Agricultural Outlook Forum Presented: February 16, 2006

THE CURRENT STATE OF SCIENCE ON AVIAN INFLUENZA

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Understanding Evolution and Pathogenesis of HPAI

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- Introduction to Avian Influenza
  - Origins of Infection
  - Disease in poultry
  - Trade implications of outbreaks
- History of H5N1 Avian Influenza in Europe and Asia
  - Origins of the virus
  - Why this virus is unique

Natural Ecology of Avian Influenza

Mallards

Blue Wing Teal

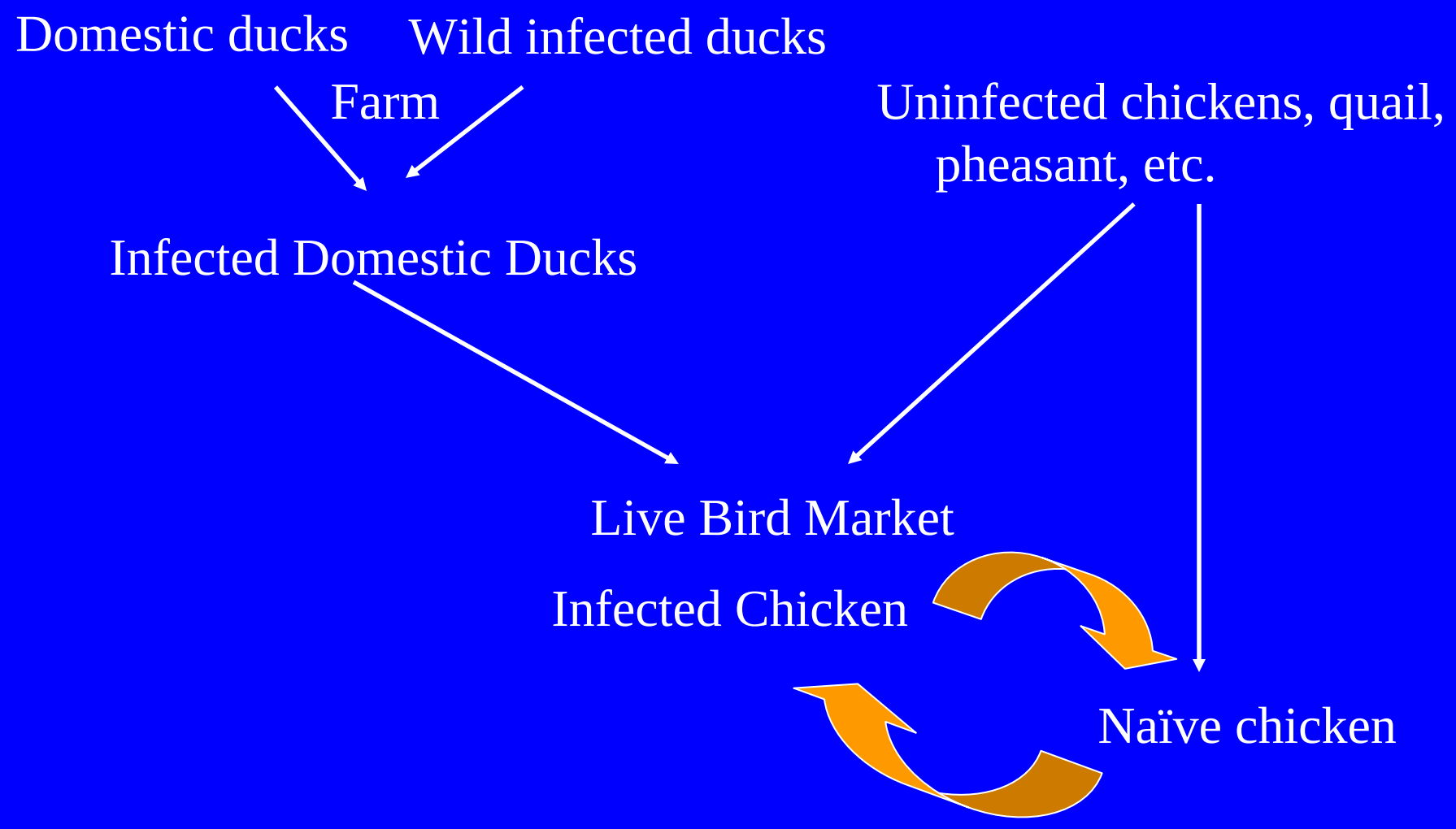
Herring Gulls

- Avian Influenza is naturally found in wild birds
- Virus infection is not normally thought to cause disease in its natural host (Viruses are low pathogenic)
- Wild bird surveys have shown certain duck, gull, and shorebirds species are commonly infected at different times of the year
- All type A influenza viruses are thought to originate from wild birds

