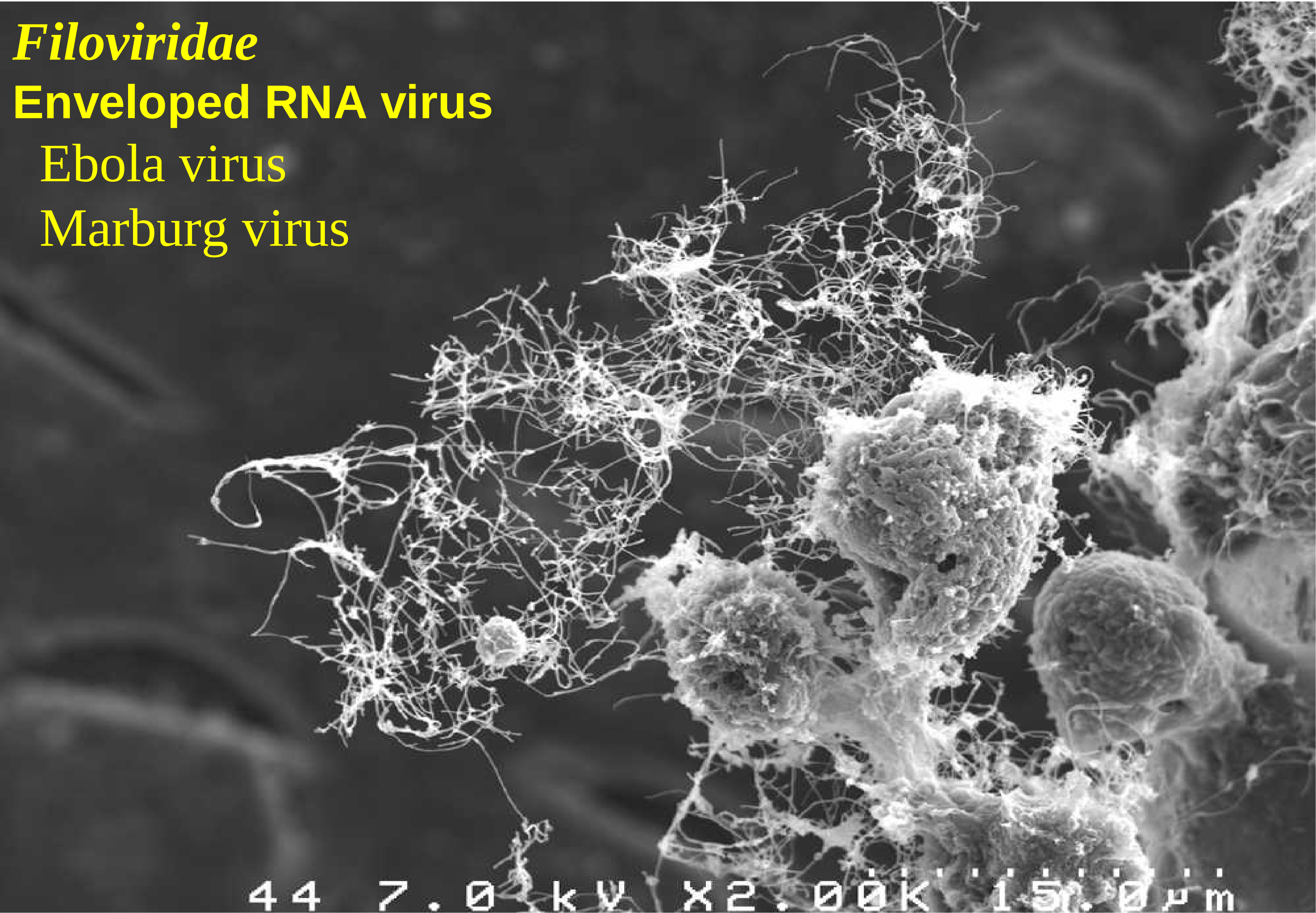
The Ecology of Filoviruses

Filoviridae

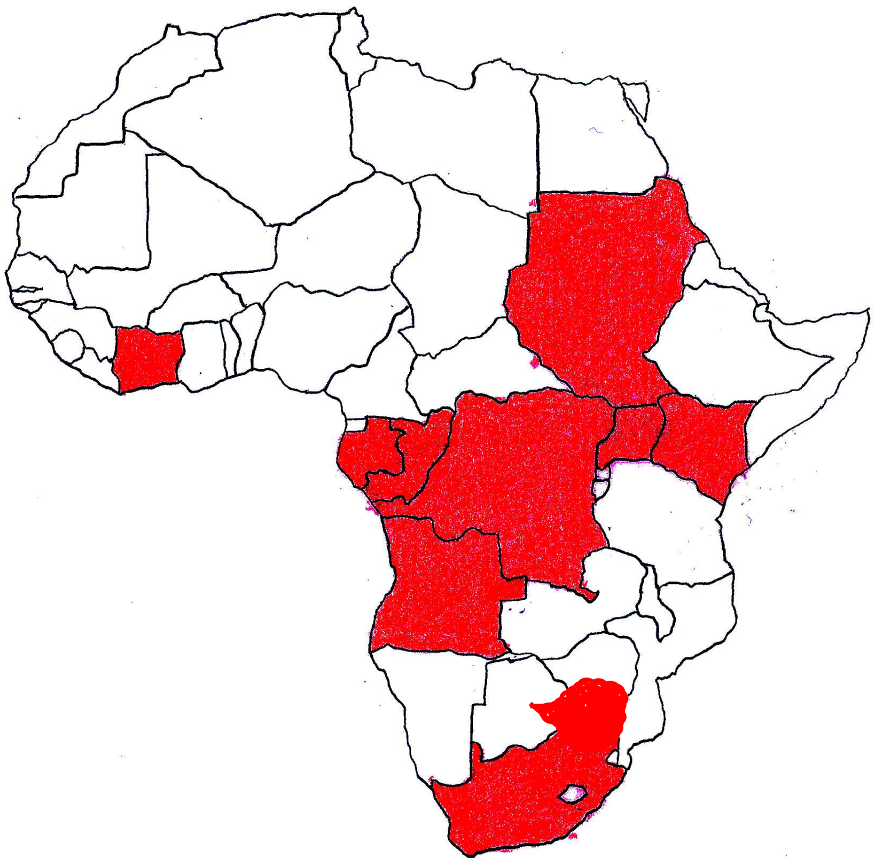
Enveloped RNA virus

Ebola virus

Marburg virus



Filoviruses

