

Overview of Avian Influenza and the U.S. Poultry Industry



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Protecting AI Responders – September 2007



Outline

- **Avian Influenza Overview**
 - **Virus Characteristics and Transmission**
 - **Natural Reservoirs**
 - **Risks of AIV Transmission**
- **LPAI and HPAI Pathogenesis**
- **U.S. Commercial Poultry Industry**
 - **Meat-type Chickens (Broilers)**
 - **Meat-type Turkeys**
 - **Table egg birds (Layers)**

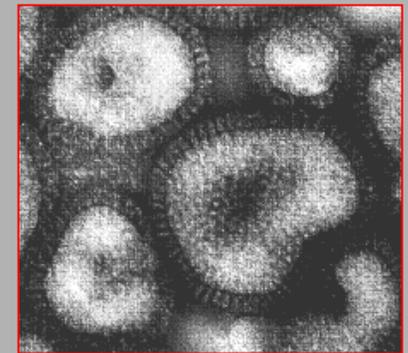
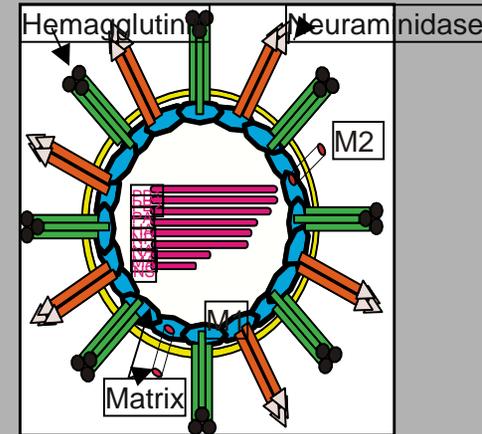
Avian Influenza Overview

- Avian influenza (AI) - identified in the early 1900s
- Three HPAI (“Fowl Plague”) Outbreaks in the U.S.
 - 1924 – affected live bird markets in the Northeastern U.S.
 - 1983 – destruction of 17 million birds in commercial poultry in PA
 - 2004 – quickly contained to one poultry farm and eradicated in TX
- HPAI – causes rapid, infectious illness, ↓egg production, sudden death in birds.
- LPAI causes mild to no illness in birds.
- Vast majority of AI viruses found in birds do not represent a public health concern



Avian Influenza Overview

- Orthomyxovirus – RNA, single stranded, enveloped
- Major surface proteins – hemagglutinin (HA) and neurominidase (NA).
- 144 different characterizations of the virus based on 16 H types and 9 N types.
- AI viruses mutate easily – only H5 and H7 viruses have the potential to mutate from LPAI to HPAI form.
- AI viruses vary widely in pathogenicity from strain to strain.
- Not all H5N1 subtypes are infectious for people or pathogenic to poultry.