Avian Influenza in Poultry

- AIV is not normally found in domestic ducks, chickens and turkeys
- Transmission of AIV from wild birds to domestic poultry species occurs commonly (ducks>turkeys> chickens)
- AIV on rare occasions may become established in chickens and turkeys and result in serious disease outbreaks
- AIV once adapted to chickens and turkeys can be difficult to eradicate

Scenario For Introduction-Live Bird Markets




VIVERO
VIVERO
بسم الله الرحمن الرحيم
Webster Live Chicken
VIVERO
LAMB + GOAT
HALAL
1167 • POULTRY • LAMB • GOAT • CHICKEN • TURKEN • GUINEA • RABBITS • DUCKS • PALOMAS • GUINEAS HENS • PIGEONS
LIVE
LAMB 1.
SHEEP .89

Avian Influenza: Infection and Disease

- Infection may cause a wide range of clinical signs from no disease (asymptomatic), respiratory disease, to severe disease with high mortality
- Localized Infection-mild to moderate disease
  - Intestinal-wild ducks and shorebirds, poultry
  - Respiratory-humans, swine, horses, poultry, domestic ducks, seal, mink
- Systemic Infection-high mortality
  - chickens, turkeys, other gallinaceous birds

Highly Pathogenic Avian Influenza

- Systemic, rapidly fatal disease of poultry
- Only H5 and H7 subtypes are recognized to cause HPAI
- OIE List A Disease-outbreaks are reportable
- HA cleavage site critical virulence factor
- Low pathogenic H5 and H7 AI viruses can mutate into the highly pathogenic form of the virus

Emergence of HPAI

LPAI H5 or H7 virus transmitted to poultry

LPAI virus circulates in poultry with mild disease

LPAI Virus Mutates to HPAI with severe disease

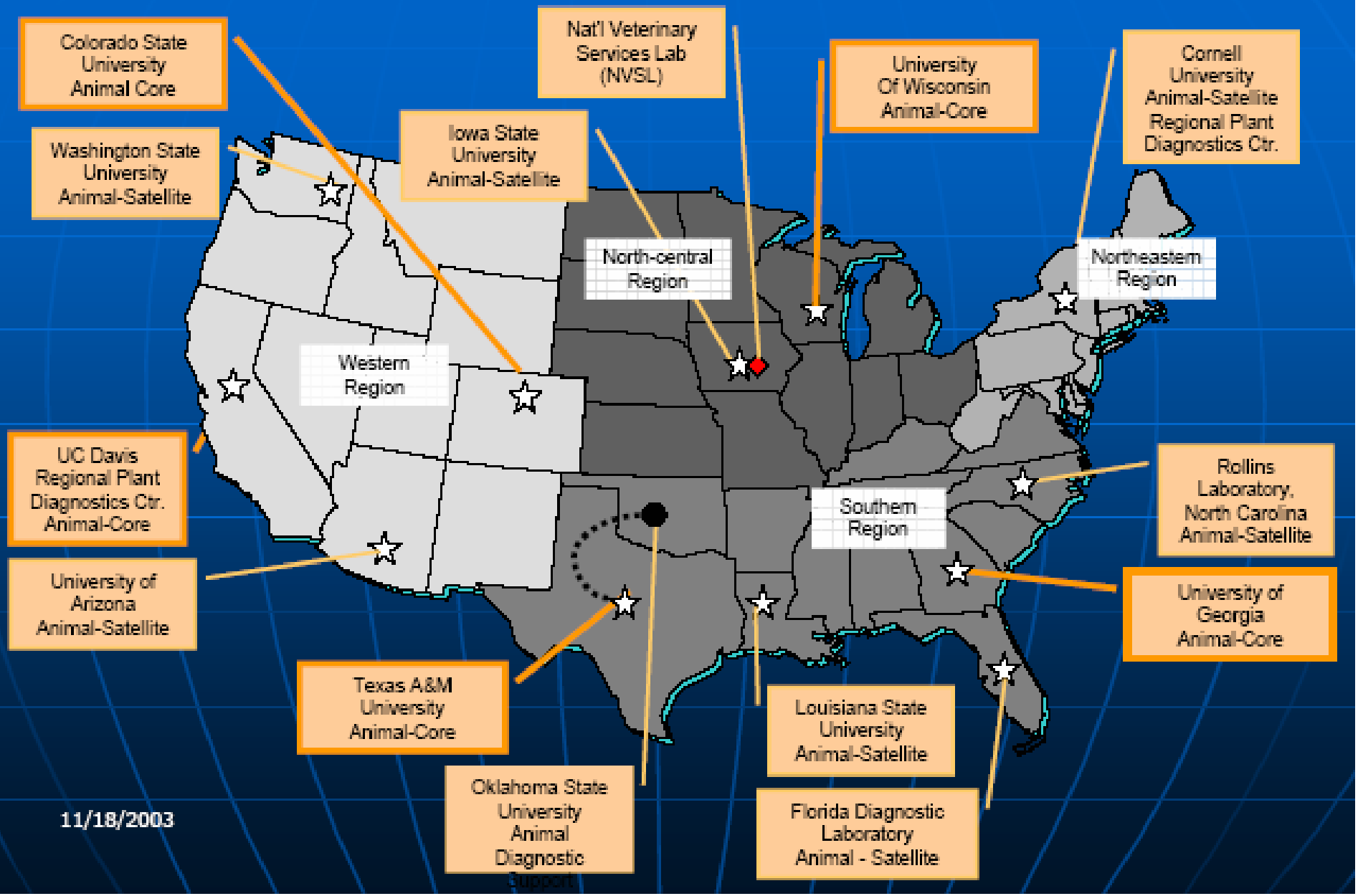
History of HPAI in the Americas in the last 30 years