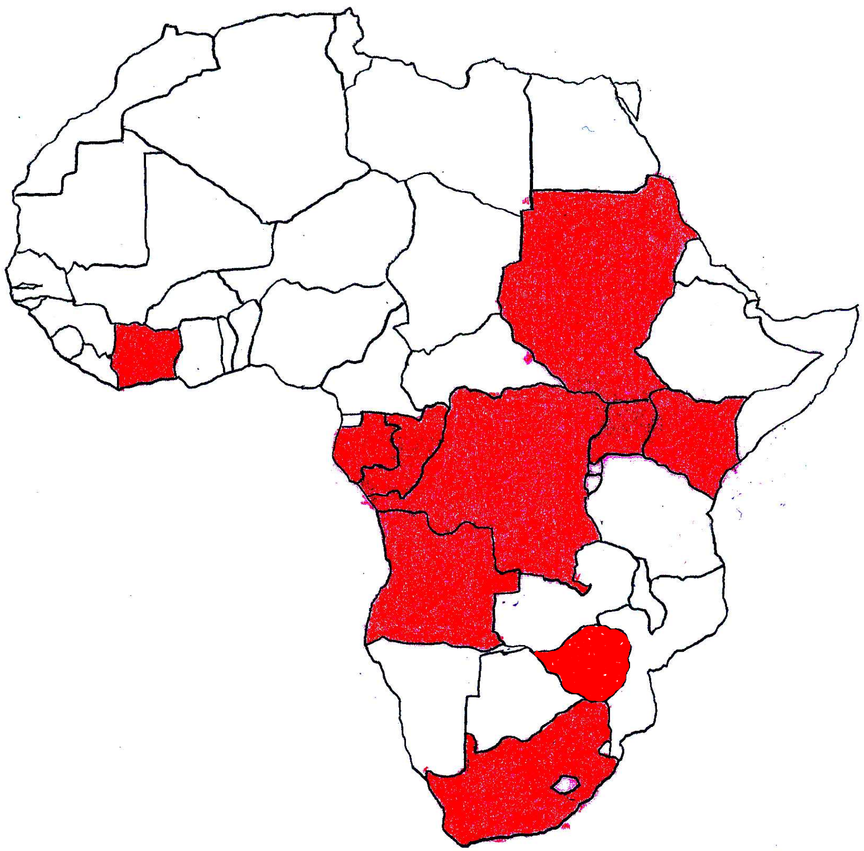


- Sporadic outbreaks of lethal hemorrhagic disease in central Africa
- No effective vaccine or antiviral treatment is currently available.
- Biosafety Level 4 facility is required.

