May 2006

Public Health Confronts the Chicken, the Hamster, and the Goat

W. John Pape
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Public Health Confronts The Chicken, The Hamster and The Goat

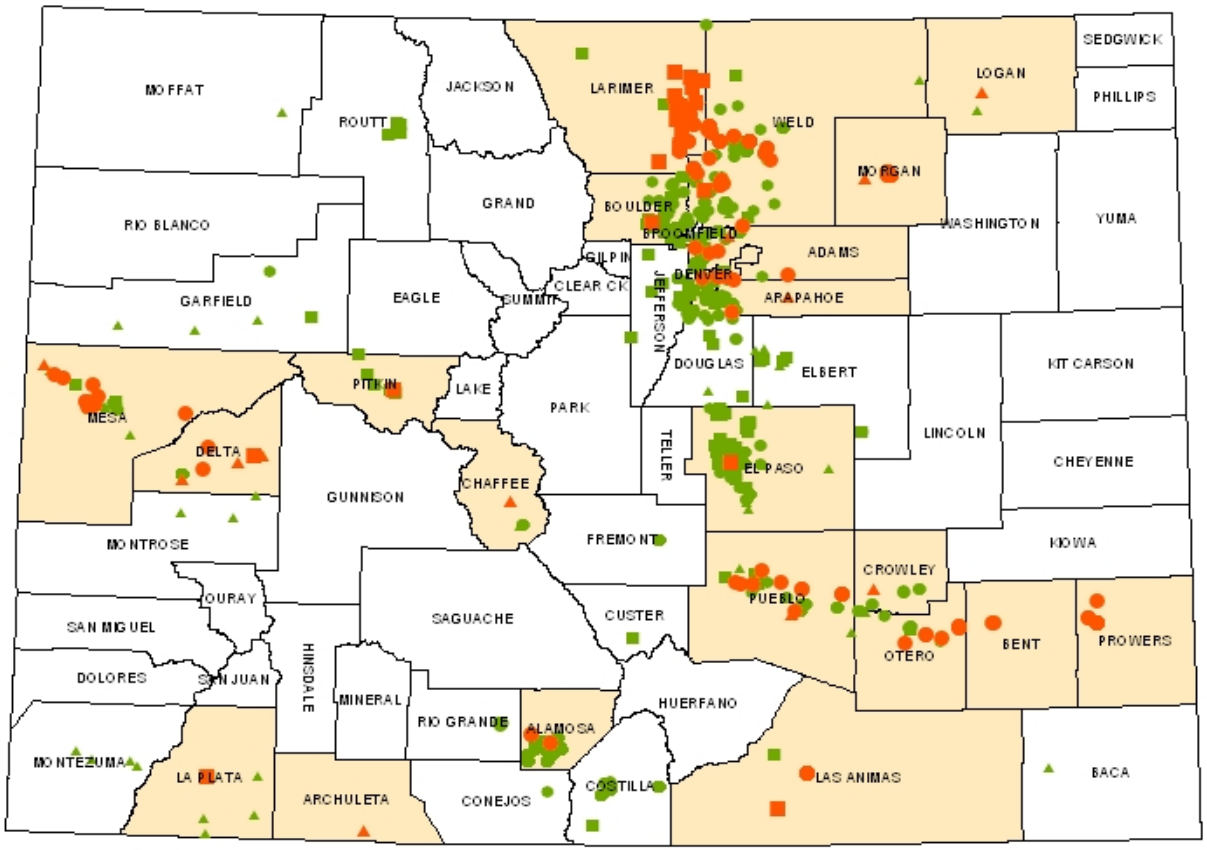
John Pape, Epidemiologist
Communicable Disease Epidemiology Program
Colorado Department of Public Health & Environment

Zoonoses: Diseases of animals transmissible to humans under natural conditions

Characteristics of Zoonoses

- **common in natural reservior, uncommon in people**
- **rural exposure**
- **serious disease, high fatality rates**
- **complex cycles**
- **prevention via "The Weakest Link"**
- **zoonotic diseases comprise the majority of potential bioterrorist agents and emerging infections**

Primary inoculation site, Marshfield index case, 5/26/03
Hospital day 4, 13 days following prairie dog bite



2005 Colorado West Nile Virus

October 7, 2005 Animal Surveillance

Legend

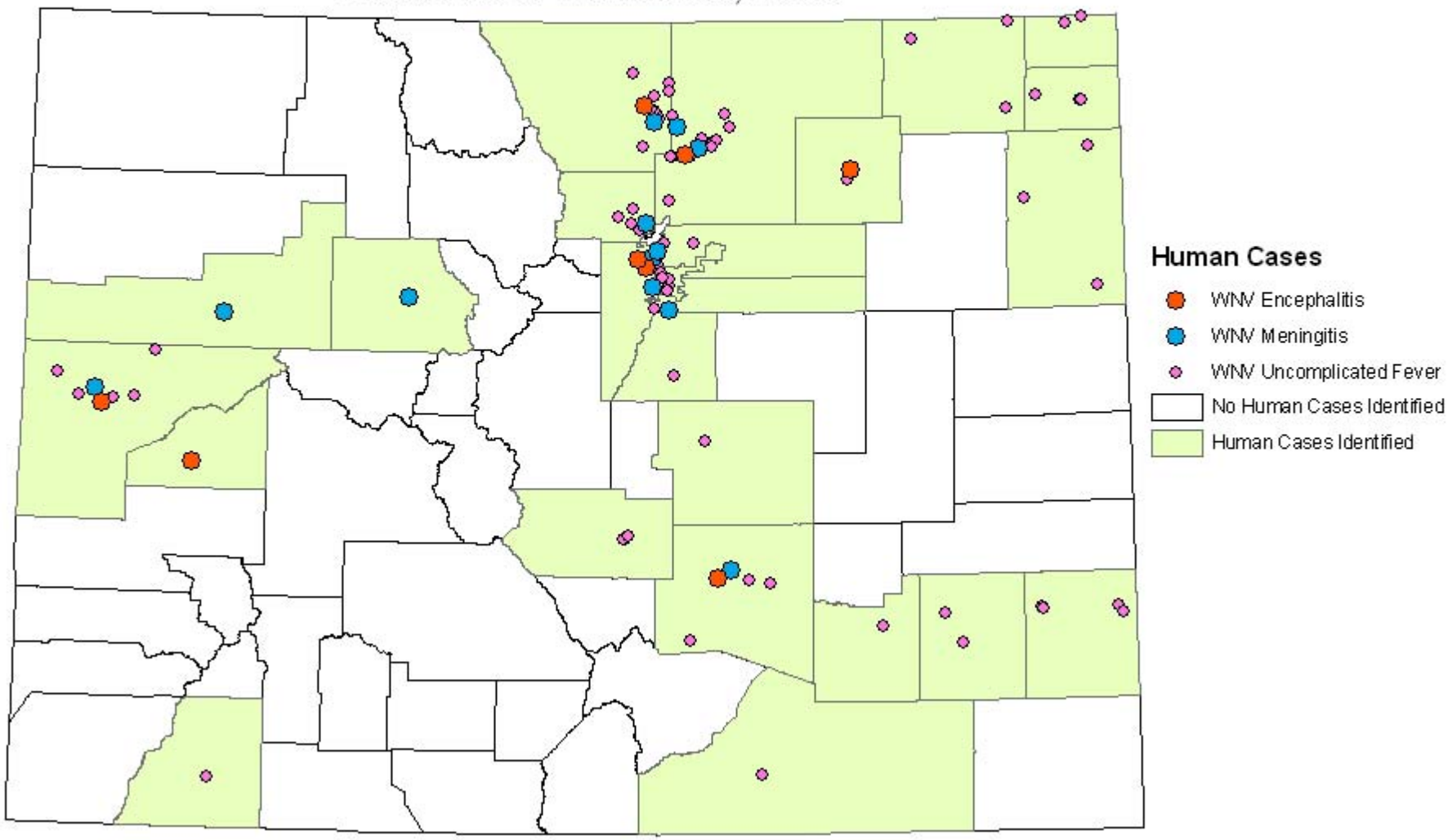
- Positive Bird
- Positive Rodent
- Positive Horse
- Positive Mosquito
- Negative Bird
- Negative Horse
- Negative Mosquito
- Positive tests

Colorado Department of Public Health and Environment

October 7

Colorado West Nile Virus Human Cases 2005

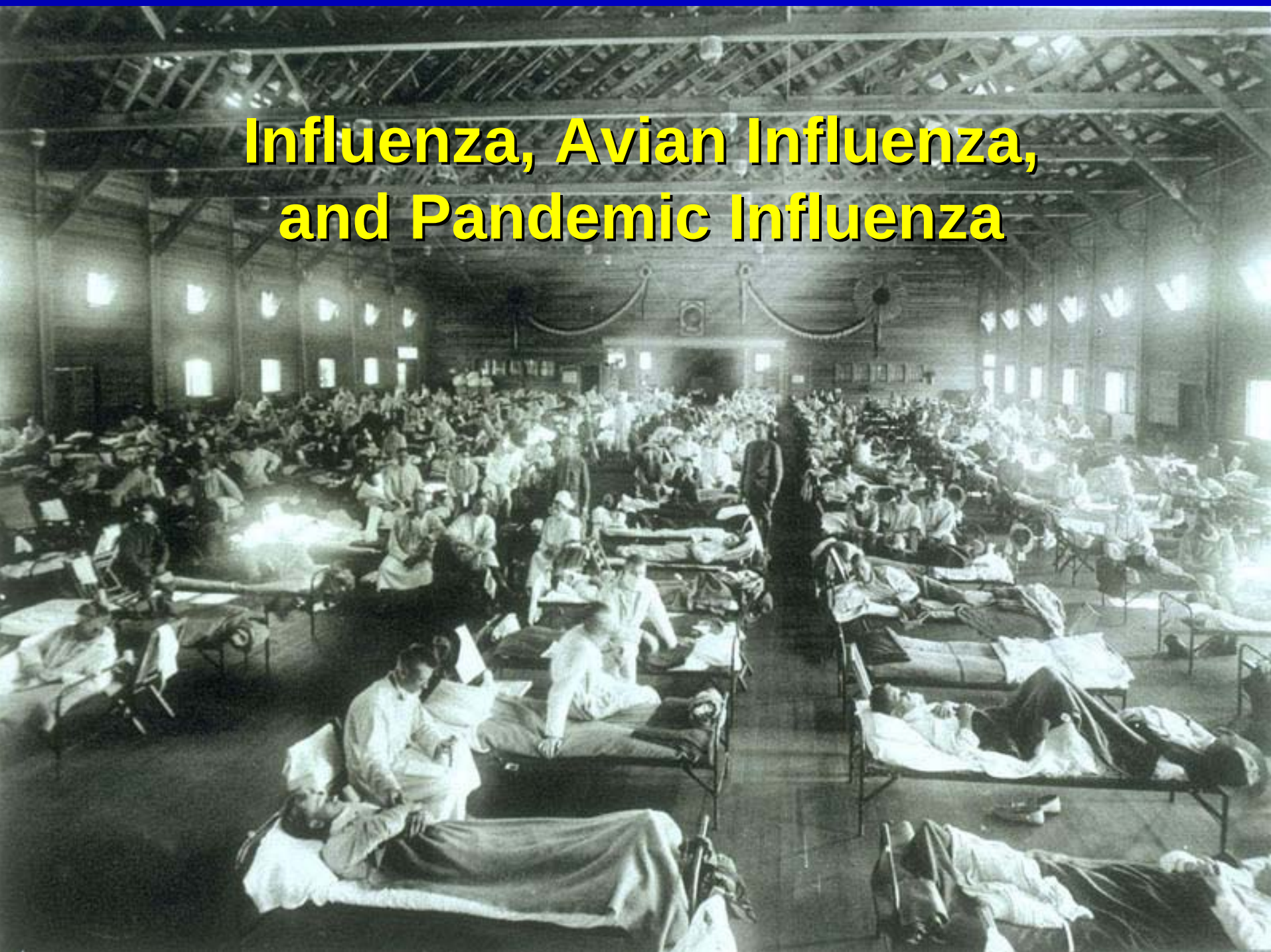
Status as of November, 2005

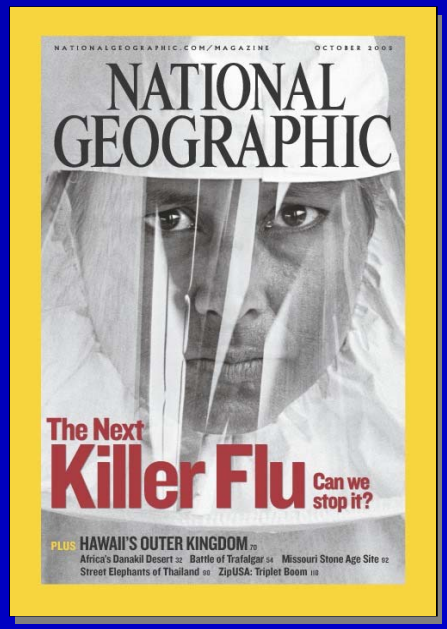


N=101

NOTE: Points have been displaced from actual location to protect confidentiality.