- HPAI is considered a foreign animal disease in the Americas
- Five HPAI outbreaks have occurred in the Americas
  - Pennsylvania 1983-84 (17 million birds)
  - Mexico 1994-95 (Millions of birds)
  - Chile 2002 (2 million birds)
  - Canada 2004 (17 million birds)
  - Texas 2004-Molecular definition of HPAI only (5,000 birds)

Control of HPAI

- Most outbreaks of HPAI are controlled through either eradication and/or vaccination
- U.S. has used eradication for HPAI outbreaks
- U.S. also has control programs for H5 or H7 LPAI because of concern of mutation to HPAI
- Strong veterinary infrastructure needed for rapid control of both LPAI and HPAI

National Animal Health Laboratory Network



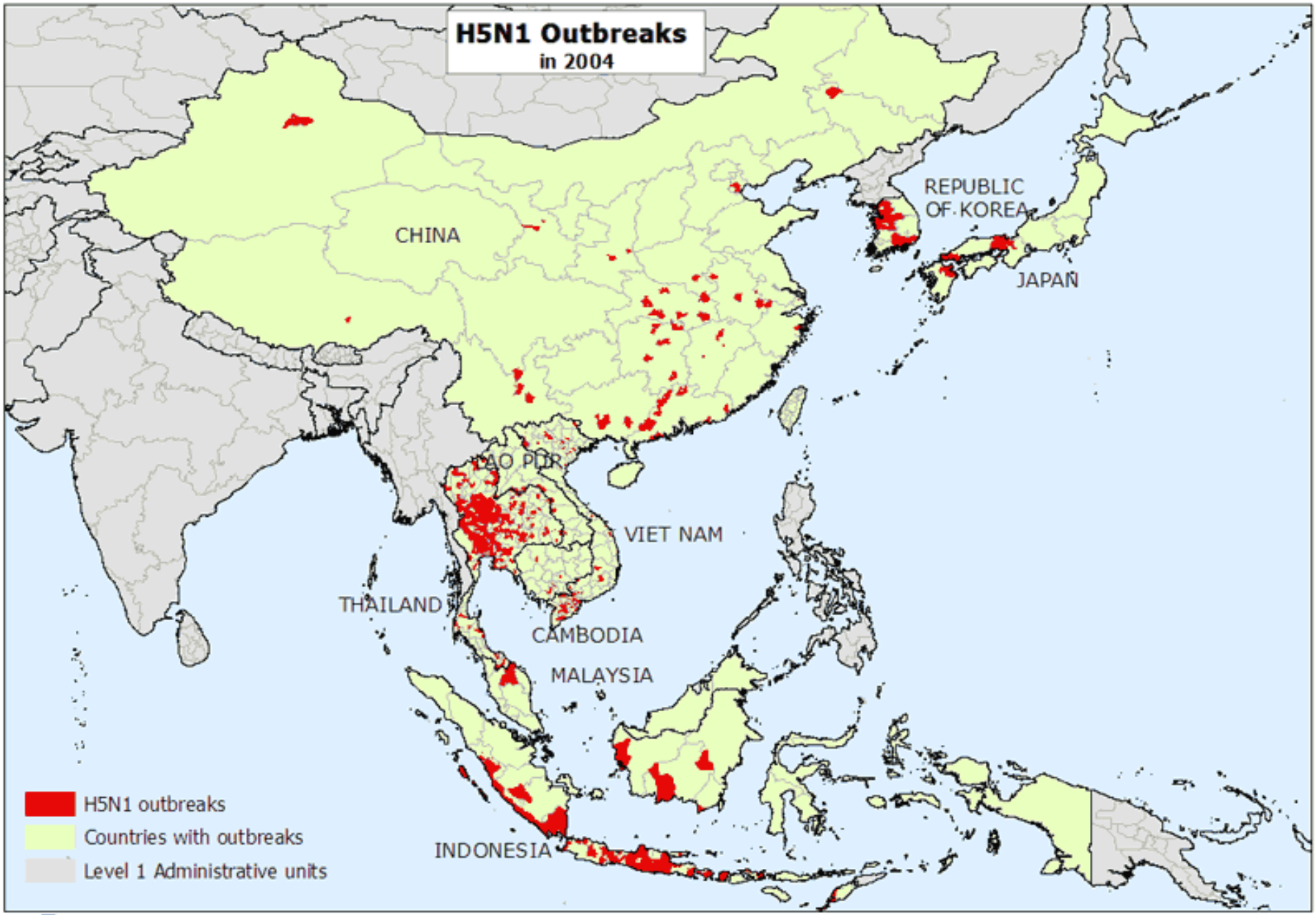
11/18/2003

H5N1 Asian “Bird Flu”

- The HPAI H5N1 Asian lineage was first detected in China in 1996 with the Goose/Guangdong/1/96 isolate
- This isolate had a unique multi-basic aa cleavage site and was highly pathogenic for chickens
- 1997 Hong Kong poultry and human H5N1 viruses had same H5 gene but different internal genes
- 1999 Hong Kong goose viruses were most similar to Guangdong/96 virus
- 2001 Korean quarantine station isolate (from China) 4 genes like Guangdong/96 including HA and four unique genes
- 2001 Hong Kong H5N1 viruses with 5 distinct combinations of genes observed (same HA)