Outbreaks of filovirus Diseases

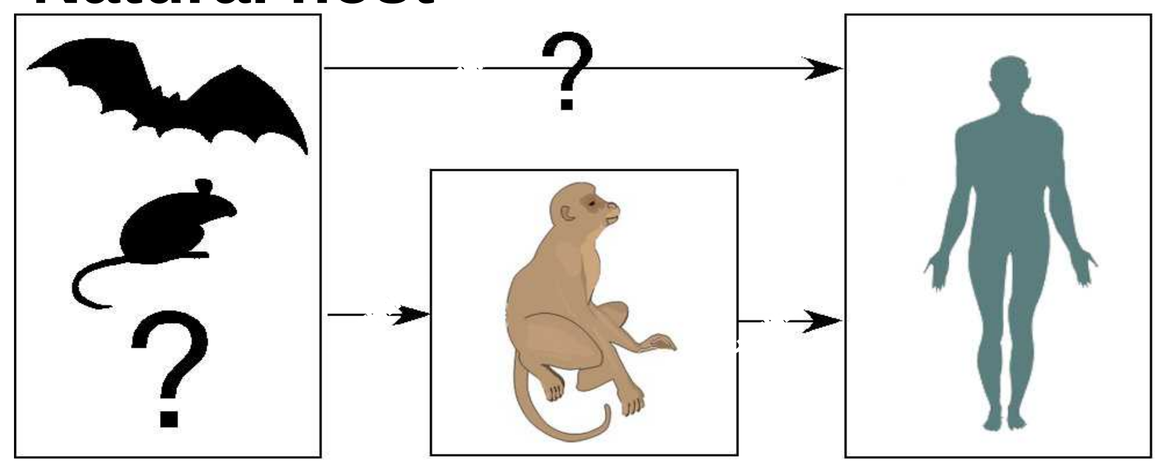
Species	Year	Location	Human cases (%mortality)
Marburg	1967	Germany, Yugoslavia	32 (23)
	1975	South Africa, Zimbabwe	3 (33)
	1980	Kenya	2 (50)
	1987	Kenya	1 (100)
	1999-2000	DR Congo (Zaire)	?
	2005	Angola	374 (88)
Ebola Zaire	1976	DR Congo (Zaire)	318 (88)
	1977	DR Congo (Zaire)	1 (100)
	1994	Gabon	49 (59)
	1995	DR Congo (Zaire)	315 (77)
	1996	Gabon	31 (68)
	1996	Gabon, South Africa	60 (75)
	2001-2002	Gabon	60 (83)
	2001-2002	DR Congo	32 (59)
	2003	R Congo	143 (89)
	2003-2004	DR Congo	35 (83)
Ebola Sudan	1976	Sudan	284 (53)
	1979	Sudan	34 (65)
	2001-2002	Uganda	423 (40)
	2004	Sudan	18<?
Ebola Ivory Coast	1994	Ivory Coast	1 (0)
Ebola Reston	1989	USA	1?
	1992	Italy	0
	1996	USA	0
Ebola new species?	2007	Uganda	93< (?)