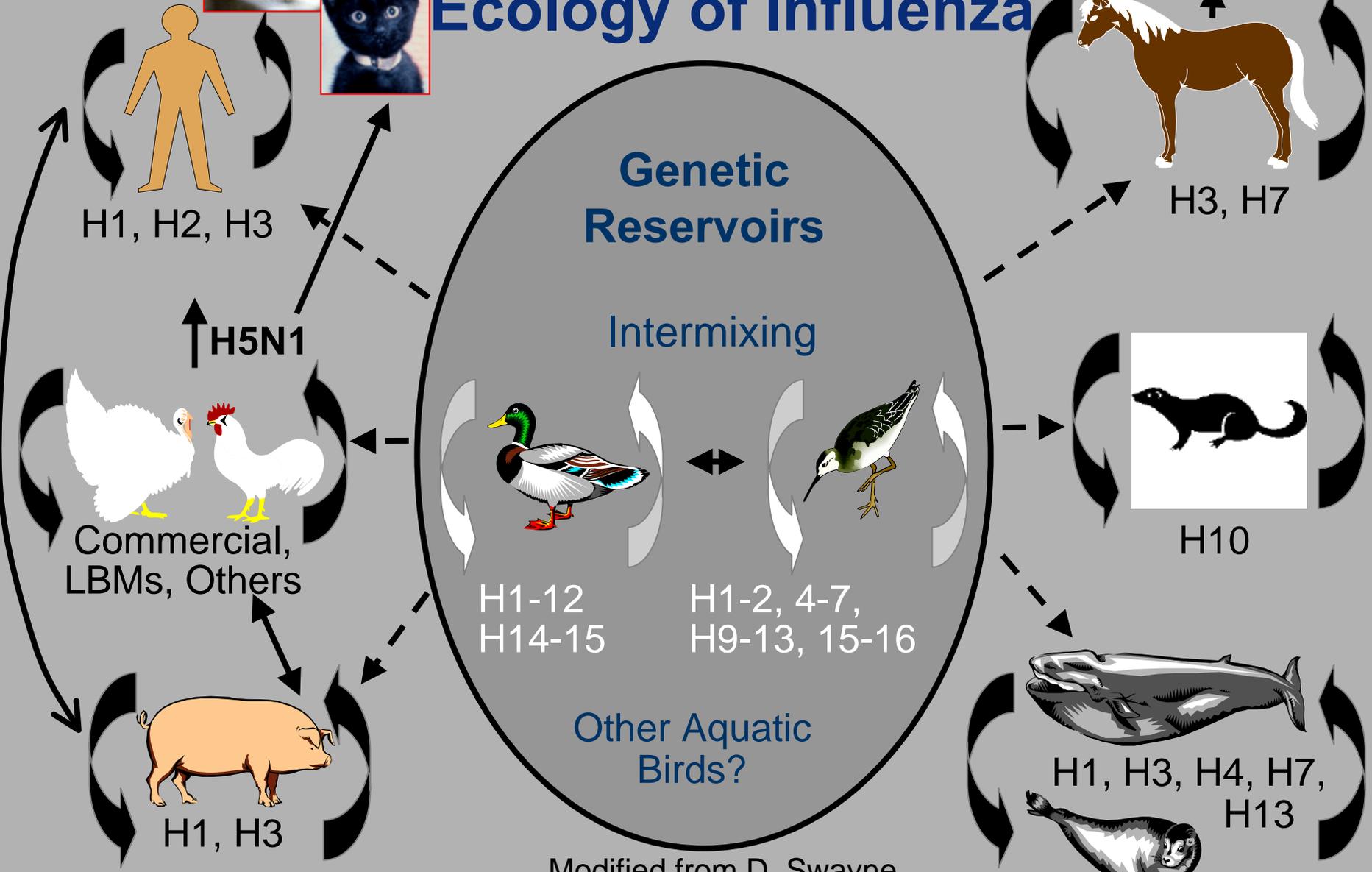


Natural Reservoirs of Influenza A Viruses

- Wild aquatic birds
- Majority are represented by two Orders
 - Anseriformes (ducks, geese, swans)
 - Charadriiformes (gulls, terns, shorebirds)
- No clinical disease
 - Except: A/Turn/South Africa/61
 - HPAI H5N1 infection in wild birds in Europe, Asia



Ecology of Influenza



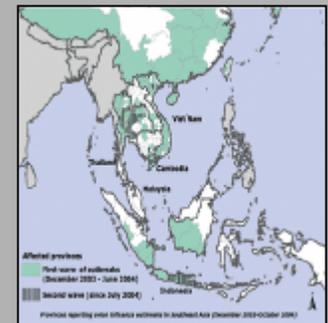
Modified from D. Swayne

Avian Influenza Viruses Change Frequently

- **Antigenic Drift** : Minor antigenic changes to HA protein caused by mutations in H gene
 - Continuous process
 - Limits cross – protective immunity
- **Antigenic Shift** : Replacement of H or N gene type
 - Emergence of novel (pandemic) strains
 - Genetic re-assortment (human and animal viruses)
- **Recombination** :
 - Insertion of large portion of extraneous RNA near the HA cleavage site – virulence shift

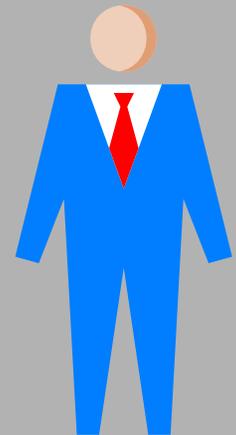
Risks of AI Disease Transmission

- Risk of spread of LPAI in LBMS to commercial poultry operations.
- Risk of mutation of H5/H7 LPAI viruses to highly pathogenic viruses.
- Recent HPAI occurrences in poultry:
 - Euro-Asia/ Africa: 1997- 2007 (H5N1)
 - Italy: 1999 - 2000 (H7N1)
 - Netherlands: 2003 (H7N7)
 - Chile: 2002 (H7N3)
 - British Columbia: 2004 (H7N3)
 - U.S.A. (Texas) 2005 (H5N2)
- Interruptions of international trade



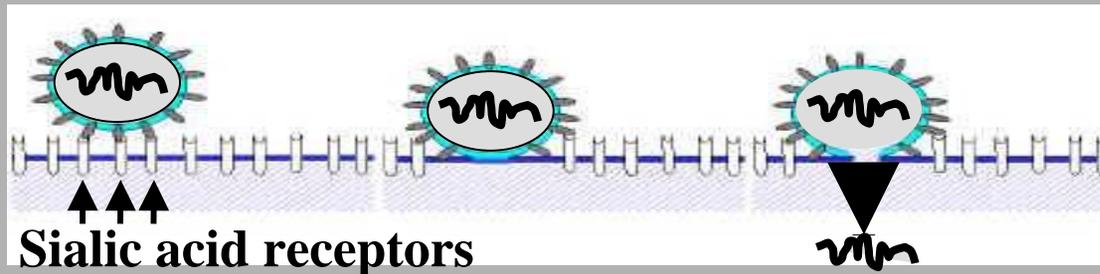
Risk of AIV Transmission to Humans

Historically, H1, H2, H3 human pandemics have followed adaptation of AI viruses to swine

