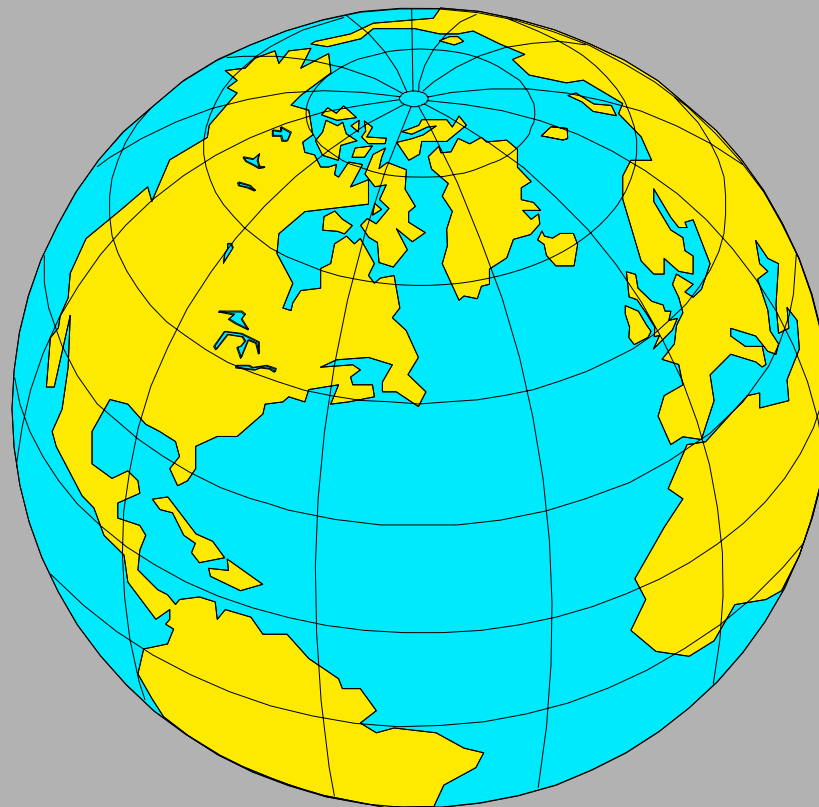


# Newcastle Disease

**Dennis A. Senne**

dennis.a.senne@aphis.usda.gov



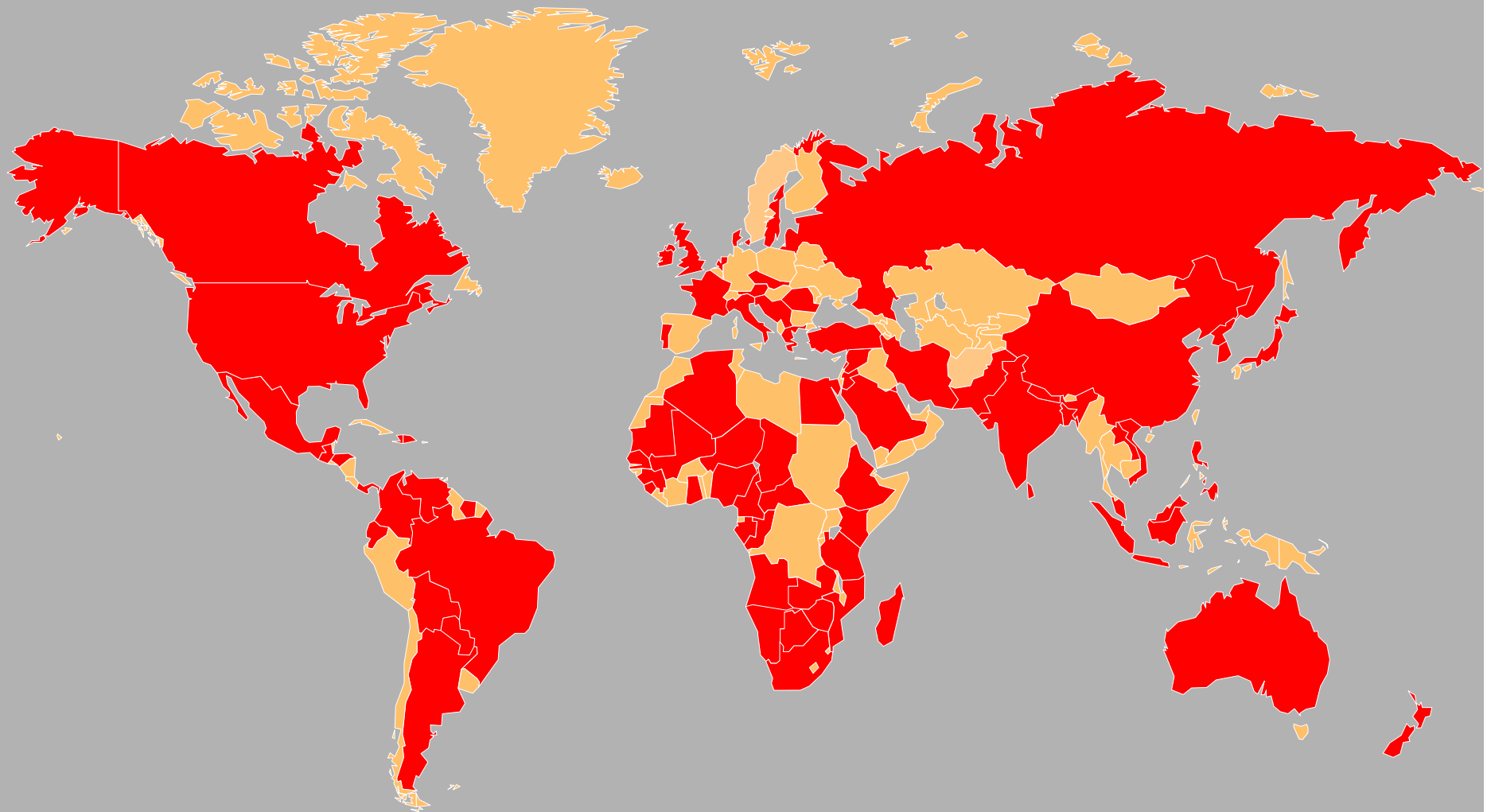
U.S. Department of Agriculture, Animal and Plant Health Inspection Service,  
Veterinary Services, National Veterinary Services Laboratories, Ames, IA 50010