Ebola・Marburg hemorrhagic fever
ー Filovirus infections ー



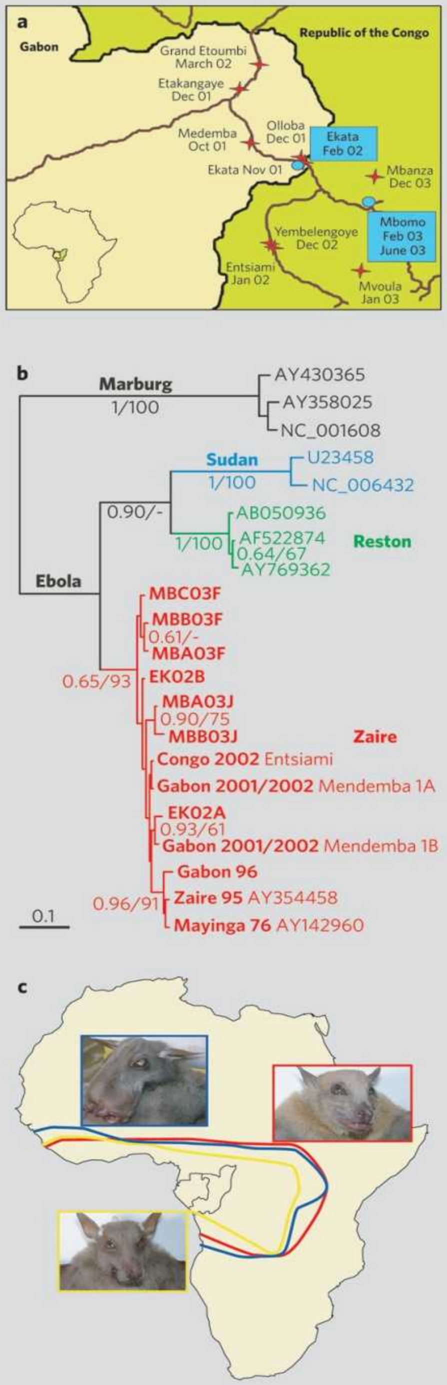
have been emerging every year in Africa in this century. Natural host is not known.

Natural host



Bats ?
Rodents ?

Lethal **Lethal**



Nature **438**, 575-576 (1 December 2005)

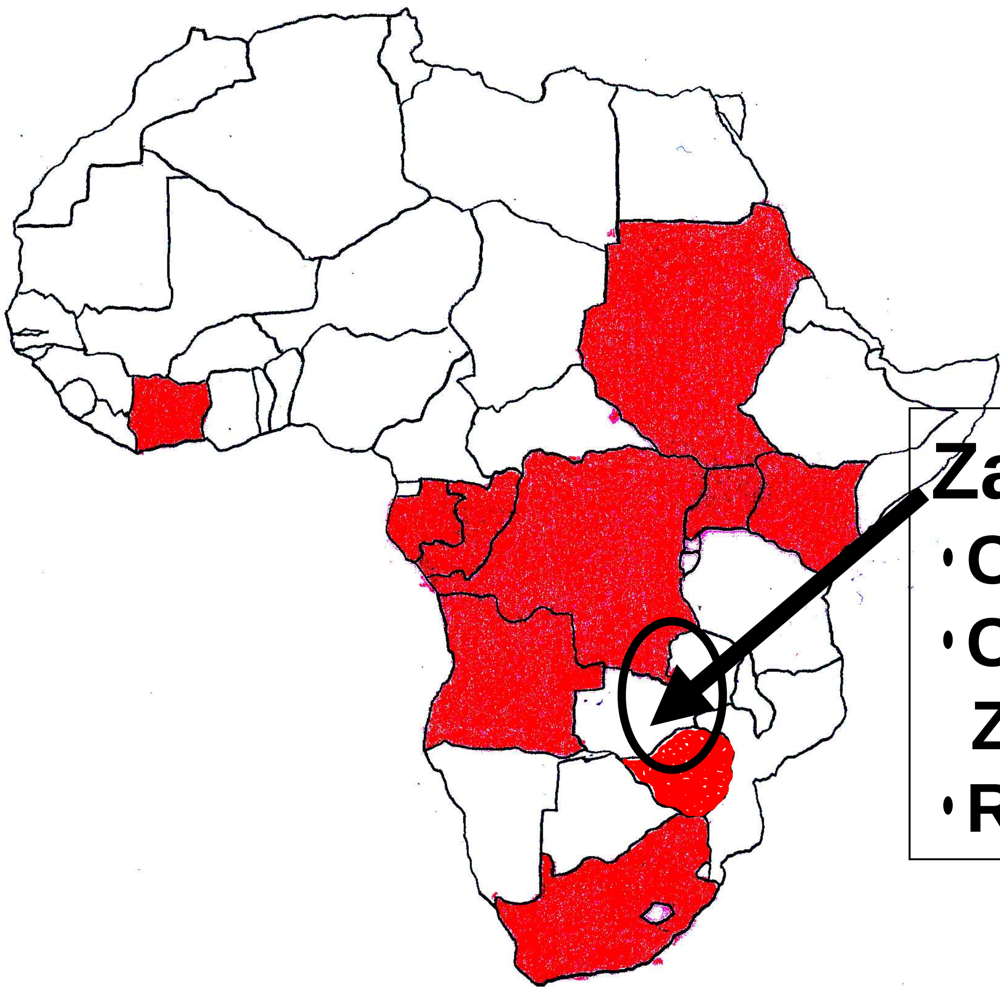
Fruit bats as reservoirs of Ebola virus

Eric M. Leroy, Brice Kumulungui, Xavier Pourrut, Pierre Rouquet, Alexandre Hassanin, Philippe Yaba, André Délicat, Janusz T. Paweska, Jean-Paul Gonzalez and Robert Swanepoel