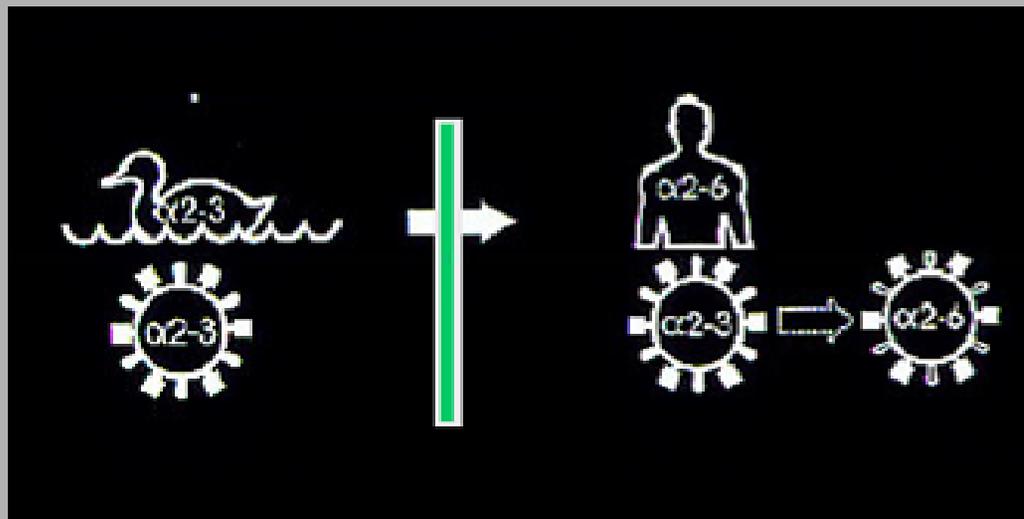


Recently, H5 and H7 human infections have resulted from direct transmission from poultry (Asia, The Netherlands, Canada)

Interspecies Transmission of Influenza A Viruses



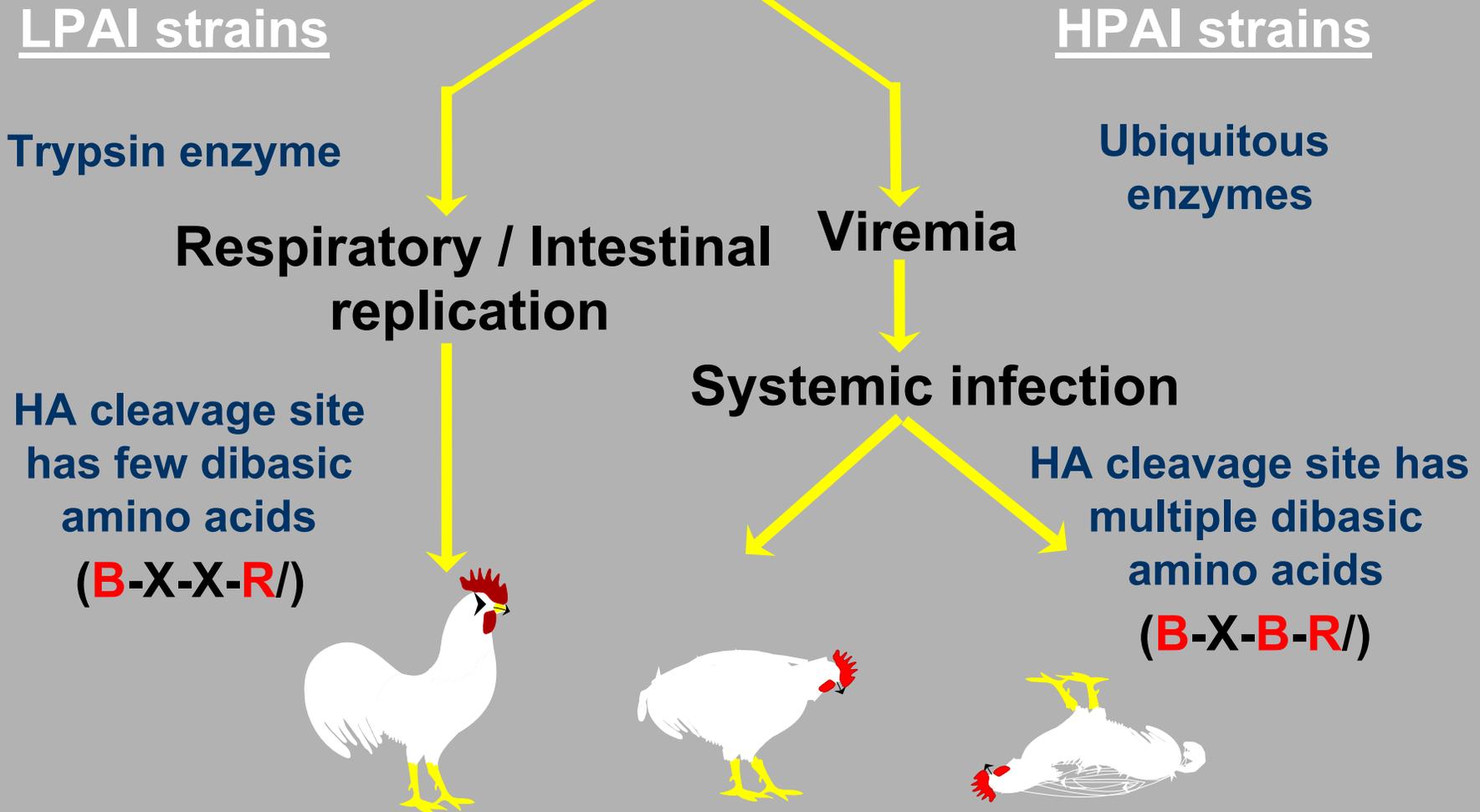
Avian-human species barrier exists



$\alpha 2-3$ Receptors / $\alpha 2-6$ Receptors

Pathogenesis of AI

Replication at point of entry



Clinicopathologic Forms of Avian Influenza

Low Pathogenicity (LPAI)