Influenza, Avian Influenza, and Pandemic Influenza




NATIONALGEOGRAPHIC.COM/MAGAZINE
OCTOBER 2005
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The Next
Killer Flu
Can we stop it?
PLUS HAWAII'S OUTER KINGDOM 70
Africa's Danakil Desert 32
Battle of Trafalgar 54
Missouri Stone Age Site 92
Street Elephants of Thailand 98
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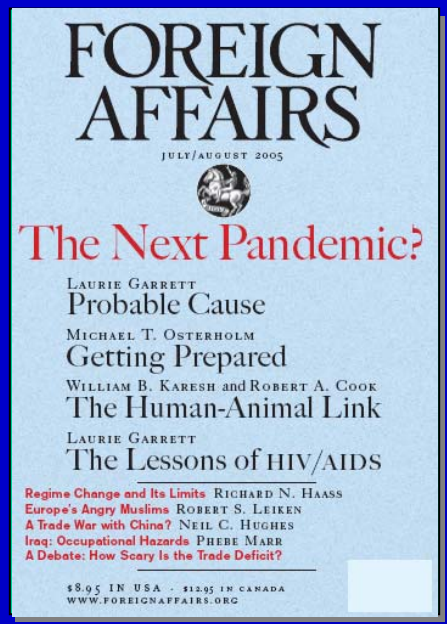
nature
BOVINE TUBERCULOSIS
Cattle movements spread disease
SOLAR SYSTEM EVOLUTION
When the giants held sway
PLANT HORMONES
At last, an auxin receptor
VISUAL SEARCH
Can't see for looking?
AVIAN FLU
Ready for a pandemic?
Gene therapy


BusinessWeek
Major quake in California. Avian flu in Chicago.
Dirty bomb in New York. Are we prepared?
THE NEXT BIG ONE
EMERGENCY


TIME
AVIAN FLU
DEATH THREAT


FOREIGN AFFAIRS
JULY/AUGUST 2005
The Next Pandemic?
Laurie Garrett
Probable Cause
Michael T. Osterholm
Getting Prepared
William B. Karesh and Robert A. Cook
The Human-Animal Link
Laurie Garrett
The Lessons of HIV/AIDS
Regime Change and Its Limits Richard N. Haass
Europe's Angry Muslims Robert S. Leiken
A Trade War with China? Neil C. Hughes
Iraq: Occupational Hazards Phebe Marr
A Debate: How Scary Is the Trade Deficit?
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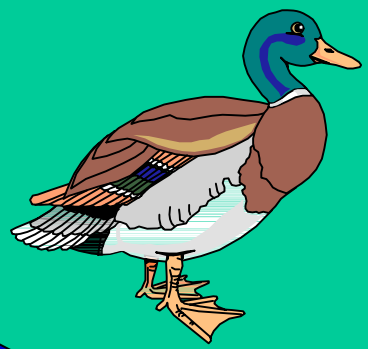
TIME
BIRD FLU

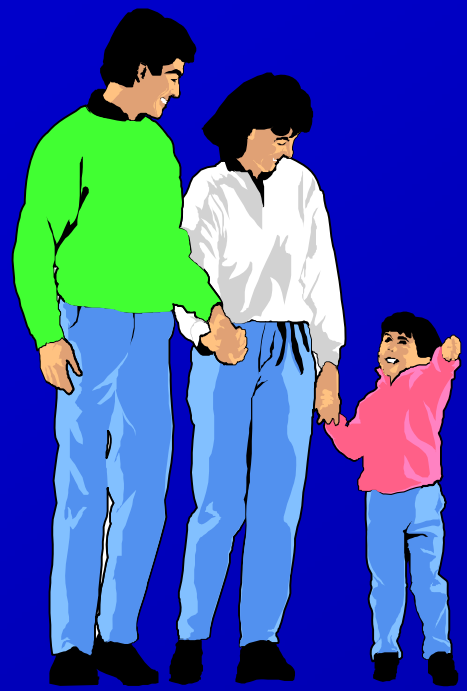
Wild Bird Population

Avian Influenza A Viruses H1 – H16

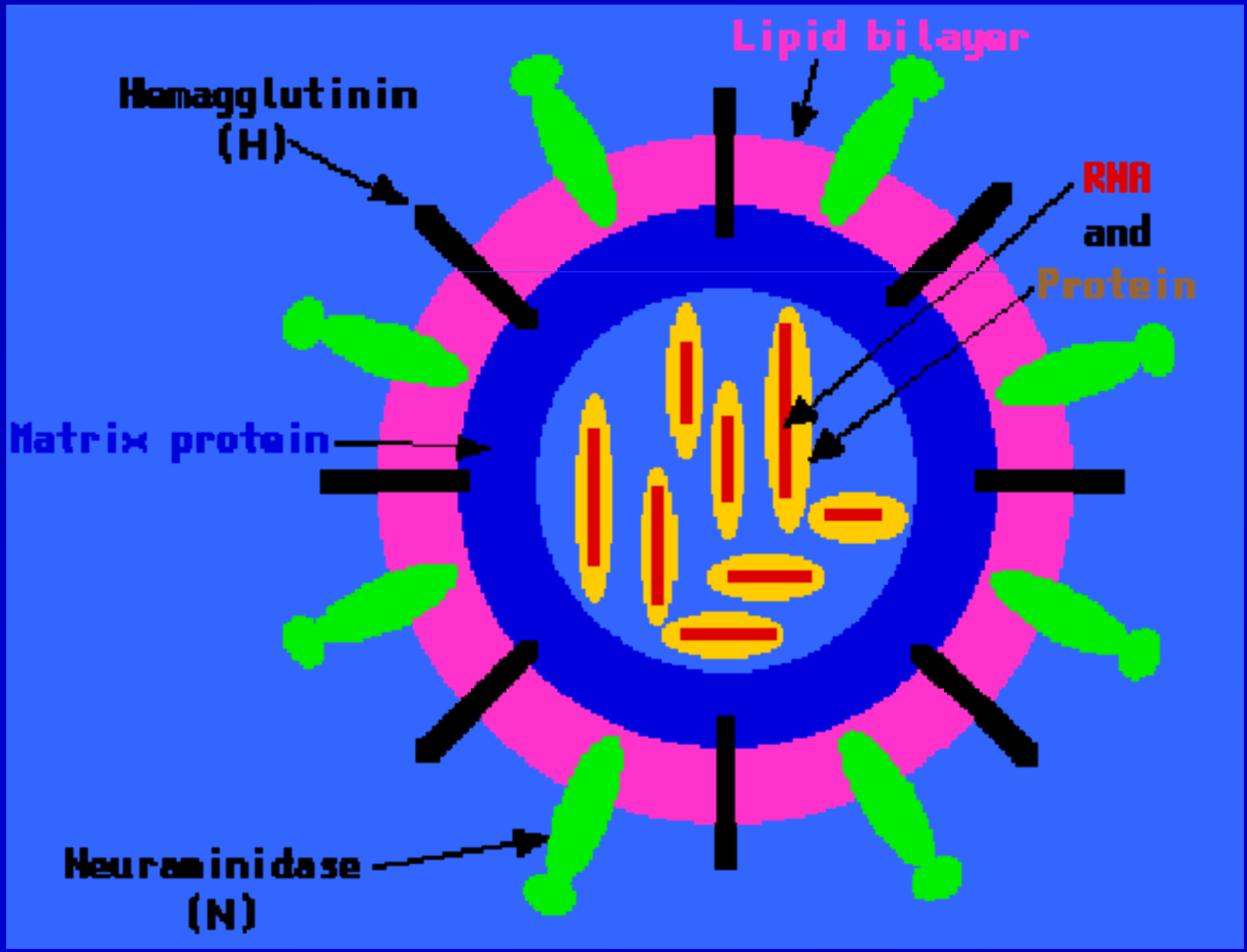


H1 – H3

Human Influenza A Viruses



Influenza A Virus



Type A Influenza Viruses

- Host range: [humans, pigs, birds, horses, marine mammals]

- Antigens/surface proteins:
  - Hemaglutinin (HA) → 16 distinct types (H1 - H16)
  - Neuraminidase (NA) → 9 distinct types (N1 – N9)

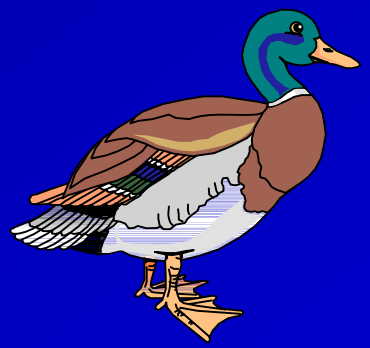
- Human infections primarily:
  - H1, H2, H3
  - N1, N2 (? N8)
  - Since 1977, H1N1 & H3N2 have co-circulated

How Influenza Viruses Change

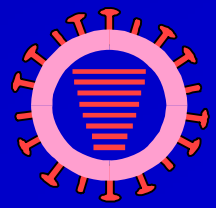
- **Drift:**
  - Minor changes in structure of (H) and (N)
  - Result of cumulative point mutations in viral RNA
  - Occurs frequently → new "strain" (of A or B)
  - Reason for updated vaccine formulation annually

- **Shift:**
  - Major change thru reassortment ("swapping") of RNA
  - Result is new "virus subtype" (i.e. new "H" or "N")
  - Populations have no immunity to new subtype
  - Occurs infrequently → may result in pandemic

Mechanisms of Influenza Virus Antigenic "Shift"