# Newcastle Disease (ND)

## *Definition:*

- **Highly contagious viral disease of chickens, turkeys, and most other birds. The most severe form of the disease is characterized in chickens by high mortality, nervous signs and hemorrhagic and necrotic lesions in the gut mucosa**
- **Zoonotic disease**
- **ND is reportable to the World Organization for Animal Health (OIE).**

# Reports of ND to OIE, 1997-2000



● Countries positive (106)

# Classic Key Lesions



Hemorrhage/Necrosis



# Newcastle Disease (ND)

## *Etiology:*

**Family: Paramyxoviridae**

**Subfamily: Paramyxovirinae**

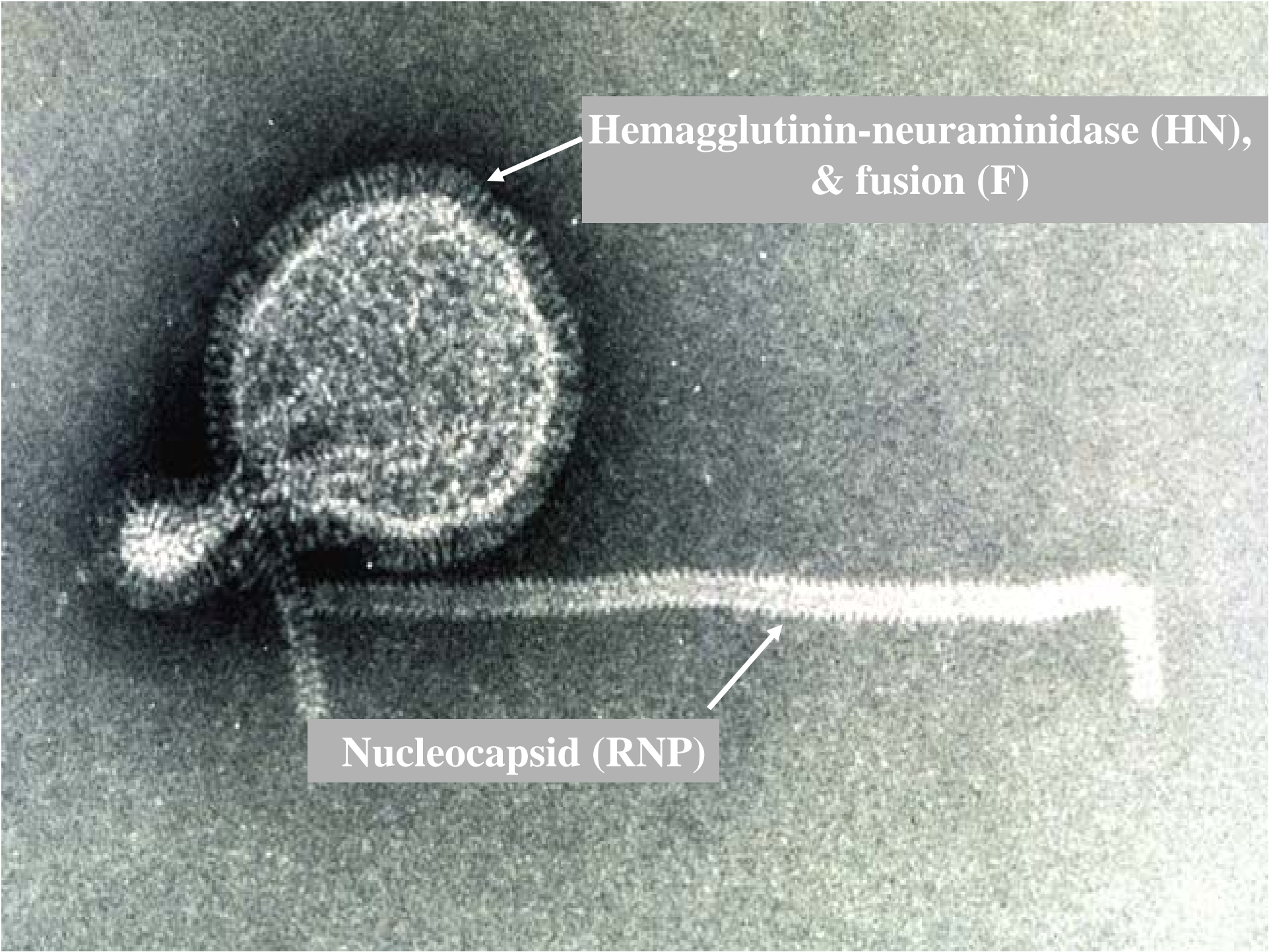
**Genus: Avulavirus**

## **Virus serotype:**

1. **APMV-1 – virulence varies**
2. **Other APMV serotypes – APMV-2 through APMV-9**

Hemagglutinin-neuraminidase (HN),  
& fusion (F)

Nucleocapsid (RNP)



# Newcastle Disease (ND)

## *Host Range and Disease:*

- **Most species of birds, both domestic and wild**