Bat species eaten by people in central Africa show evidence of symptomless Ebola infection.

The first recorded human outbreak of Ebola virus was in 1976, but the wild reservoir of this virus is still unknown. Here we test for Ebola in more than a thousand small vertebrates that were collected during Ebola outbreaks in humans and great apes between 2001 and 2003 in Gabon and the Republic of the Congo. We find evidence of asymptomatic infection by Ebola virus in three species of fruit bat, indicating that these animals may be acting as a reservoir for this deadly virus.

Natural reservoir of filoviruses？



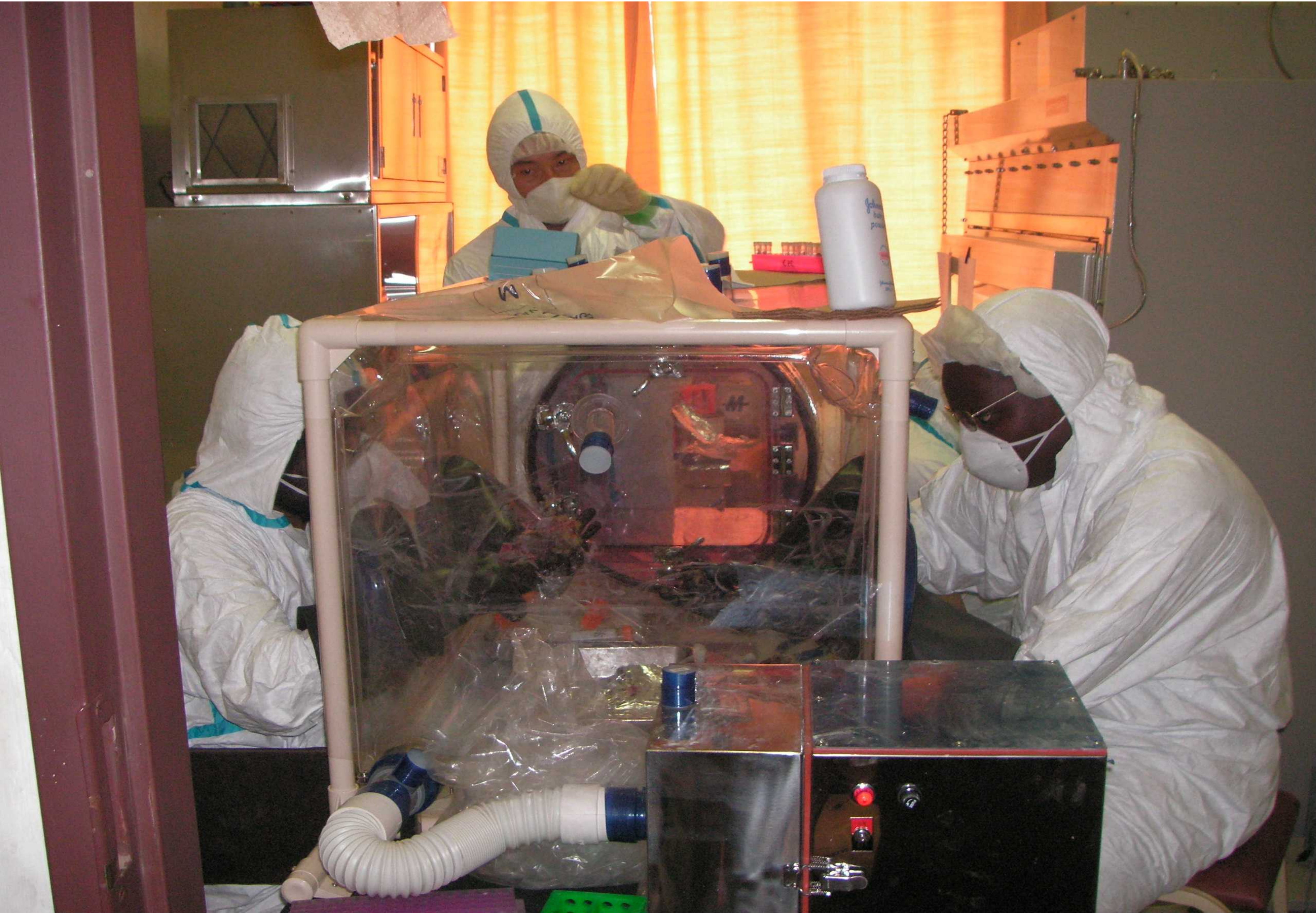
Zambia