Localized infection

No or mild disease →
Any subtype
Waterfowl - intestines
Domestic birds- respiratory
No virus in muscle/eggs

Highly Pathogenic (HPAI)

Acute, systemic disease

High mortality
H5 & H7 subtypes
Domestic birds -
chickens, turkeys
Virus in muscle/eggs

LPAI: *Clinical Signs & Lesions*

- First sign: Drop in egg production (layers, breeders)
- Rough, misshapen eggs
- Hemorrhage in ovary



LPAI: *Clinical Signs & Lesions*

- Huddling
- Depression
- Closed eyes
- Sinusitis
- Respiratory signs



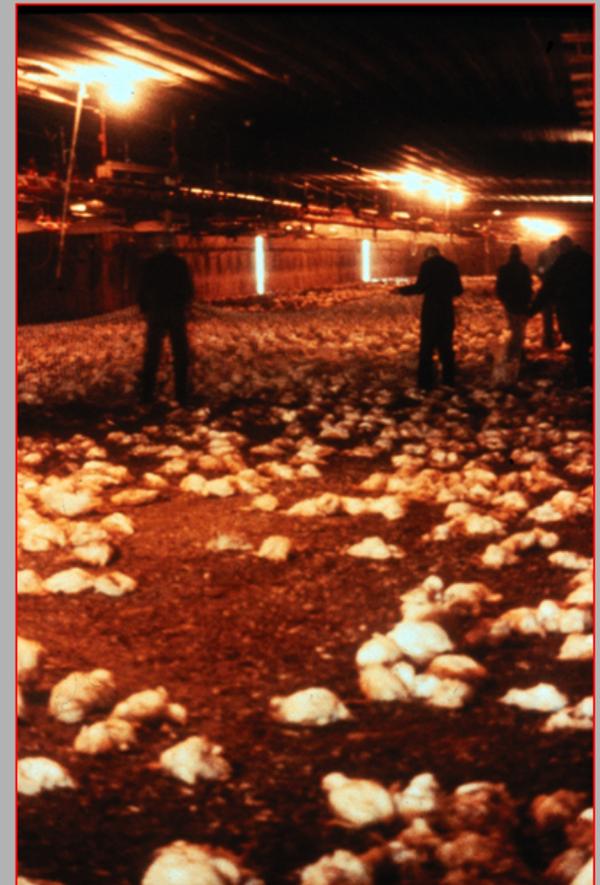
LPAI: *Clinical Signs & Lesions*

- Yolk peritonitis
- Oviduct edema
- Urates in kidney



HPAI: *Clinical Signs & Lesions*

- Sudden onset and high mortality
- Rapid spread
- Severe depression, drop in feed/water consumption



HPAI: *Clinical Signs & Lesions*

External

- Edema of head
- Edema/necrosis of comb/wattle
- Subcutaneous hemorrhage of shanks



HPAI: *Clinical Signs & Lesions*

Internal

- Hemorrhage of trachea
- Visceral hemorrhage
- Petechial hemorrhage on heart
- Petechial (spray paint) hemorrhage on fat deposits