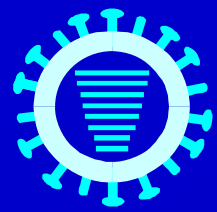


16 HAs
9 NAs

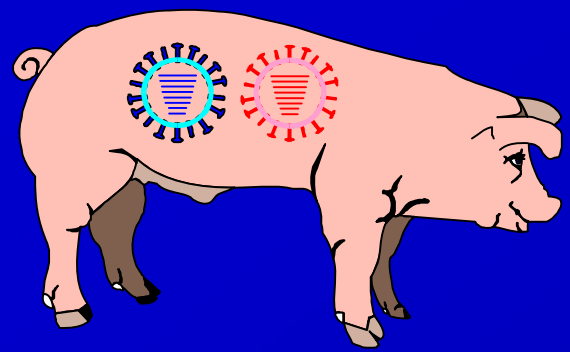


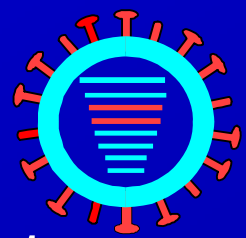
Non-human virus

DIRECT



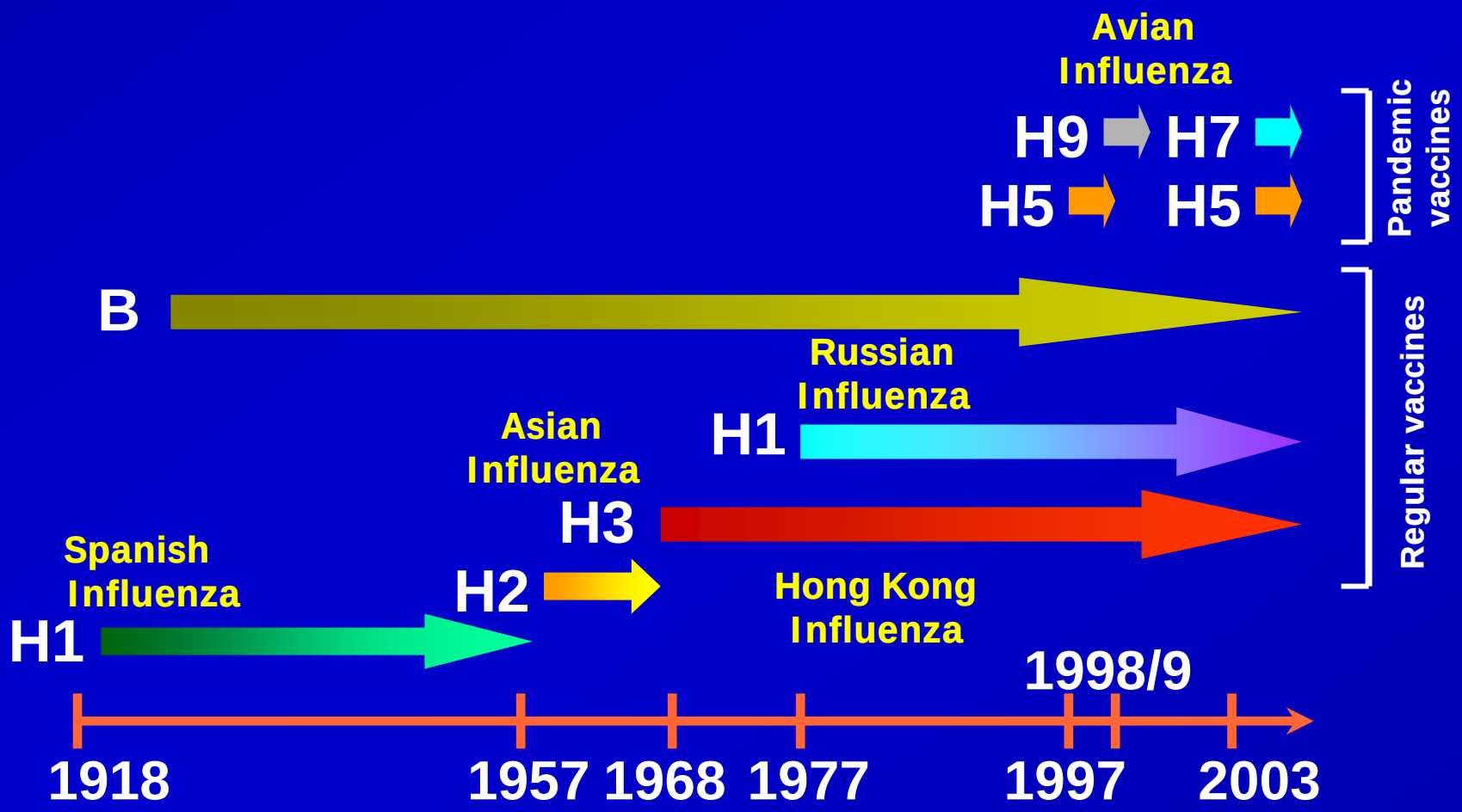
Human virus





Reassortant virus

Timeline of Emergence of Influenza Viruses in Humans



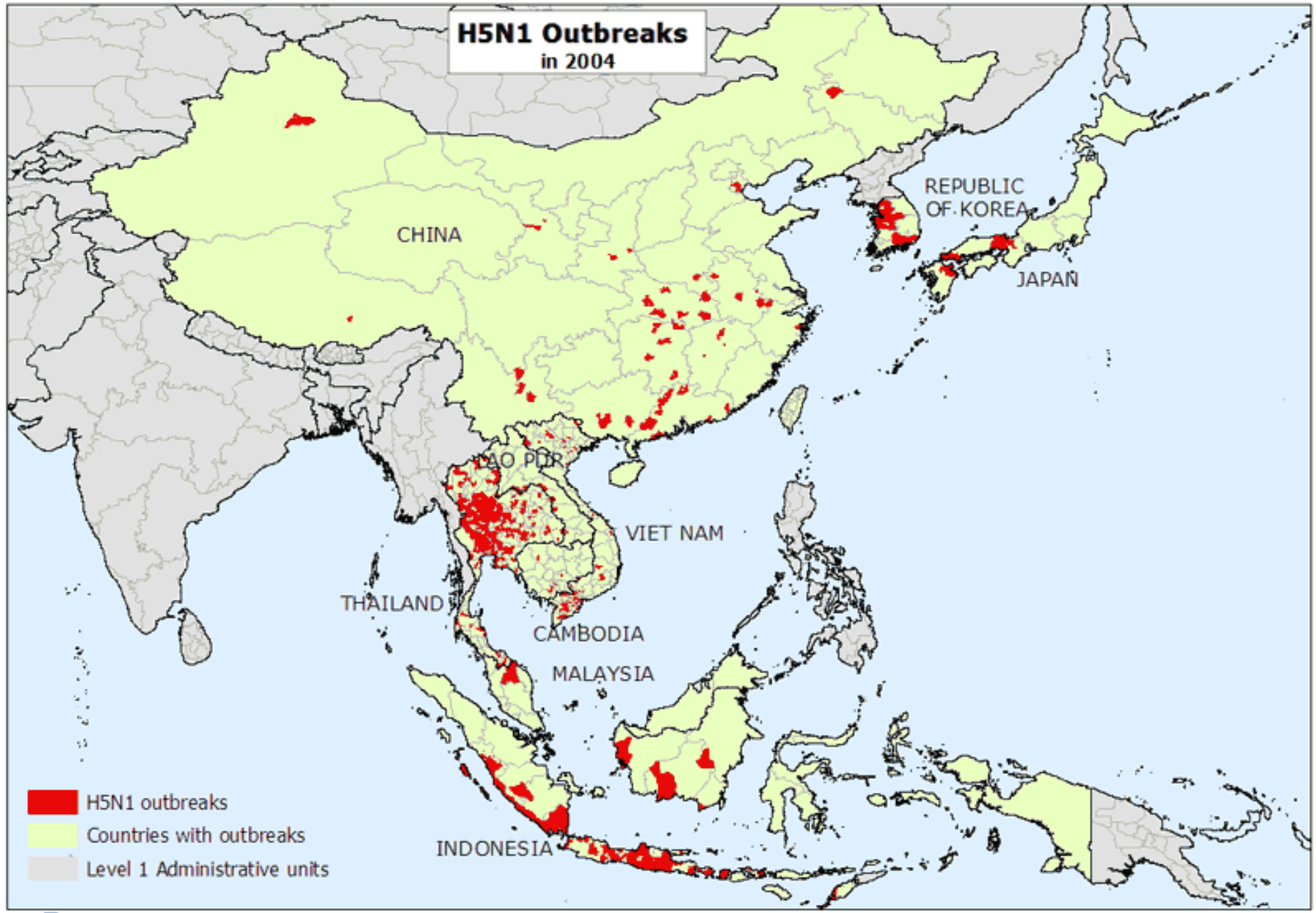
1997 H5N1 Outbreak, Hong Kong

- First evidence that AI viruses can directly infect people

- H5N1's unusual lethality
  - –6 deaths among 18 hospitalizations

Primary risk factor:
Exposure to poultry in week before illness

Outbreak stopped by culling all wholesale & vendor domestic chickens



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


RUSSIAN FEDERATION
CROATIA
ROMANIA
KAZAKHSTAN
MONGOLIA
TURKEY
CHINA
THAILAND
Species
Poultry
Wild Birds
H5N1 Outbreaks by species
between july and october 2005
Source of H5N1 outbreaks: OIE

Countries Affected by H5N1 and Major Migratory Birds' Flyways

MIGRATORY BIRDS' FLYWAYS

- Black Sea/Mediterranean
- Central Asia
- East Asia/Australian
- East Africa/West Asia
- East Atlantic

COUNTRIES AFFECTED

- Locations of H5N1 outbreaks
- Countries with outbreaks

SOURCE: UN FAO/OIE

H5N1 Positive Eagles Smuggled into Belguim from Thailand

Economic Impact

Why H5N1 is of Particular Concern

- Progressively more pathogenic for poultry
- Asymptomatically infected domestic ducks are shedding virus for longer duration compared with 2003
- Expanding mammalian host range (tigers, leopards, cats)
- Virus able to survive days longer in the environment compared to 2003
- Ability to cause severe disease in humans
- Increasing poultry infections = increased human exposures / infections
- Increasing humans infections = increased chances of reassortment
  - (e.g. H5N1 & H3N2)

Human H5N1 cases, Asia, Dec. 2003-06*

- 148 confirmed → 79 deaths (53%)
  - Vietnam: 93 cases → 42 deaths (45%)
  - Thailand: 22 cases → 14 deaths (64%)
  - Cambodia: 4 cases → 4 deaths (100%)
  - Indonesia: 17 cases → 12 deaths (71%)
  - China: 8 cases → 5 death (63%)
  - Turkey: 4 cases 2 deaths (50%)

*As of January 14, 2006 (cases officially reported by WHO)

Limited Person-Person Transmission

- 15 family clusters identified Jan. 2004 – July 2005
  - Emerg Infect Dis 2005;11:1799-1801
- Incidence of family clusters does not appear to be increasing (as a proportion of total cases)
- Most clusters compatible with common (poultry) exposure

- Thailand (September 2004)
  - 11-year old girl cared for by mother and aunt in hospital, died, not confirmed; both women confirmed with H5N1, mother died
  - NEJM 2005;352:333-40.
- Vietnam (Feb. 2005)
  - 2 nurses who cared for H5N1 patient were hospitalized with severe pneumonia
  - 1 confirmed as H5N1

Pandemic Response Challenges

- Healthcare system capacity - overwhelmed
- Antiviral supplies – insufficient / resistance
- Vaccine – manufacturing issues / supply /distribution
- Critical infrastructure - disruption
- Economy - disruption

Projected Pandemic Scenarios - COLORADO

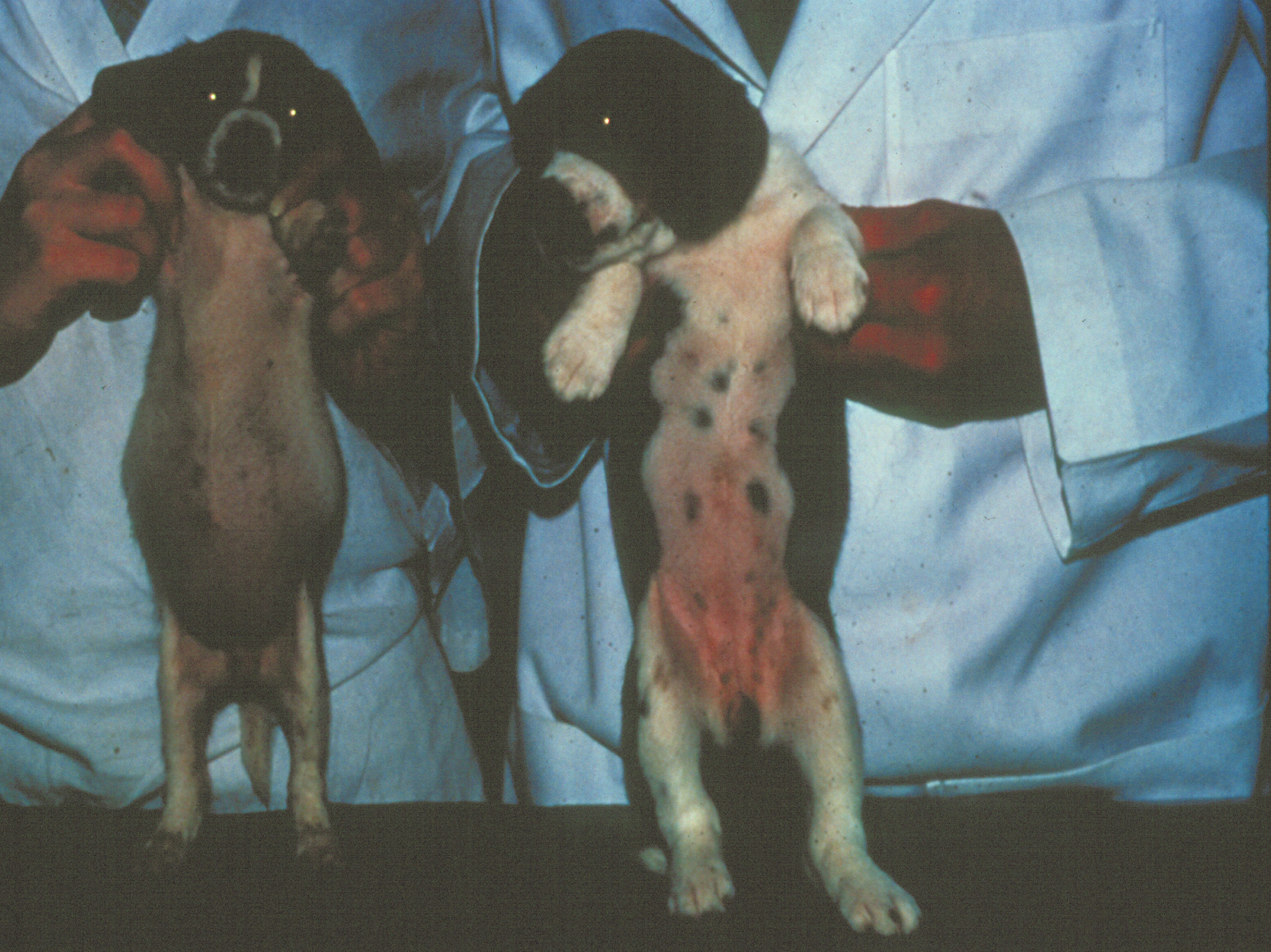
	Moderate (1958/68)	Severe (1918-like)
Illness	1,394,644	1,394,644
Outpt. medical care	697,322	697,322
Hospitalizations	13,404	153,411
ICU care	1,995	23,012
Mechanical ventilation	1,005	11,506
Deaths	3,239	29,489