- **Chickens/turkeys – most susceptible, ducks – least susceptible**
- **Mortality/morbidity influenced by species, strain of virus, environmental factors, and vaccination practices**
- **A carrier state can exist in psittacine birds and others??**

# Newcastle Disease (ND)

## *Epidemiology:*



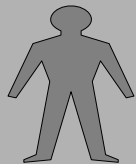
- Poultry (backyard flocks)



- Pet birds (smuggled)



- Wild birds (cormorants)



- Humans (careless activities)



# Epidemiology



**Back Yard  
Poultry**

**Back Yard  
Game Fowl**



R. Cook

# Epidemiology



## Virus Shedding in Experimentally Inoculated Pet Birds

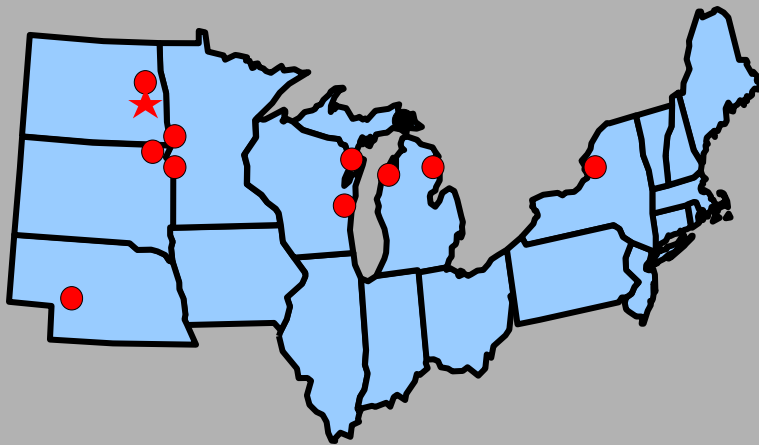


- Parrots >383 days
- Budgarigars 133 days
- Conures 112 days
- Mynahs 119 days
- Nuns 84 days
- Canaries 35 days

# Epidemiology



## Double Crested Cormorants



- 1992 – major outbreak
- Numerous outbreaks between 1995-2001
- 2003 (VT, NY, OR)
- 2005/06 (NV, WI)