D. Senne

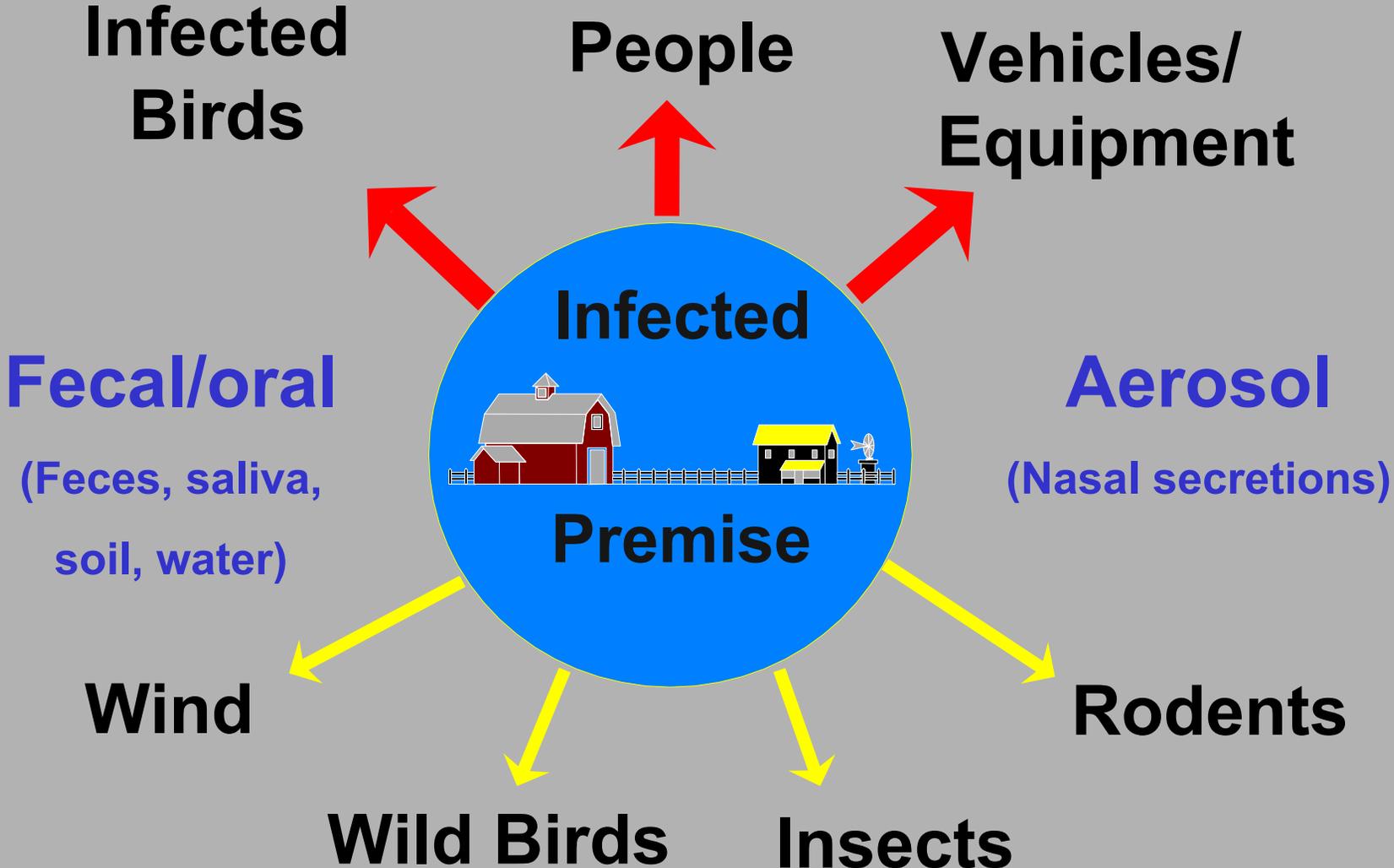
HPAI: *Differential diagnosis*

- **Exotic Newcastle disease (Paramyxovirus)**
- **Avian cholera (Pasteurella)**
- **Duck plague (Herpes virus)**
- **Infectious Laryngotracheitis (ILT - Herpes)**
- **Infectious bronchitis (IBV - Coronavirus)**
- **Water deprivation**
- **Heat exhaustion**
- **Toxins – food or water borne**

How is the AI virus spread among birds?

- Direct contact between healthy and infected birds
- Infected fecal matter
- On the unwashed egg shell surface from feces of infected birds

Methods of Spread: AI Infected Premises



Emergence of HPAI



Live-bird markets



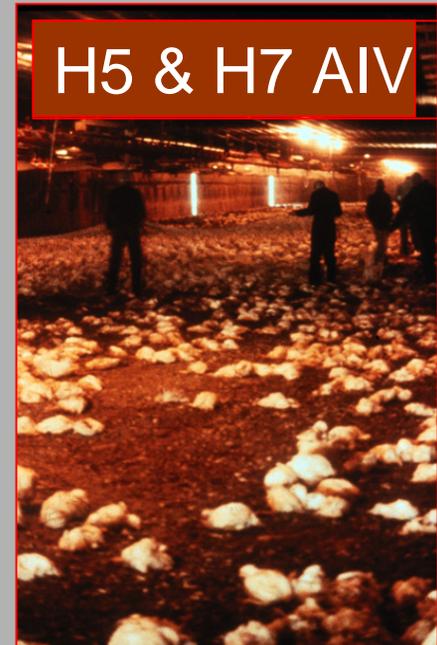
Backyard Poultry



Commercial Poultry

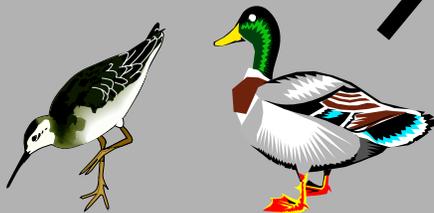


H1-H16



H5 & H7 AIV

AIV in the natural reservoir is genetically stable and LPAI



Host adaptation

Re-adaptation

Asian HPAI H5N1



HPAI outbreaks in poultry since 1959

25 outbreaks - 11 (H5), 14 (H7)

A/chicken/Scotland/59 (H5N1)

A/turkey/England/63 (H7N3)

A/turkey/Ontario/7732/66 (H5N9)

A/chicken/Victoria/76 (H7N7)

A/chicken/Germany/79 (H7N7)

A/turkey/England/199/79 (H7N7)

A/chicken/Pennsylvania/1370/83 (H5N2)

A/turkey/Ireland/1378/83 (H5N8)

A/chicken/Victoria/85 (H7N7)

A/turkey/England/50-92/91 (H5N1)

A/chicken/Victoria/1/92 (H7N3)

A/chicken/Queensland/667-6/94 (H7N3)

A/chicken/Mexico/8623-607/94 (H5N2)

A/chicken/Pakistan/447/94 (H7N3)

A/chicken/NSW/97 (H7N4)

A/chicken/Hong Kong/97 (H5N1)

A/chicken/Italy/330/97 (H5N2)

A/turkey/Italy/99 (H7N1)

A/chicken/Chile/2002 (H7N3)

A/chicken/Netherlands/2003 (H7N7)

A/chicken/SE Asia/2003 (H5N1)*

A/chicken/USA-Texas/2004 (H5N2)

A/chicken/Canada-BC/2004 (H7N3)