- **Close to DR Congo and Angola**
- **Collaboration with University of Zambia**
- **Relation through JICA**

Lusaka, Zambia

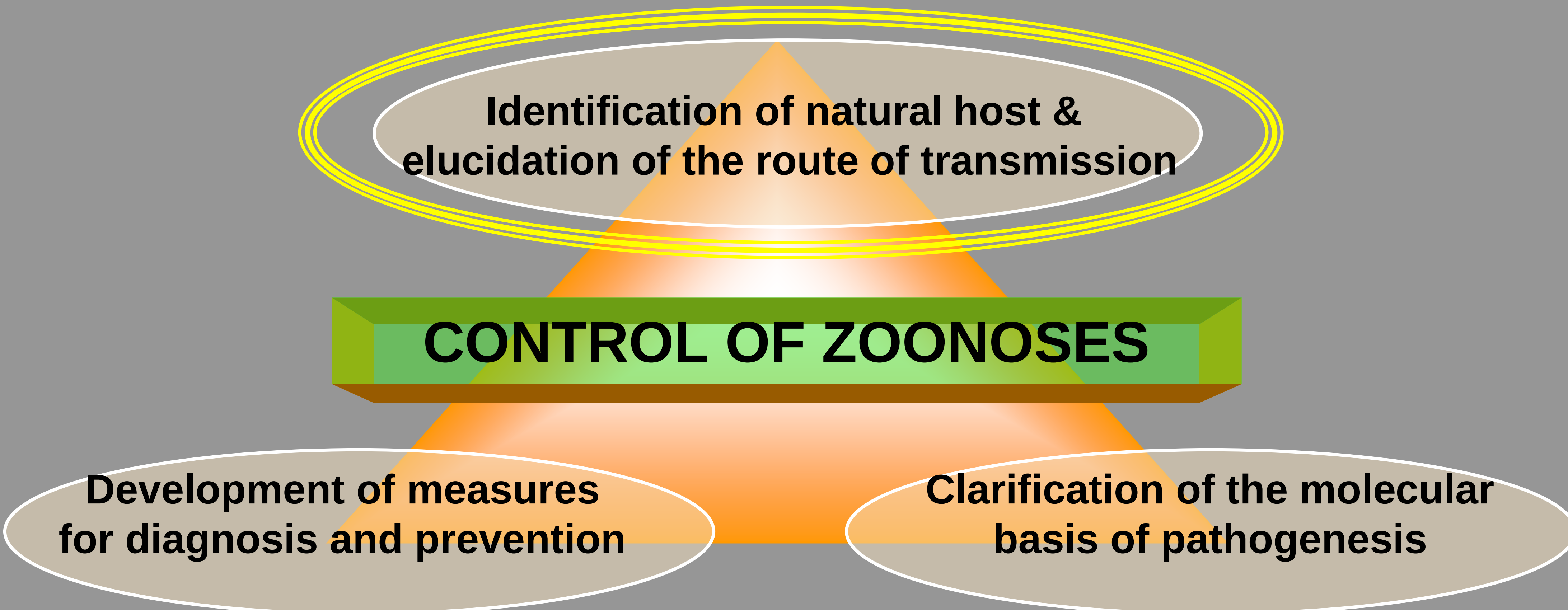
November-December, 2006-2007


Eidolon helvum




Now being investigated.
But, I may not be the only candidate・・・

Sustainable strategy for the control of zoonoses



Changes in the global environment and human behavior affect the ecology of wildlife and hence contribute to the emergence of new diseases (Changing transmission dynamics and bringing people into closer and more frequent contact with potential pathogens).

“Toward a Sustainable Low UrbanSociety”

“Toward a Sustainable Low Carbon Society”

Equipollent?