# Epidemiology



## NVNDV in Turkeys

### *North Dakota – 1992:*

- **26,000 13-week-old hens on range**
- **Located 4 miles from positive cormorants**
- **700-1000 with clinical disease**
- **500 died**



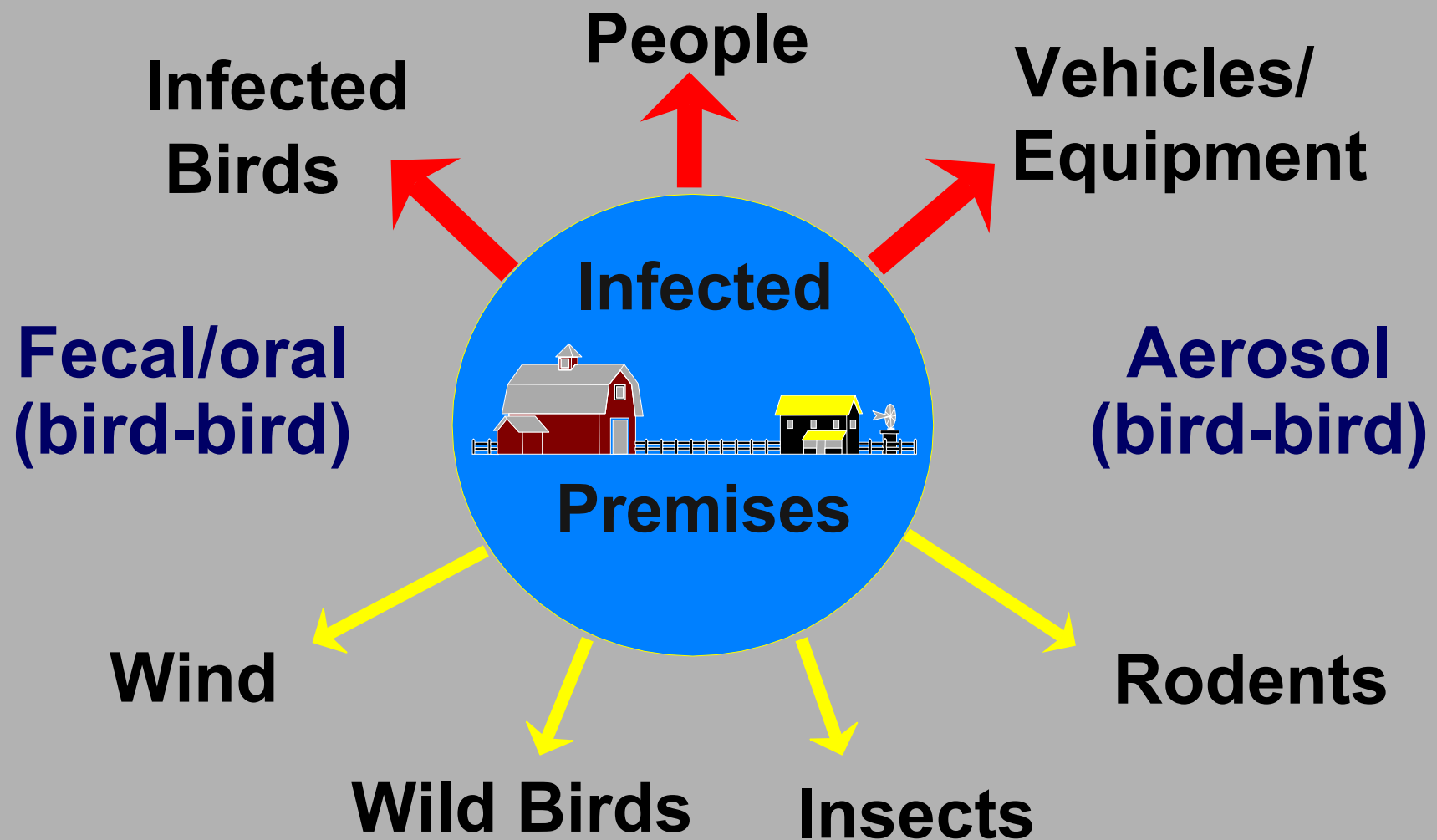
# Epidemiology



**Human can also be a host species**



# Methods of Spread: ND Infected Premises



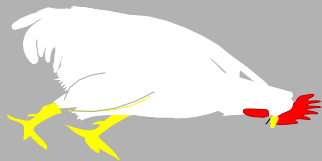
## Incubation and shedding of virus

- **Incubation period 2 to 15 days**
  - Chickens typically 2-6 days
- **Duration of virus shedding is highly variable depending on species other factors**
  - Chickens usually less than 2 weeks
  - Psittacine infected for very long time and clinically normal
- **Can have shedding and circulation of virus within a vaccinated flock**