Challenges for Physicians

- Distinguish H5N1 from “normal” flu
- Worried Well
  - Concerned of exposure
  - Want bird flu vaccine
  - Want oseltamivir
- Should I stockpile oseltamivir?

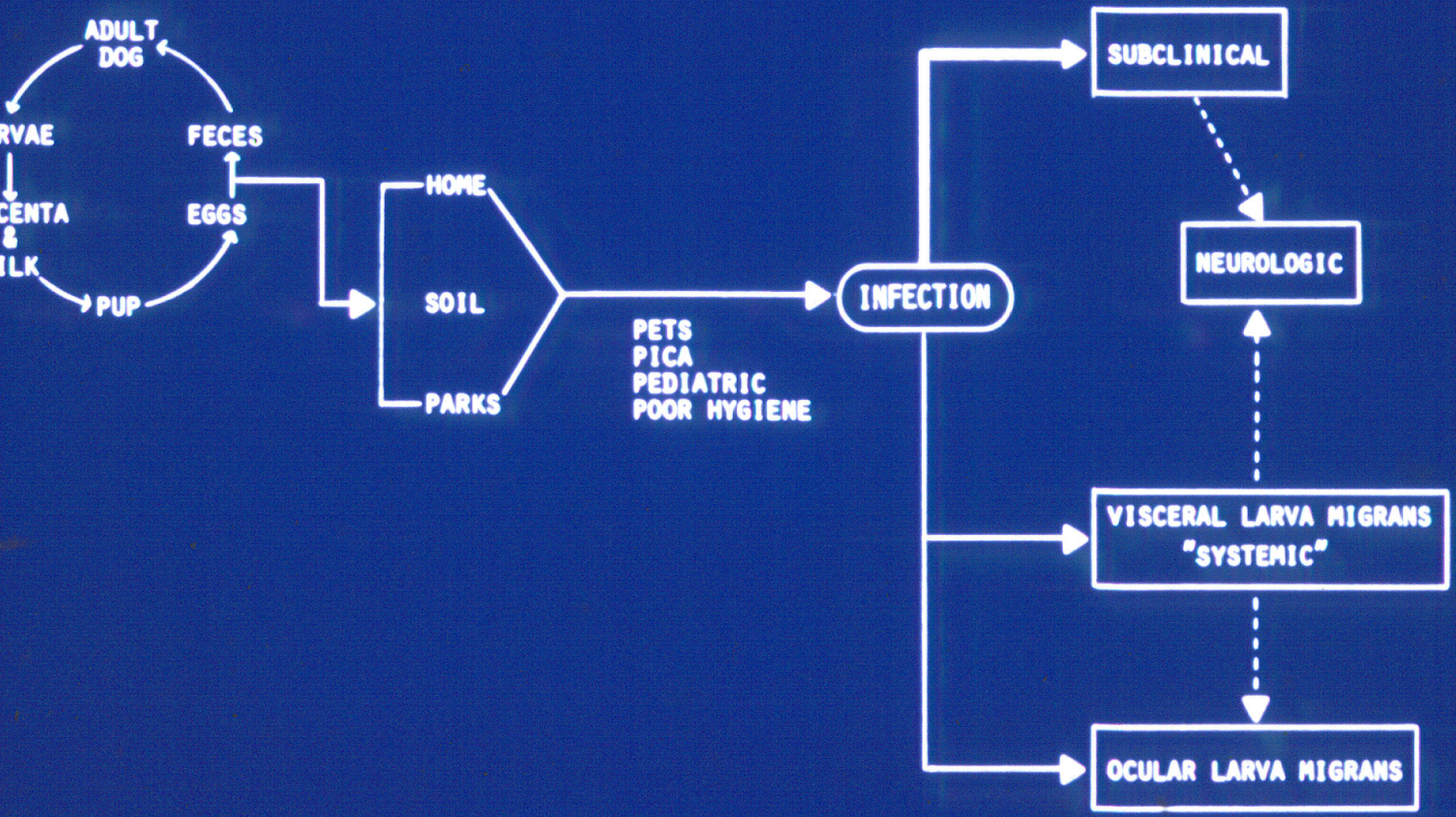
H5N1 Surveillance Strategy in US

- Focus on severe resp. illness plus travel history
  - Unexplained pneumonia or ARDS
  - Travel w/in 10 days to area w/ H5N1 in poultry/humans
- Contact & Airborne precautions
- Testing:
  - PCR for influenza (type A & H5N1) @ State Lab
  - If PCR+ → Culture & subtyping @ CDC

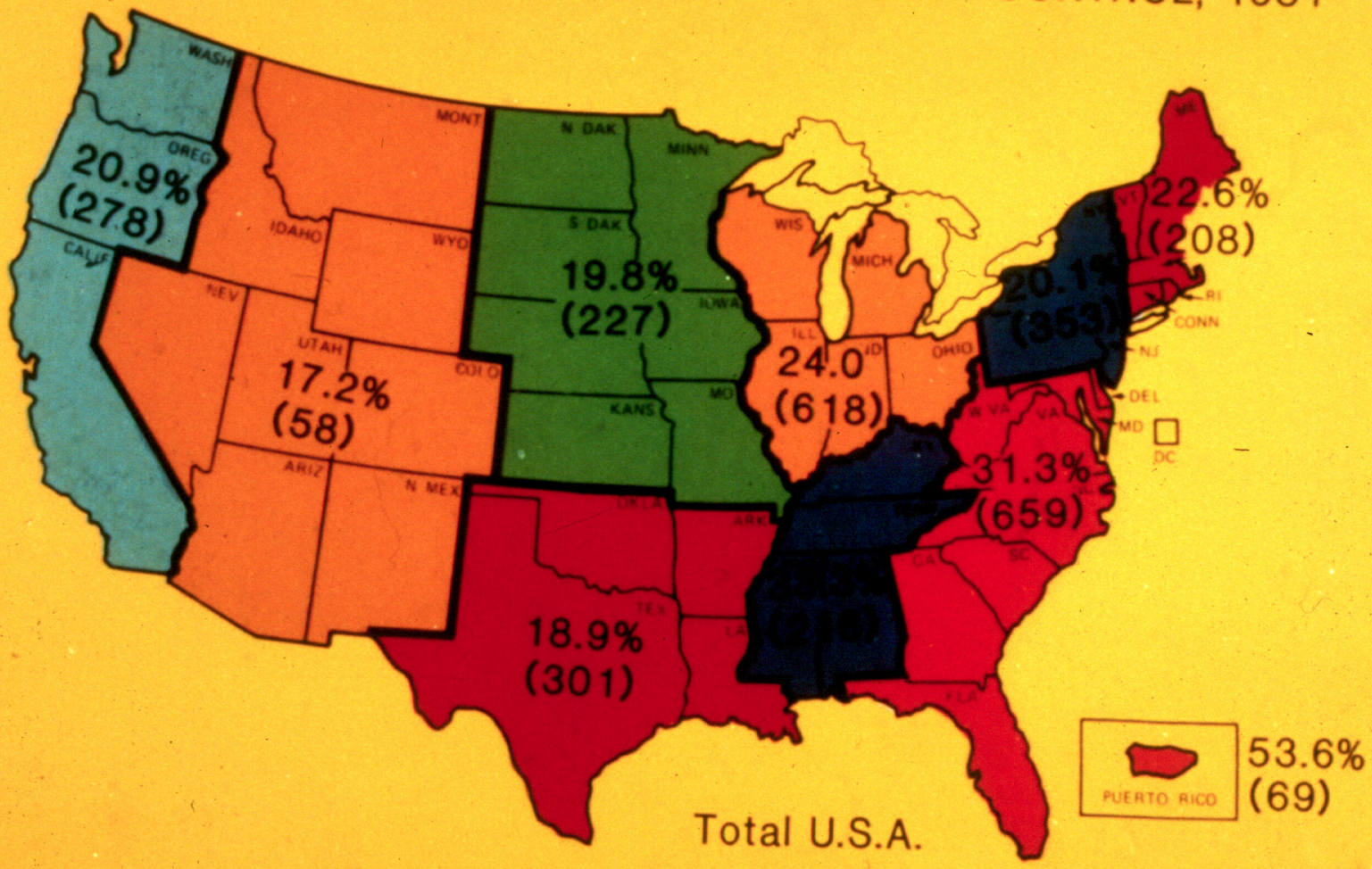


ZOONOTIC TOXOCARIASIS

NATURAL HOST	ENVIRONMENT	TRANSMISSION	ACCIDENTAL HOST



PERCENT POSITIVE TOXOCARAL ELISA TESTS IN DIAGNOSTIC SPECIMENS SUBMITTED TO STATE PUBLIC HEALTH LABORATORIES AND CENTERS FOR DISEASE CONTROL, 1981



Total U.S.A.

26.3%

(2988)

ENVIRONMENTAL CONTAMINATION WITH *TOXOCARA* SPP. EGGS
SOIL SAMPLING SURVEYS IN NORTH AMERICA

Locality	Percent contaminated	Authors
Philadelphia, PA	10% of 120	Dubin et al., 1975
Montreal, Quebec	33% of 43	Ghadirian et al.,1976
Manhattan, KS	21% of 135	Dada & Linquist, 1979
Baltimore, MD	11% of 146	Childs, 1985
Baton Rouge, LA	0.4% of 1529	Smith et al., 1984
Essex Co., NJ	0.3% of 629	Surgan et al., 1980

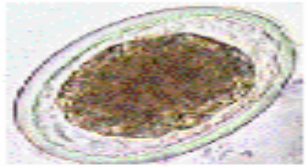
Procyon lotor

Baylisascaris procyonis

Life cycle of *Baylisascaris procyonis*

Adult roundworms reside in the small intestines of raccoons

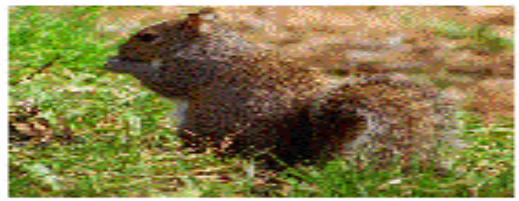
Eggs are passed in the raccoon's feces



Eggs become infective 3-4 weeks after passage

Raccoons are infected when they ingest infective eggs.

Encysted larvae are ingested when a raccoon ingests tissues of this animal.



Eggs are ingested by other animals (mice, squirrels, beavers, humans, etc.)

Larvae from eggs migrate to and encyst in tissues, particularly the central nervous system and eyes.