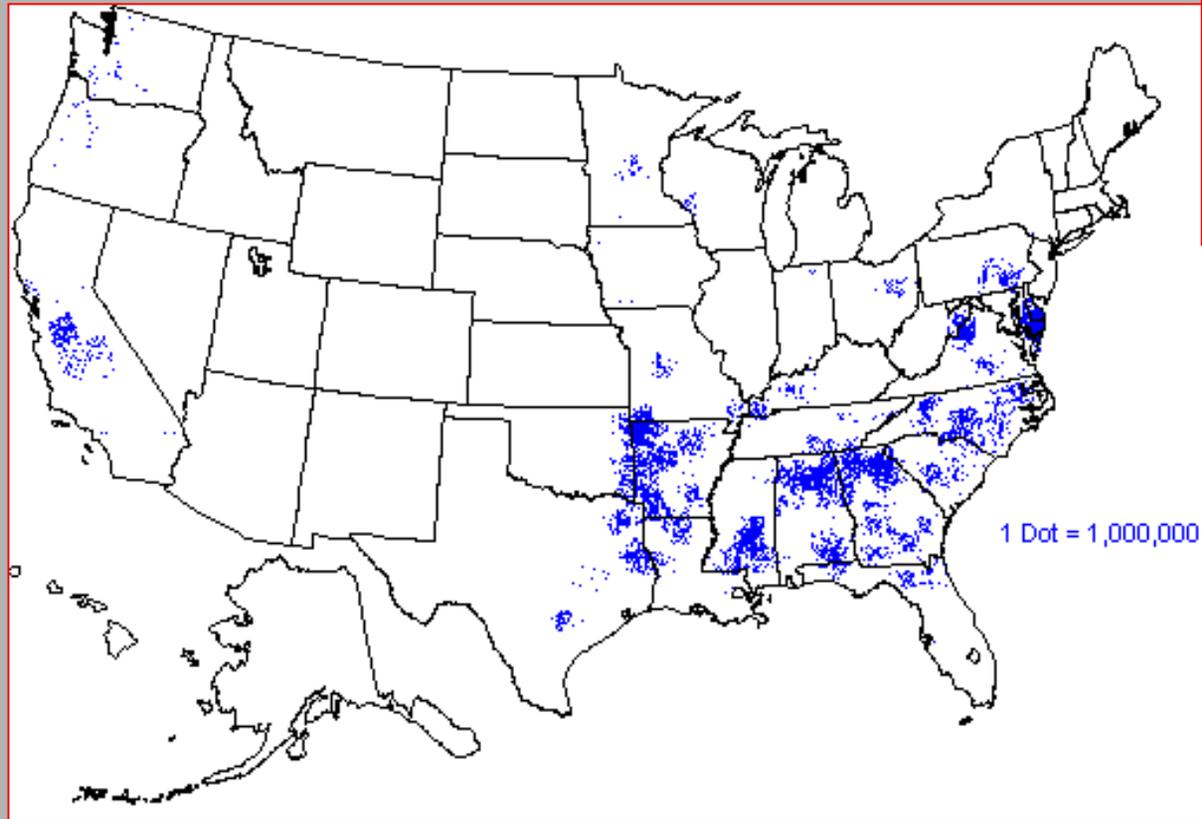
A/Ostrich/South Africa/2004 (H5N2)