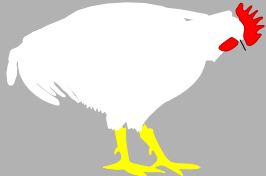


# Newcastle Disease (ND)

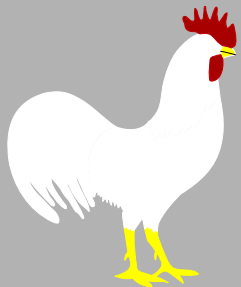
## *Clinicopathologic Forms:*



- **Velogenic (most virulent form)**
  - Viscerotropic velogenic (VVND)
  - Neurotropic velogenic (NVND)



- **Mesogenic (intermediate form)**



- **Lentogenic (mild form, vaccines)**
  - Respiratory
  - Asymptomatic enteric

# Newcastle Disease (ND)

## *OIE Definition*

- **APMV-1 serotype and:**
- **Intracerebral Pathogenicity Index of  $\geq 0.7$** 
  - Inoculate ten, 1 day old chicks, and give a numerical value for the number ill and dead each day

**OR**

- **Multiple basic amino acids at the C terminus of F2 (fusion) protein and phenylalanine at residue 117 (NH2 terminus of F1)**

# Pathogenesis of ND

## Replication at point of entry

Avirulent strains

Virulent strains

F cleaved by trypsin

F cleaved by furin

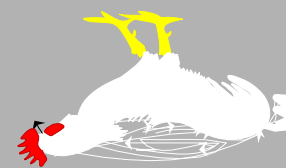
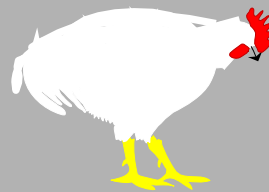
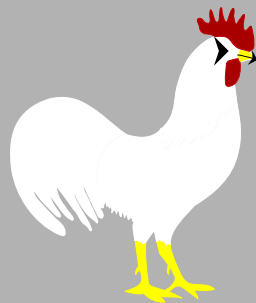
Respiratory / Intestinal replication

Viremia

Systemic infection

Few basic amino acids, /L  
(B-X-X-R/L)

Multiple basic amino acids, /F  
(B-X-B-R/F)



# General Features of ND in Vaccinated and Non Vaccinated Poultry

- Non Vaccinated poultry
  - high morbidity and mortality (>90%)
  
- Vaccinated poultry -
  - low morbidity and mortality (0.7 – 5%)



# Newcastle Disease

## *Clinical Signs & Lesions:*

- Sudden onset and high mortality
- Rapid spread
- Drop in egg production, misshapen eggs



# Newcastle Disease (ND)

## *Clinical Signs and Lesions:*

- Respiratory signs
- Depression/CNS



## Poultry:

- No pathognomonic gross lesions
- **Viscerotropic strains**
  - Necrosis, hemorrhage: oral cavity, pharynx, trachea, proventriculus, gut, and cecal tonsil
  - Peritracheal-head edema
- **Neurotropic strains**
  - Mortality with no gross lesions