In most species of animals, the migrating larvae of Baylisascaris procyonis cause significant pathology in the visceral organs, central nervous system and/or eye, causing visceral, neural, or ocular larval migrans. Depending on the number of larvae migrating and the tissues involved, these diseases can range from asymptomatic to lethal.

Baylisascaris Adult Worms

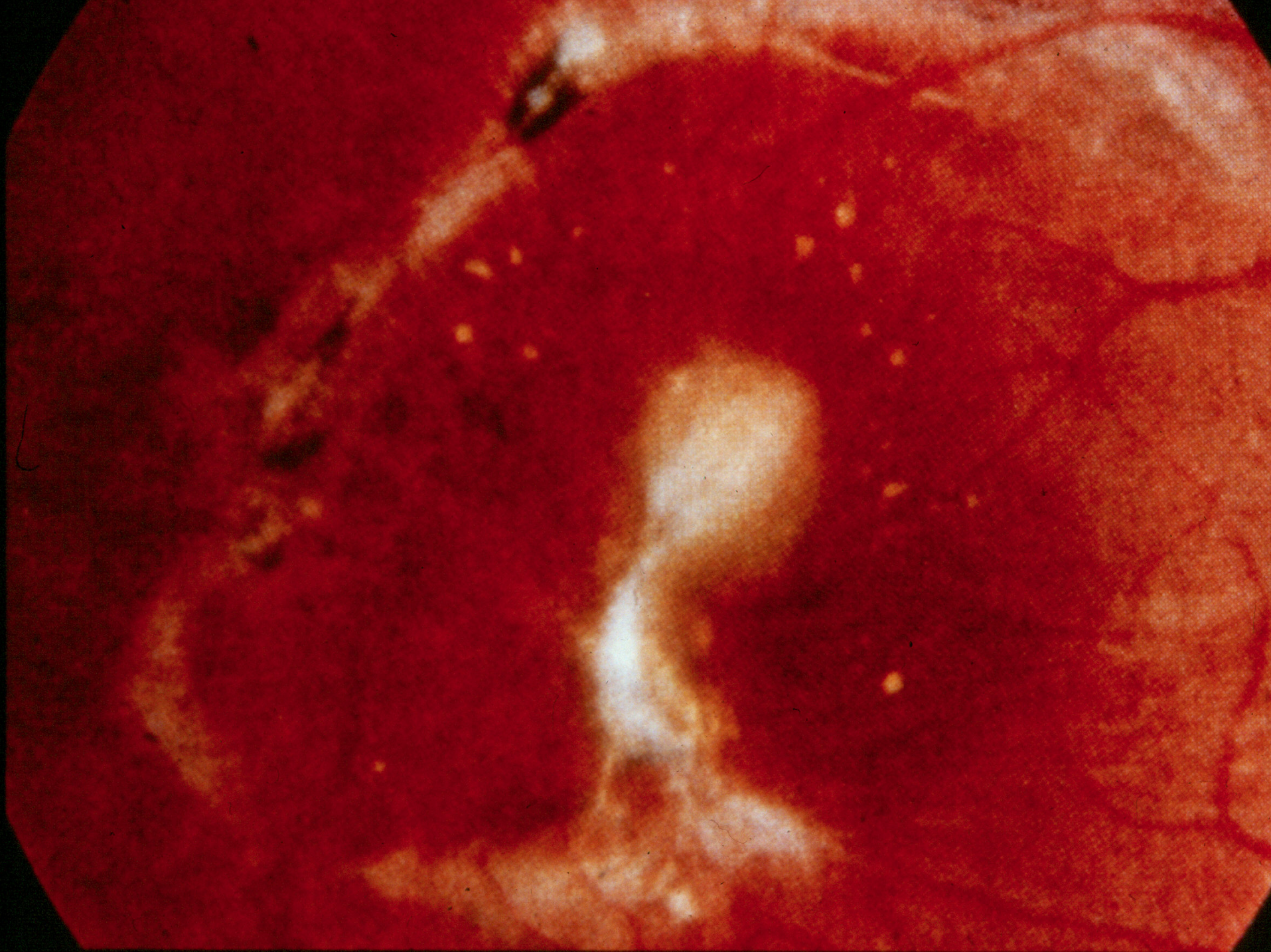
- Fully grown 15-20 cm
- 50-80% adult raccons carry worms
  - 90% in juvenile animals
- 2-3 months from infection to shedding eggs
- Asymptomatic infections
  - Obstruction, malnutrition, intussusception

Baylisascais Eggs

- Infected raccoons shed in feces
  - 20 – 100,000 eggs/gm (100 gm/defecation)
- Eggs infective in 30 days
- Highly resistant
  - Lab frig for 12 years
  - 3-5 years in soil
  - Resistant to most disinfectants
- Sticky
- Treat by flaming, boiling lye/lysol

Baylisascaris Larvae

- Raccoons
  - Ingest eggs or encysted larvae
- Intermediate host
  - Penetrate intestine & migrate throughout body
    - Larvae in lung 12-18 hours after ingestion, brain by day 3
  - Encyst in muscle, liver, lungs
  - Affinity for nerve tissue – 5-15% reach brain
  - Grow to 1.5-2mm during migration
- Impact depends on number of larvae, tissue involved and size of host



New Haven Register;

, Wednesday, April 11, 1990

Blind in 1 eye from sick dog, teen to get $1.5 million

By Pamela McLoughlin
Register Staff

KILLINGWORTH — A 16-year-old girl blinded in one eye by a parasite from a diseased puppy has obtained a $1.5 million settlement from the insurance company representing Animal Kingdom II in East Haven.

RISK FACTORS FOR TOXOCARAL LARVA MIGRANS SYNDROMES

- Age (2–11 years)
- Pica (geophagia)
- Own pet dogs
- Low socioeconomic group
- Occupational/avocational factors ?

CDC -- AAVP -- NORDEN LABORATORIES

PUBLIC AWARENESS CAMPAIGN ON PETS, PARASITES AND PUBLIC HEALTH

The Message:

1) Dogs and cats get worms

2) Humans can get infected too, from their pets

3) Prevention involves:

   a) preventing/eliminating intestinal worms by medication administered as recommended by a veterinarian

   b) good sanitation, i.e. cleaning up after pets, and

   c) common sense hygiene, i.e. wash hands after handling dogs, etc.

Baylisascaris Prevention

- No pet raccoons
- Assume infected until treated
  - Negative stool culture $\neq$ not infected
- Exclude from chimneys, attics, woodpiles
- Protect feed, hay, bedding
- Special problems for rehabilitators
- Hand-washing, hand-washing, hand-washing

Q Fever

- Highly infectious by aerosol route
- Persists in resistant spore-like form
- Febrile illness – self-limited FUO
  - Asymptomatic infections common
  - Low mortality
- Common in sheep/goats
  - Heavy shedding during birthing
- High infectivity and durability make it an ideal incapacitating biological warfare agent

Q Fever

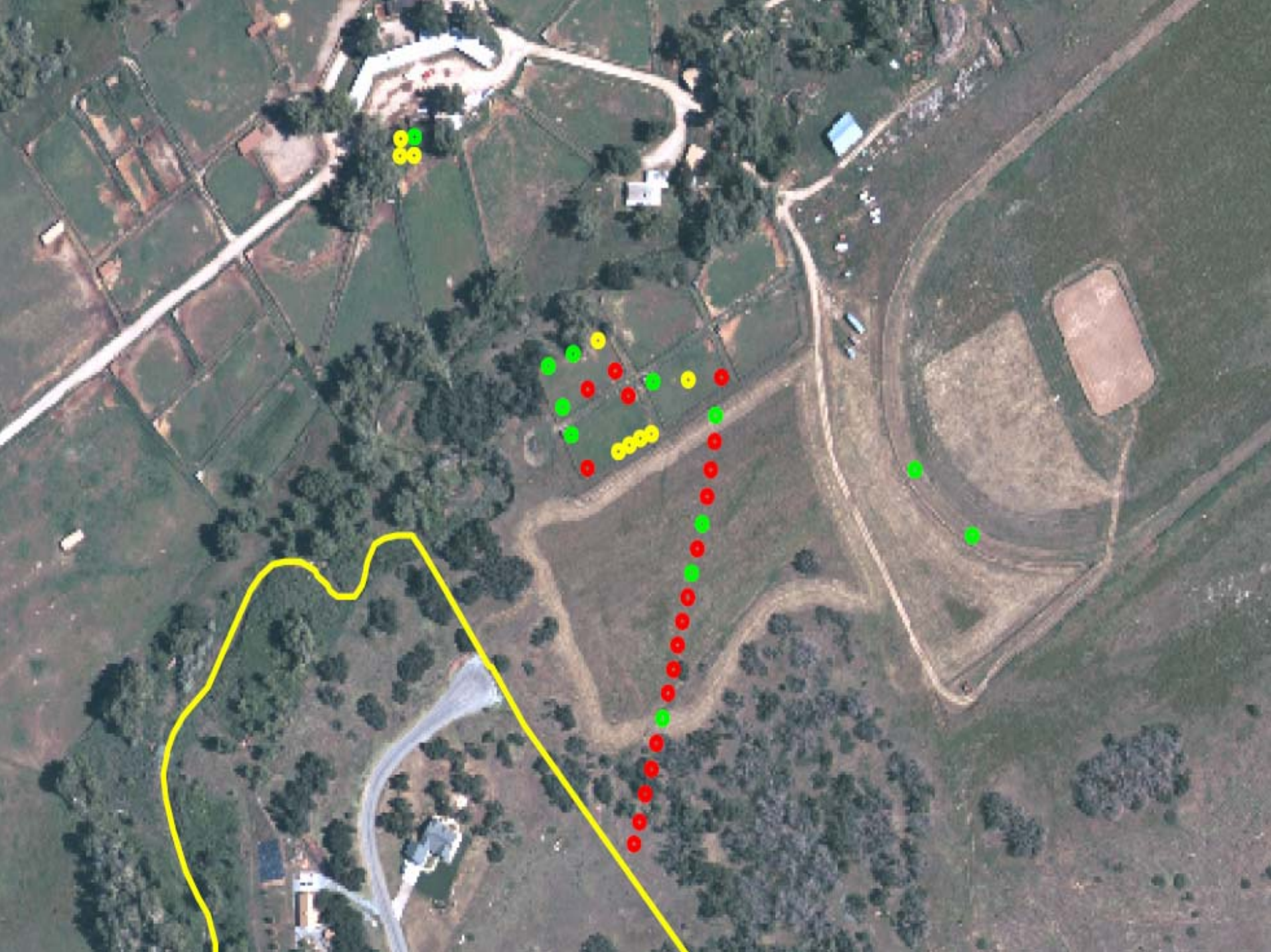
- 25 cases reported
  - 12 probable, 10 confirmed
  - 3 clusters Weld (n=5), Rio Blanco (n=2), Pueblo
- From 2000-2004: 12 reported cases (2.4/year)
- Exposures
  - owned livestock (n=9) or lived next to livestock (n=4)
  - contact with goats (n=9)
  - large animal veterinarian, abattoir worker and exposure to a livestock barn
- Highly undiagnosed disease

Q-fever Outbreak Associated with Goats

- Report of case in September 2005
  - Pt had assisted with birthing goats
- Ranch has recently purchased 360 head
  - ~20% stillbirth rate June-August
- Horse boarders had assisted with birthing
- Conducted cohort study and environmental assessment

Q-fever Outbreak Associated with Goats

- Sixty-eight persons with potential exposure
  - 66 interviewed; 37 (56%) provide blood
  - 18 persons (49%) had serological evidence of infection; 9 ill / 9 asymptomatic
- 40 soil samples from pens/pasture
  - 9 (23%) confirmed, 12 (30%) presumptive +
- 51 goats tested (vaginal and/or milk)
  - 7 positive (2 vaginal, 3 milk, 2 both)



Q-fever Outbreak Associated with Goats

- Risk associated with goat contact
  - Any goat contact RR 3.4 (0.9-12.3) p=0.02
  - Contact with newborn RR 2.3 (1.7-2.6) p=0.01
  - Pull goats RR 2.1 (1.3-3.6) p=0.04
- No risk from petting goats, time spent on the ranch or any activities associated with horses