* Largest outbreak in last 50 years

Compartmentalization



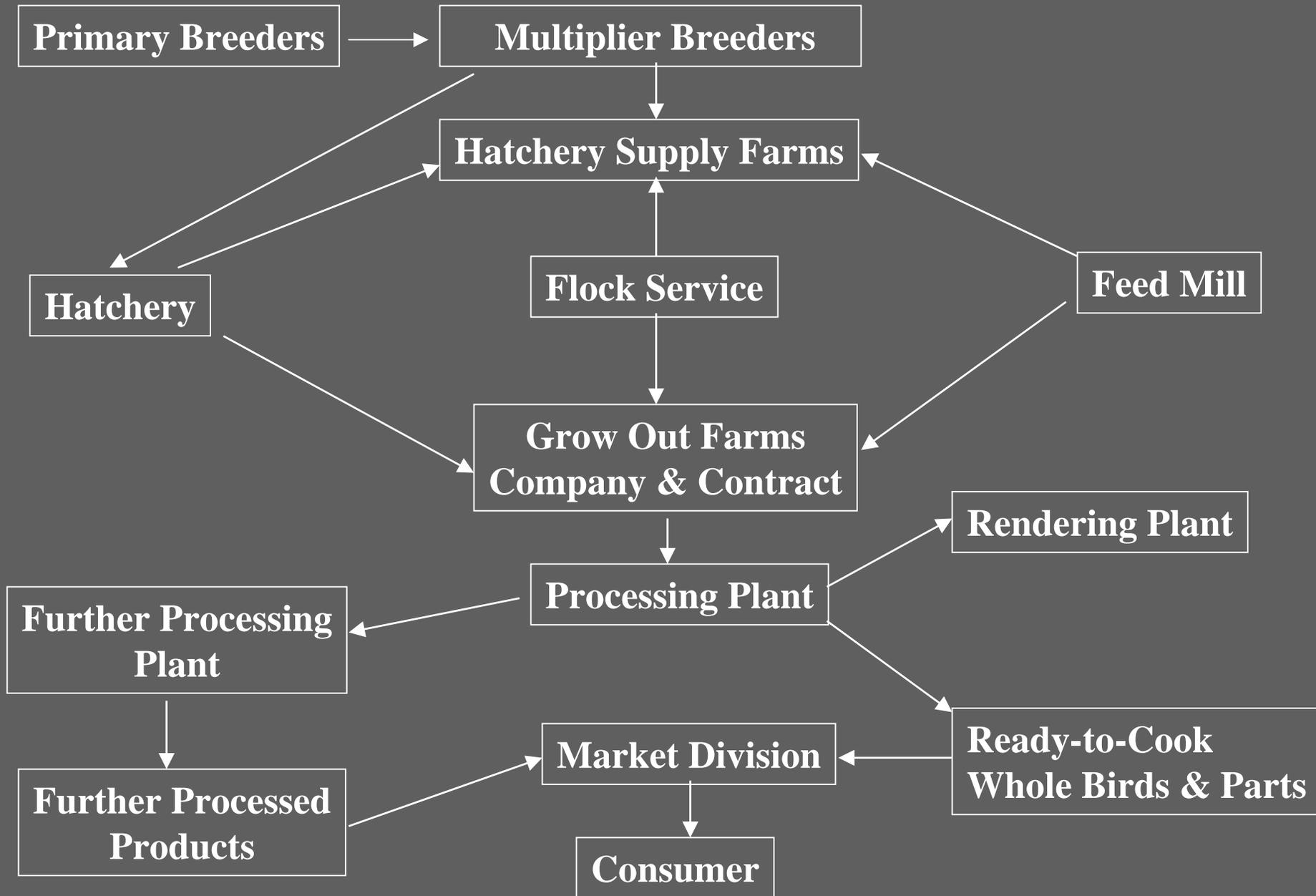
Top Broiler States



**Georgia, Arkansas, Alabama, N. Carolina, Mississippi,
DelMarVa, California**

Tyson Foods, Gold Kist, Pilgrim's Pride, Perdue Farms, Wayne Farms, Fieldale Farms

Vertical Integration in the Broiler Industry



Poultry Industry Feed Production

- Companies often operate own feed manufacturing facilities and transport feed to farms
- Typical company may supply four to five different feeds throughout life of flock





Meat-type Chickens

Broiler Growers

- Newly hatched broiler chicks are transported to contract growers (or company growers)
- Growers care for and raise birds under supervision of technical service personnel
- Grower provides labor, properly equipped housing, and utilities
- Company provides birds, feed, medication, technical support and load-out crew