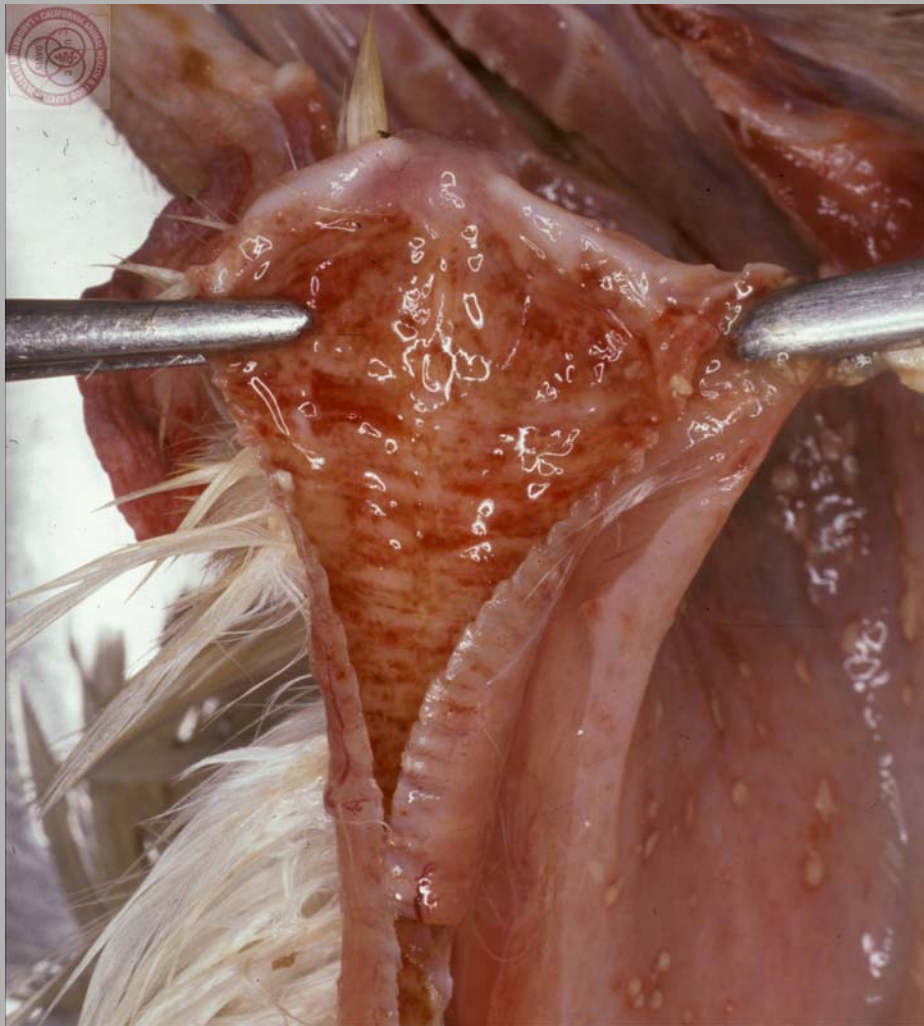


# Pathology

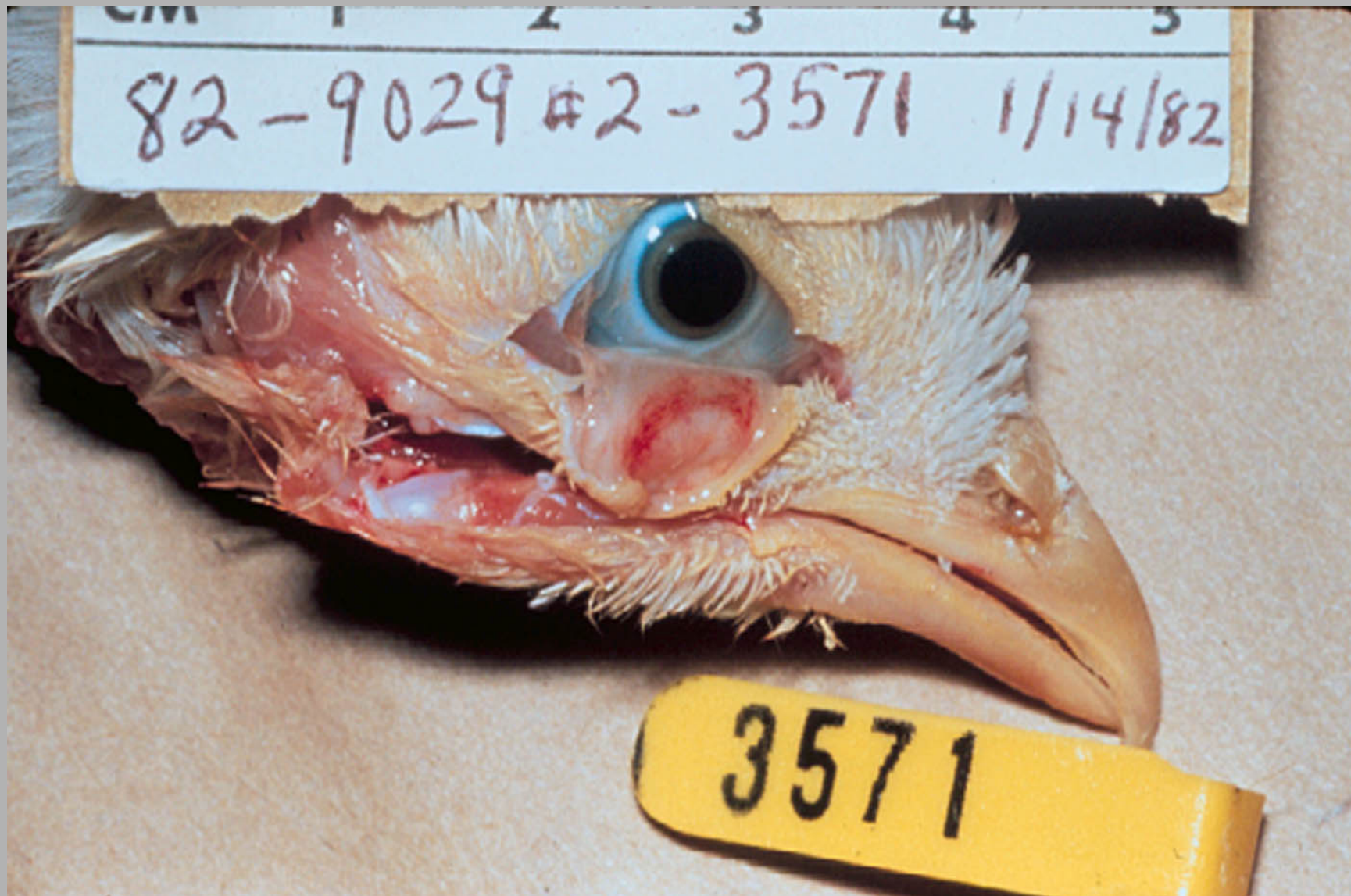




# Pathology



# Pathology



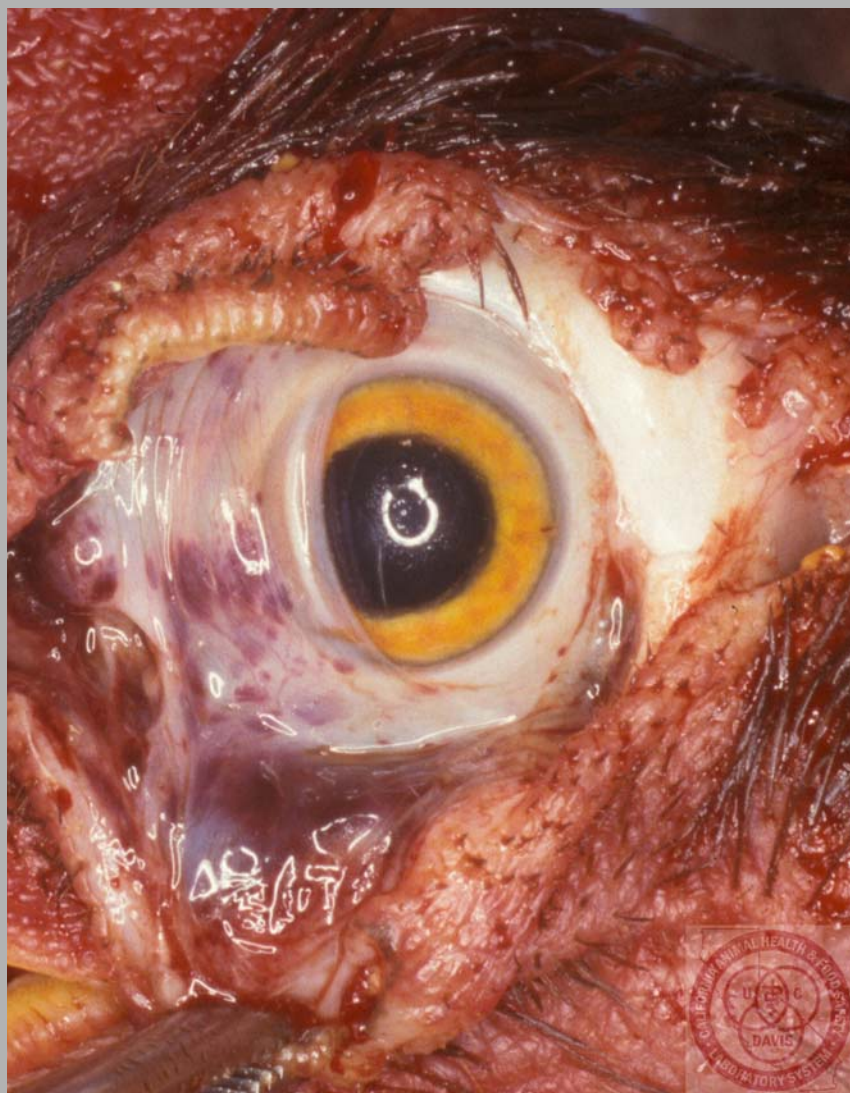
# Pathology



## Classic Game fowl lesion for 2002-3 Outbreak



# Pathology



# Pathology



# Newcastle Disease (ND)

## *Clinical Signs in Pet Birds:*

- **Respiratory signs**

- Rapid/labored breathing
- Wheezing/sneezing



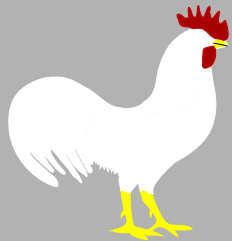
- **Central nervous signs**

- Depression
- Paralysis (wing droop, leg weakness)
- Head shaking

**WING DROOP**  
**ATAXIA**  
**DYSYPNEA**

# Newcastle Disease (ND)

## *Differential Diagnosis:*



- Acute fowl cholera
- Avian influenza
- Infectious laryngotracheitis
- Fowl pox (diphtheritic form)



- Psittacine herpes virus (Pacheco's disease)
- Chlamydiosis (psittacines)



# **Sample collection END is the same as sample collection for AI**

**Why is sample collection the same?**

- 1. Serology**

- When is serology useful for END?**

# Sample Collection (cont'd)

## 2. Tissue

- Lung and spleen, any affected organ (brain if CNS)
- Do not pool tissue from different birds
- Typically sample 3-5 birds per flock

## 3. Swabs – tracheal or oropharyngeal, cloacal

- Can pool (up to 5/tube)