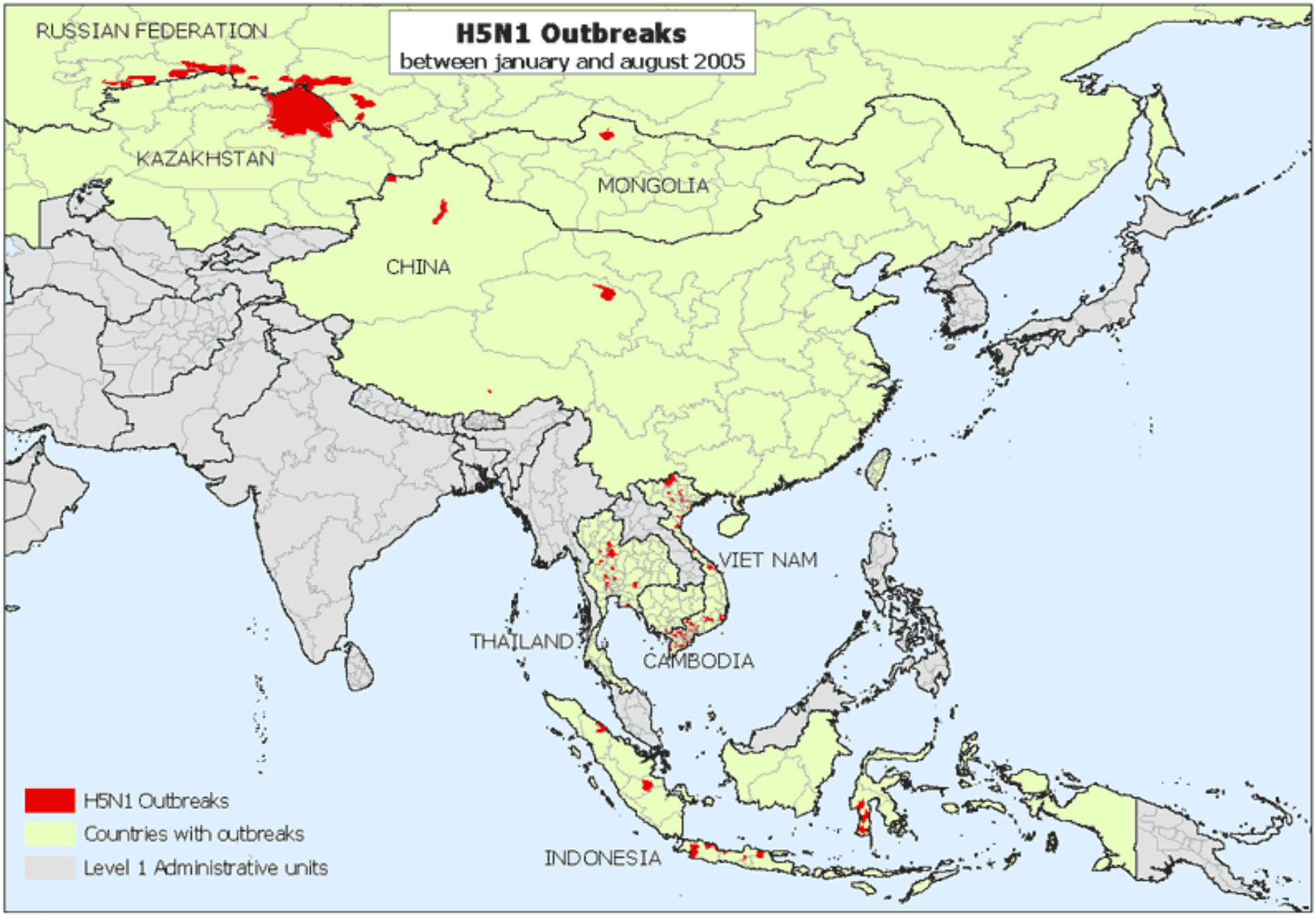
H5N1 Epizootic

- The virus started spreading more widely at the end of 2003
- Has spread to at least 20 different countries in Asia, Europe, and Africa
- Virus is changing in its ability to cause disease in ducks and wild birds
- There are H5N1 viruses with different biological properties



This map represents the districts or provinces that experienced outbreaks of H5N1 type of Avian Influenza between January and December 2004. The original data have been collected and aggregated at the most detailed administrative level and for the units available for each country.

Data source: OIE, FAO and Government sources



This map represents the districts or provinces that experienced outbreaks of H5N1 type of Avian Influenza since January 2005 (map updated to 31 August 2005). The original data have been collected and aggregated at the most detailed administrative level and for the units available for each country.

Data source: OIE, FAO and Government sources


EUROPE
Avian Influenza Outbreaks
October 2005 - January 13th 2006
Ukraine
Moldova
Russian Federation
Romania
Croatia
Bulgaria
Georgia
Armenia
Greece
Turkey
Iran
Syrian Republic
Irak
Observed outbreaks
January's 2006 outbreaks
December's outbreaks
November's outbreaks
October's outbreaks
Level 1 Administrative units
Interested Adm units
Countries with outbreaks
This map represents the provinces that experienced outbreaks of H5N1 type of Avian Influenza in Europe from October through 13 January 2006. The original data have been collected and aggregated at the most detailed administrative level and for the units available for each country. Source: AI outbreaks: FAO, OIE and Official government sources

Differences in Species Susceptibility

- All the H5N1 viruses tested are highly pathogenic for chickens-killing rapidly (1-2 days by I.V. route)
- Differences in domestic duck pathogenicity
  - Historically HPAI viruses can infect but do not kill ducks (including Asian H5N1)
  - Starting in 2002 some H5N1 viruses from Hong Kong were highly pathogenic for ducks
  - Some recent viruses may cause high mortality in ducks
- Other species
  - Little work done with other species-Hong Kong 97 viruses was generally lethal only for gallinaceous birds

Role of Wild Birds

- Many species of wild birds have been shown to be susceptible to infection
- Isolates primarily from dead or dying animals
- Some isolates from predator or carrion eating birds (falcons, crows)
- Most of these wildbird infections are thought to occur from spillover from infected poultry
- Only recently has strong epidemiologic evidence shown that migratory birds are likely spreading virus within a country or between countries

Conclusions

- HPAI H5N1 is endemic in certain countries in S.E. Asia
- The virus is present in wild birds and it may be a source of transmission to poultry
- The virus has shown the ability to change and infect new species
- Control in the short term is unlikely
- Vaccination likely to be used widely in the region as a control method
- More international support will be needed to control the problem