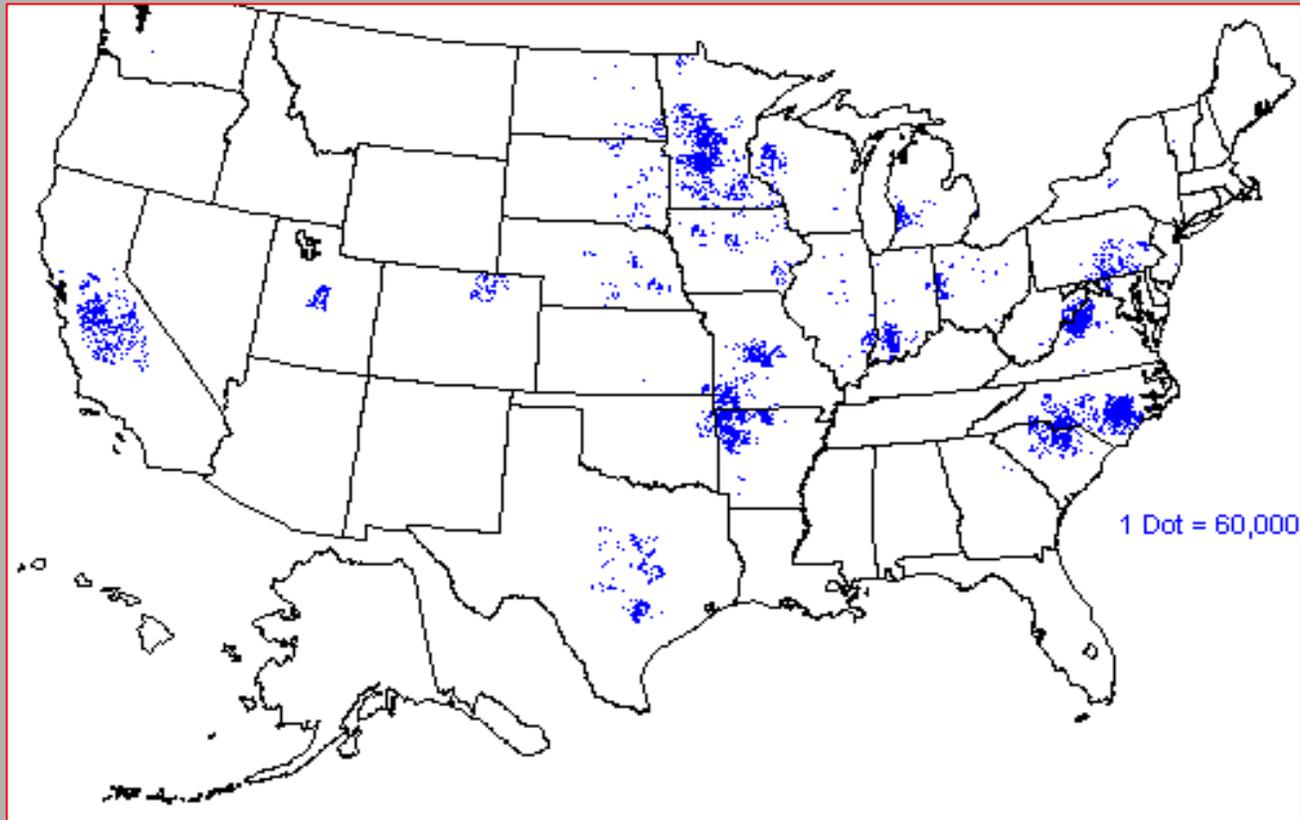


Broiler Industry-Summary

- Vertical Integration allows company control of product and costs of production
- Contract growers shift burden of production facilities away from company
- Development of value added products has increased cost of processing but stabilized market



Top Five Turkey States



Minnesota, N. Carolina, Arkansas, Virginia, Missouri

Jennie-O Foods, Butterball Turkey, Pilgrim's Pride,
Cargill North American, Carolina Turkey

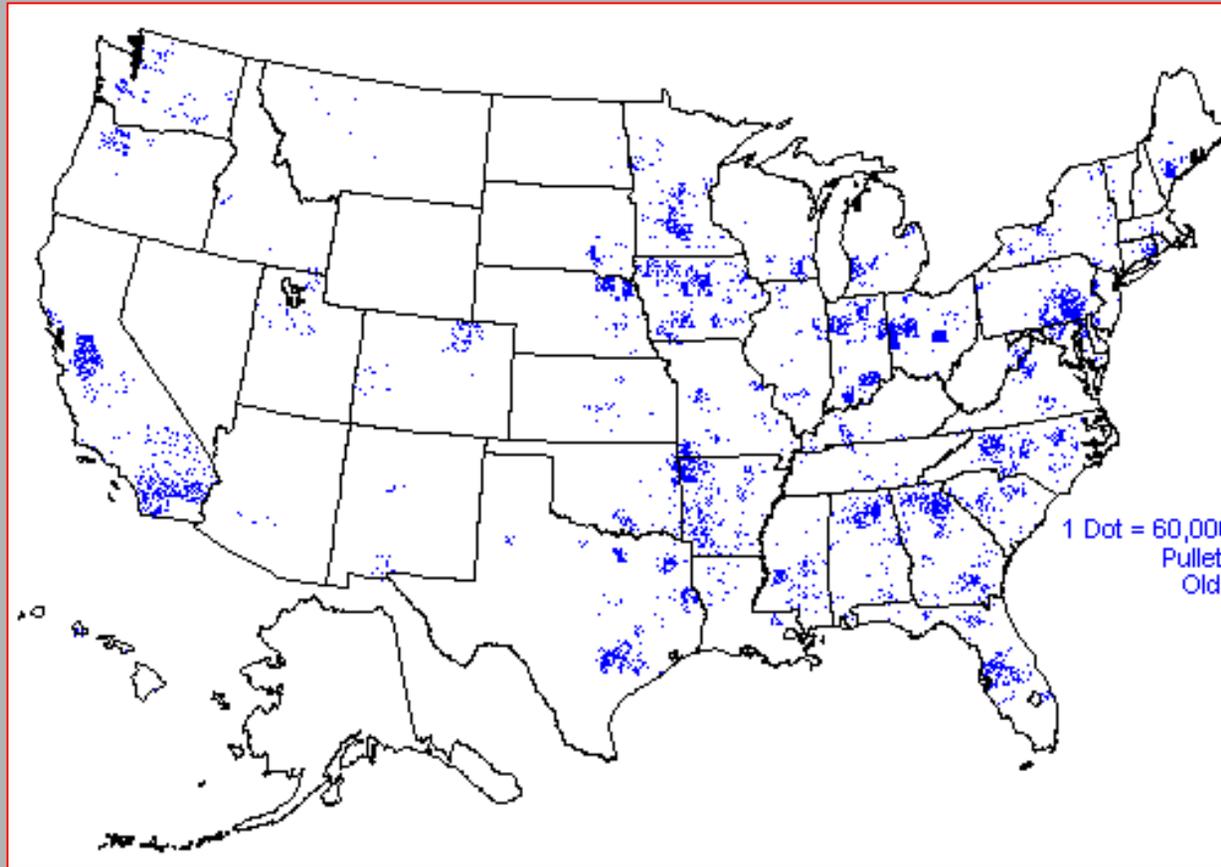


Turkey Industry



- Primarily located in Southeast and Midwest
- Level of integration similar to broiler industry
- Turkeys grown in two or more facilities during live of flock
- Toms grown separately from hens
- Has a slightly higher cost of production facilities versus broiler industry
- Turkey industry has maintained commodity status and has greater fluctuations in supply and demand

Top Egg Production



Iowa, Ohio, Indiana, California, Pennsylvania, Indiana, Georgia
 Cal-Maine Foods, Rose Acre Farms, Michaels Foods

Commercial Layers

- Production companies buy day-old pullets from genetic-line companies and raise in company owned cage facilities
- Raise pullets to production age (18 weeks)
- Transfer birds to concentrated layer facilities
- Many companies have million bird complexes
- Birds remain in production as long as 110 weeks
- Egg industry has remained a commodity supplier and is very much dependent on supply and demand for price of product



Questions?



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