- Do not mix TR/OP with cloacal swabs
- Typically sample 30 birds per flock

### ■ Shipping/Storage of tissue and swabs

- Short term (up to 3-4 days): 4C
- Long term: -70C

# Newcastle Disease (ND)

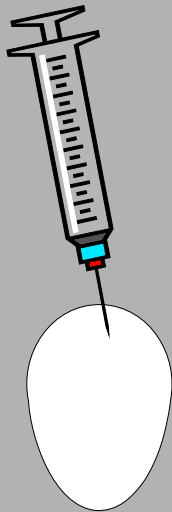
## *Diagnosis:*

### ■ Virus Isolation (gold standard)

- Necessary for virus characterization
- Embryonating chicken eggs – takes 2-12 days
- Specimens to collect:
  - tracheal/oropharyngeal & cloacal swabs
  - Lung, spleen (brain if CNS)

### ■ Serology

- HI, ELISA – same day
- Not useful to diagnose virulent ND



# Molecular Diagnostics

- Real Time RT-PCR (RRT-PCR)
  - Highly sensitive (85-95%) and specific (>98-99%)
  - Results in 2.5 hr
  - Can differentiate virulent from avirulent virus



# Disinfectants

- Peroxygens (Virkon-S)
- Iodophores
- Phenolics
- Quaternary ammoniums
- Ethanol
- Bleach



# On-Farm Biosecurity

- Use good management practices - all-in, all-out
- Limit access to farm
- Buy from reputable sources
- Provide clean clothing and boots to workers
- Protect poultry, feed and water from contact with other birds/feces
- Clean and decontaminate all vehicles and equipment coming on to the farm
- Don't bring in equipment from other farms
- Avoid visiting other farms and live bird markets