Hamsters & Tularemia

- April 2004
  - 3 yo boy reported with tularemia
    - Isolate from excised axillary lymph node (3/31)
- January 2004
  - Family purchased 1st hamster
  - Bitten Feb 4; onset Feb 11
- Pet store noted hamster die-off
  - No hamsters available for testing
  - 1 store cat + tularemia antibody titer
- No other cases in employees (n=2) or hamster purchasers (n=15)

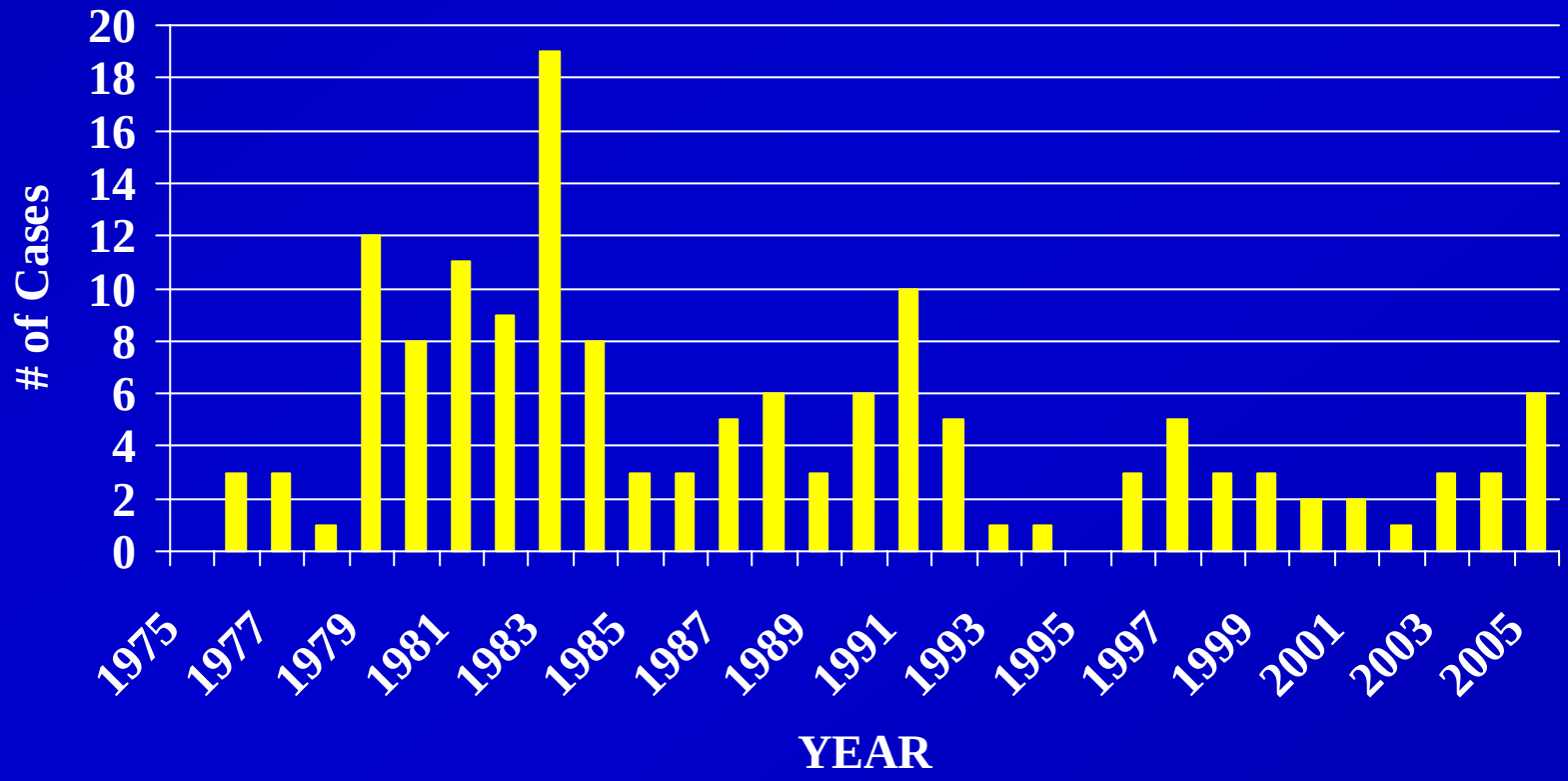
Hamsters & Tularemia

- October 2005
  - CDPHE notified of 2 shipments of hamsters possibly infected with tularemia
  - Store indicated ½ of one shipment DOA
    - 4/6 carcasses positive
    - Doxycycline Rx
  - 2 employees–negative
- No further cases ID

Year of the Rodent

- CDPHE initiated routine tularemia testing
  - What to do with this information?
- Six human cases
  - 1 pneumonia – likely lawn mowing associated
  - 1 rabbit contact, 2 arthropod bite, 2 unk
- 23/192 (12%) specimens tularemia positive
  - 16 rabbits, 6 squirrels, 1 cat
- Tularemia cycles in patterns similar to plague

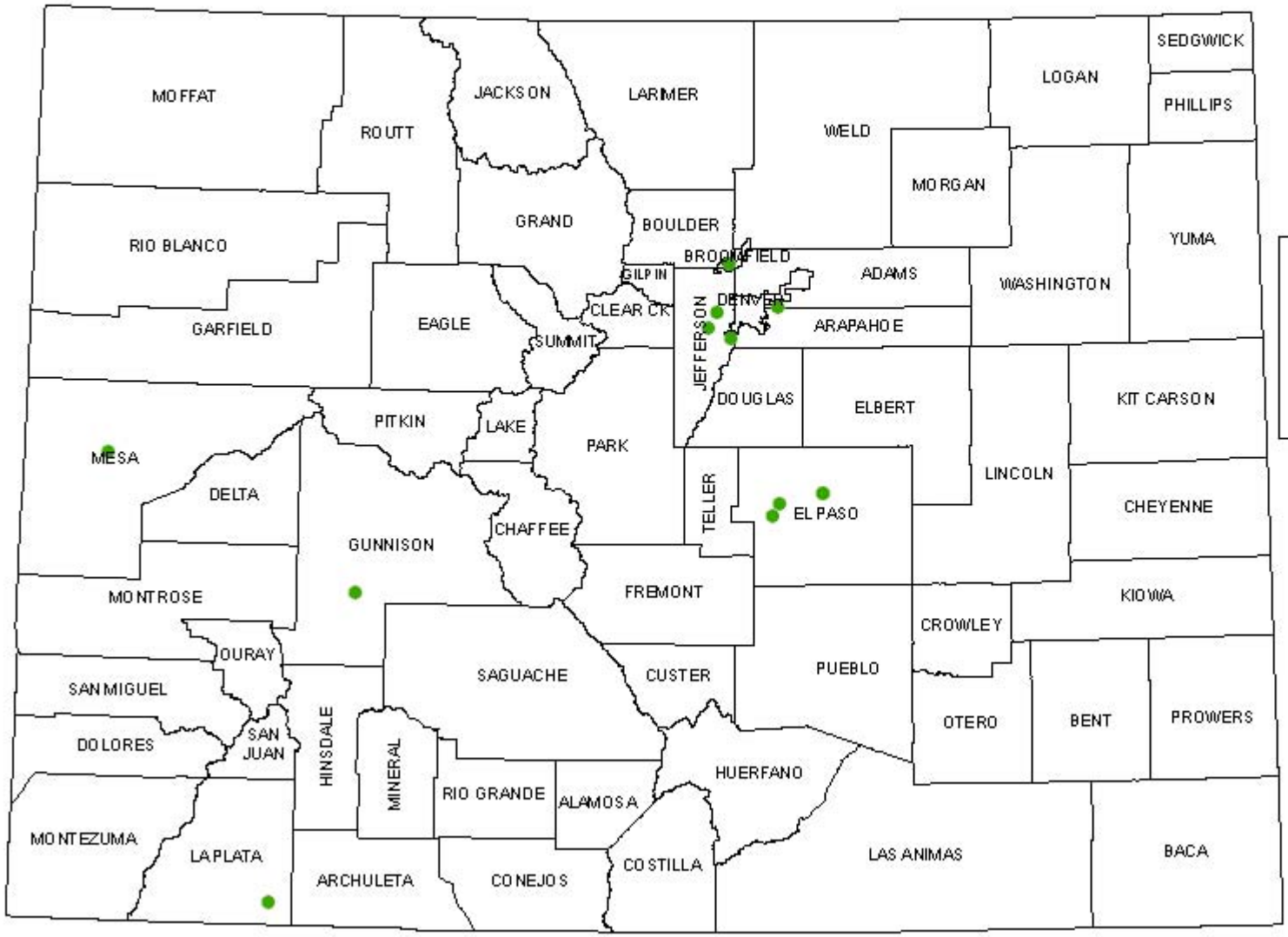
Tularemia Cases by Year, Colorado, 1975-2005*



* Provisional data for 2005

Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before May 20, 2005



Legend

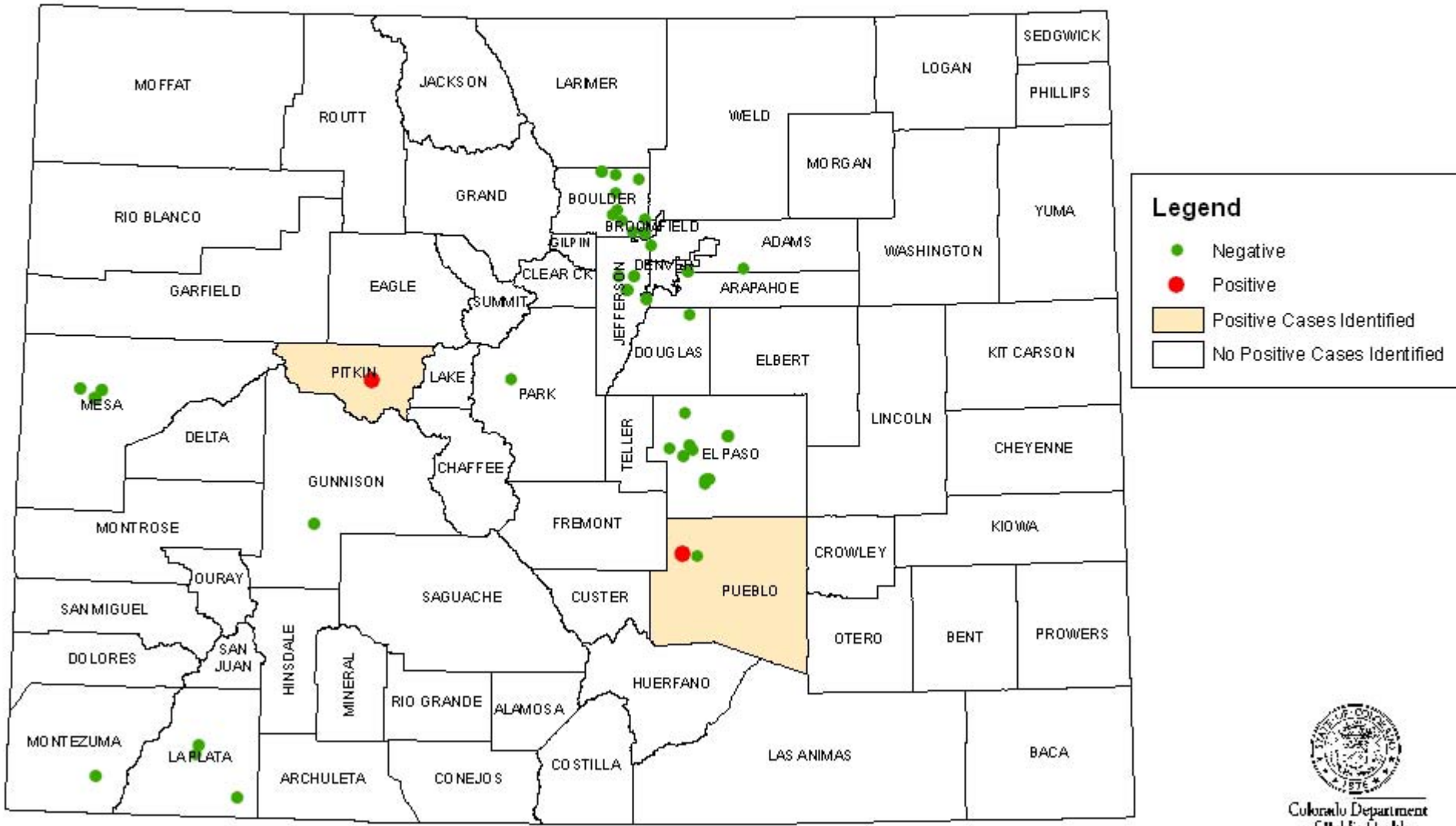
- Negative
- Positive
- No Positive Cases Identified