# Newcastle Disease (ND)

## *Prevention/Control:*

### ■ Vaccination:

#### – Live virus

- Lentogenic strains (B1, La Sota)
- Administered by spray or in water
- Multiple exposures needed

#### - Killed virus

- Oil-emulsion, administered SQ
- Used in layers, breeders (after live virus)

# National Biosecurity

- **Import restrictions** on poultry and poultry products and hatching eggs from countries with Newcastle disease
  
- **Heighten border surveillance**
  
- **Testing Imported live and caged birds**
  - 30 day quarantine
  - Laboratory testing required




# Newcastle Disease

## *Summary:*

- **Very important viral disease of poultry**
- **Numerous outbreaks recorded worldwide**
  - Commercial poultry
  - Illegal bird imports (pet and backyard fowl)
  - Wild birds - cormorants
- **Virulent forms are reportable**
  - Domestic poultry – high mortality, hemorrhagic gut lesions, CNS
  - Pet birds – respiratory, CNS
- **Control**
  - Vaccination
  - Biosecurity, movement restrictions (pet birds and poultry)

# Acknowledgements

- **Dr. Bruce Thomsen (NVSL)**
- **California Animal Health and Food Safety**



**Thank You For Your  
Attention!**

**NVSL, Ames, Iowa**

**OIE Reference Laboratory:  
Avian Influenza  
Newcastle disease**