Colorado Department of Public Health and Environment

Positives N=0

Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before June 7, 2005

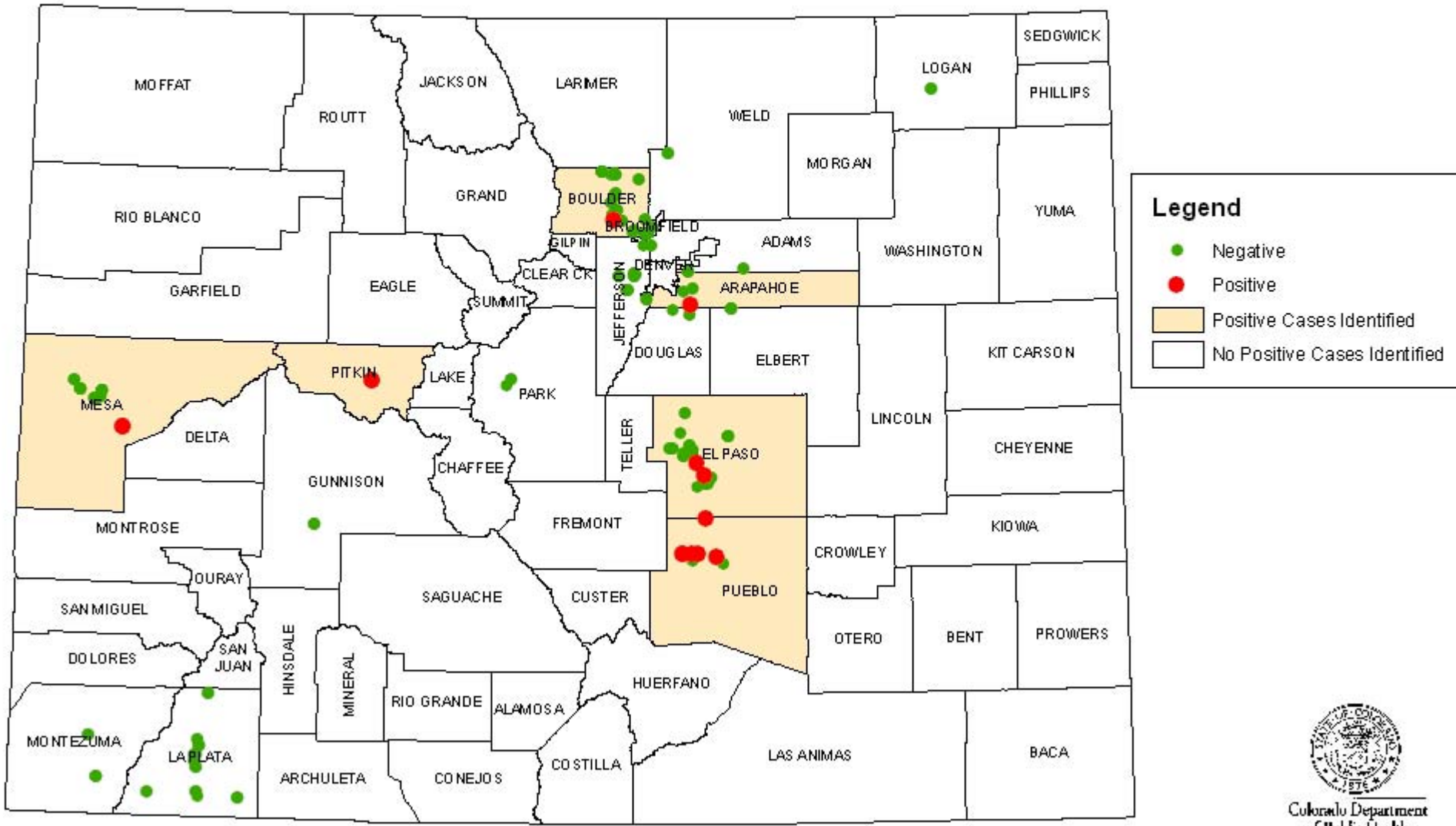


Positives N=2

Colorado Department of Public Health and Environment

Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before July 15, 2005

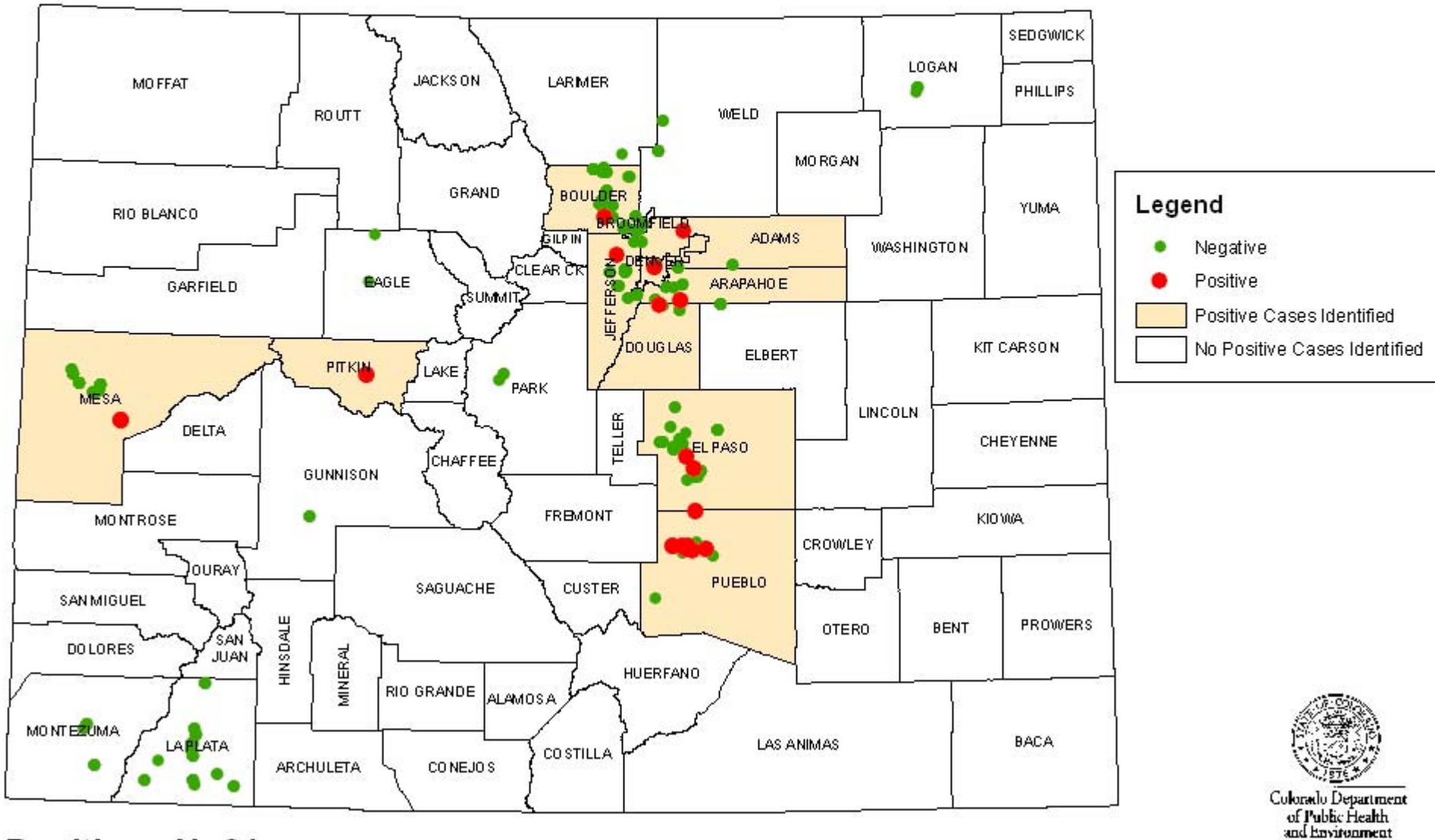


Positives N=12

Colorado Department of Public Health and Environment

Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before August 12, 2005



Positives N=21

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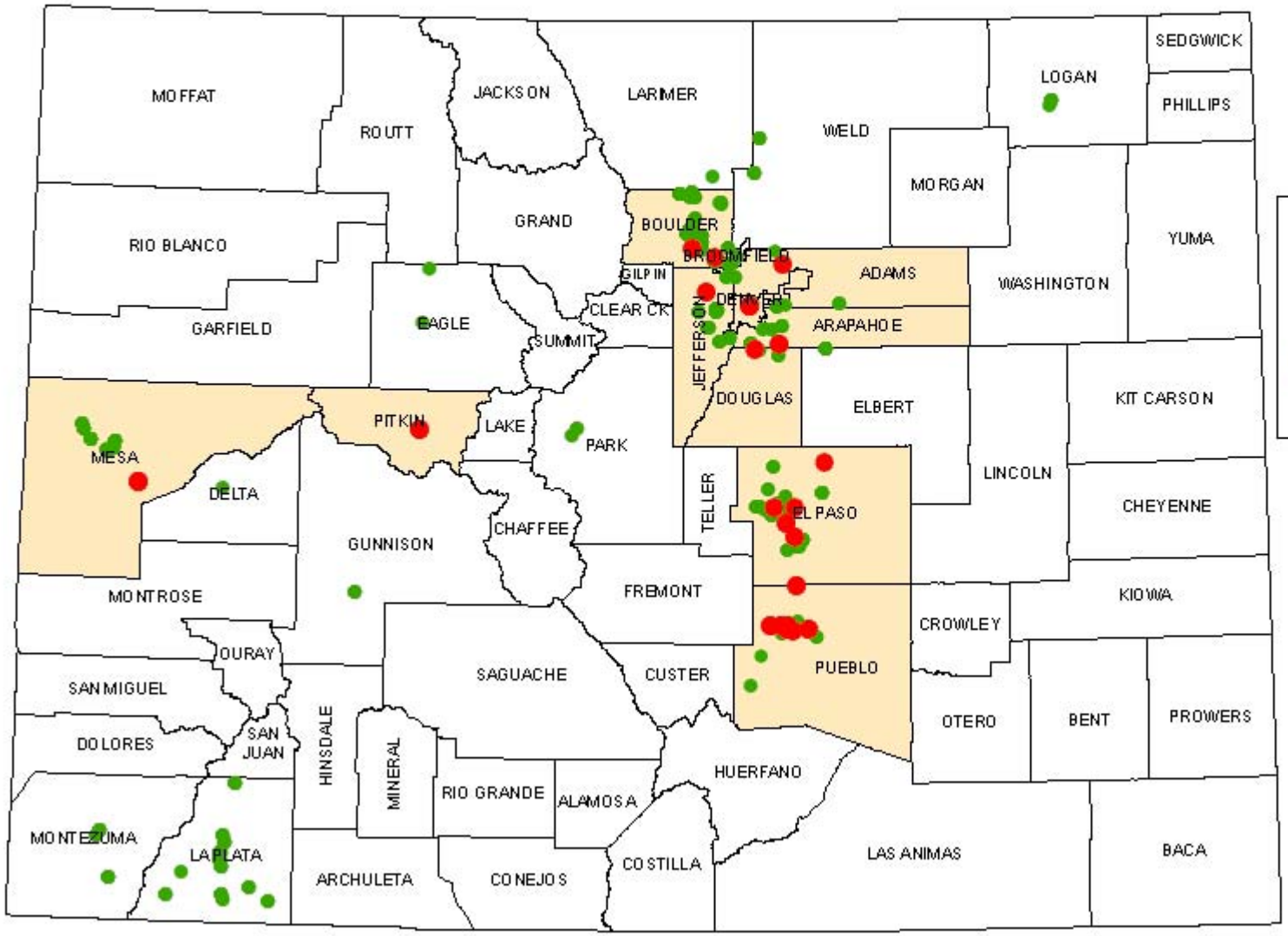
Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before September 2, 2005

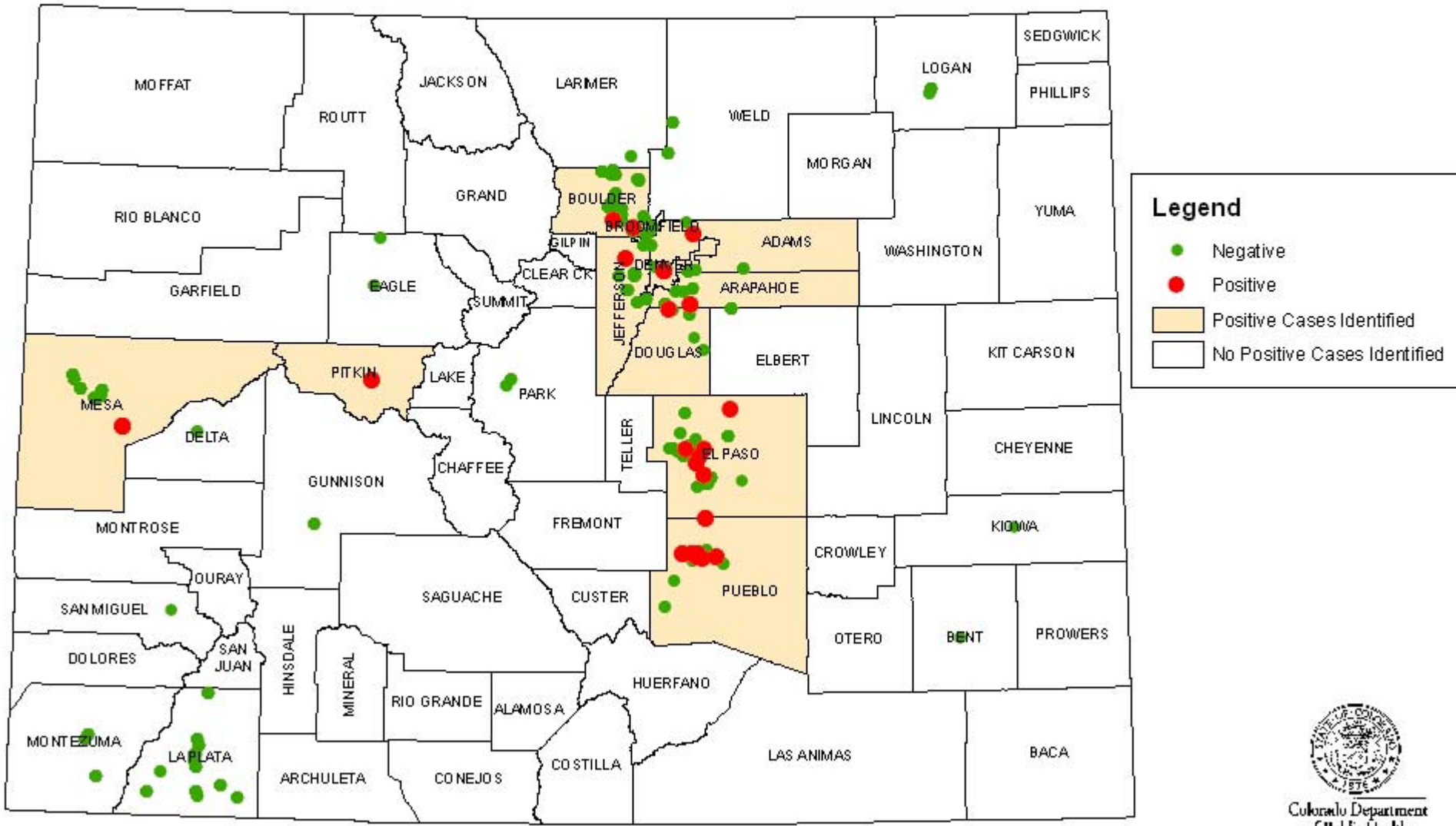


Positives N=26

Colorado Department of Public Health and Environment

Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before September 30, 2005

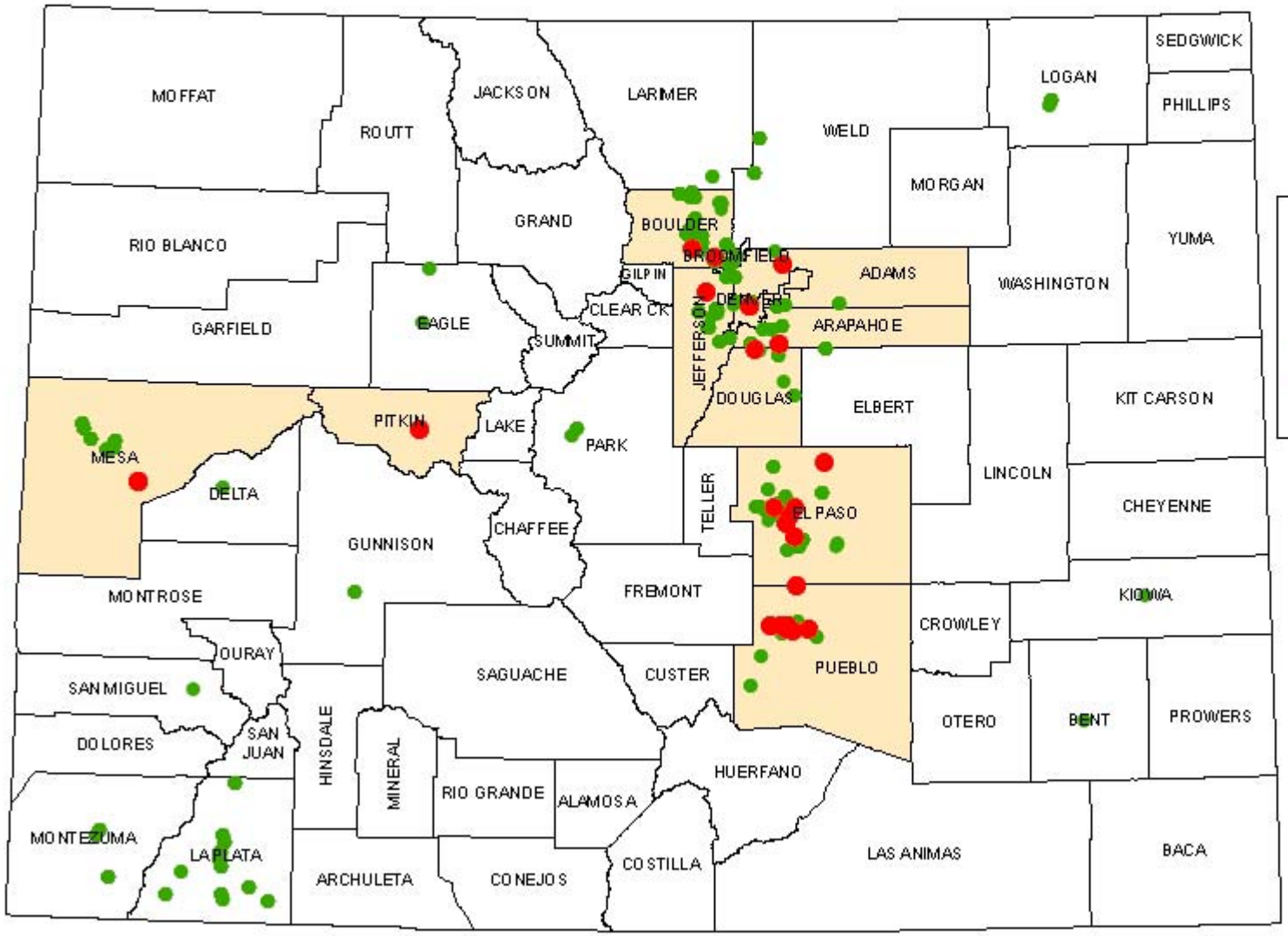


Positives N=27

Colorado Department of Public Health and Environment

Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before October 28, 2005



Legend

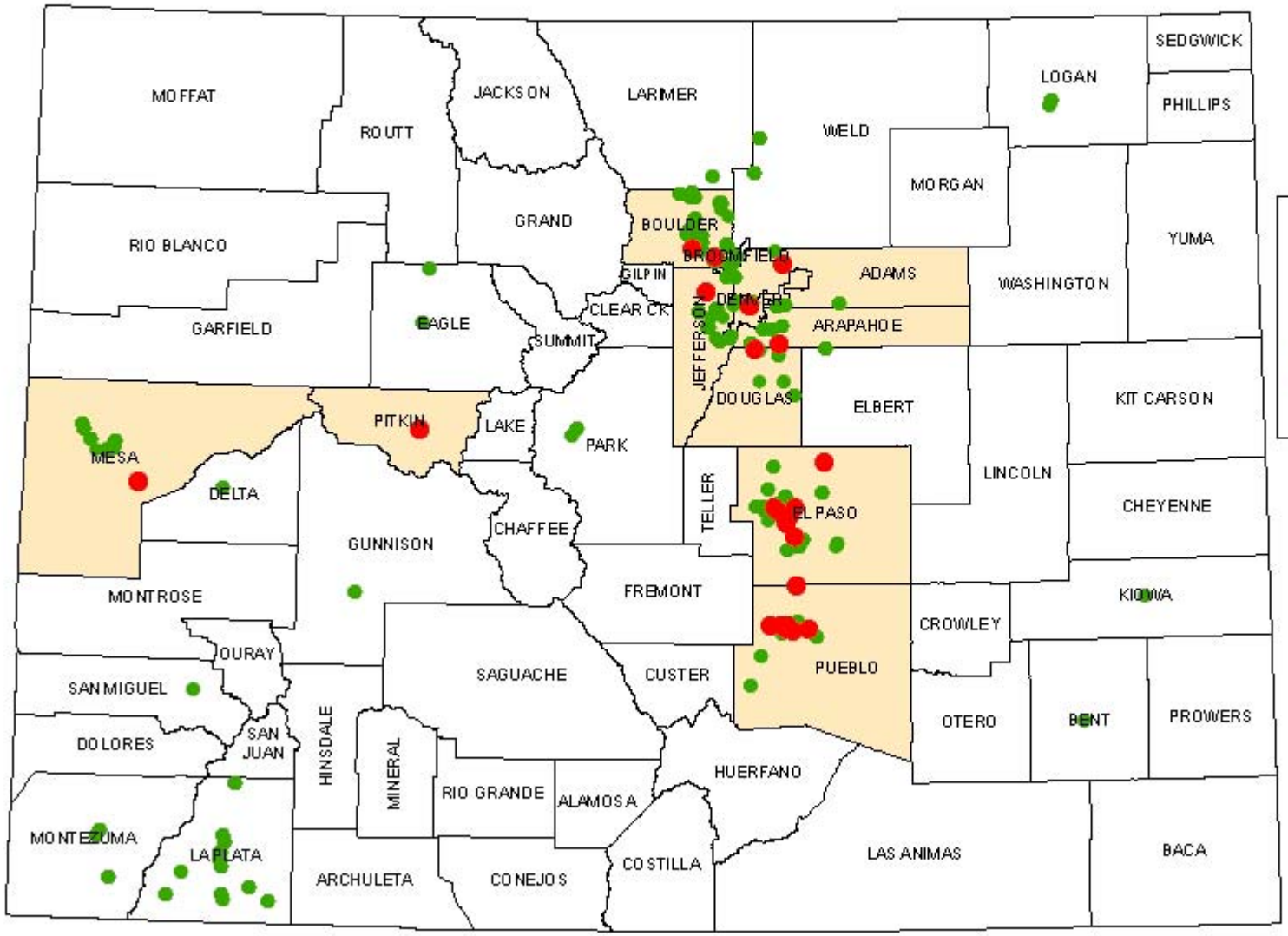
- Negative
- Positive
- Positive Cases Identified
- No Positive Cases Identified

Colorado Department of Public Health and Environment

Positives N=27

Animal Tularemia Surveillance
Colorado, 2005

Samples Collected on or Before December 2, 2005



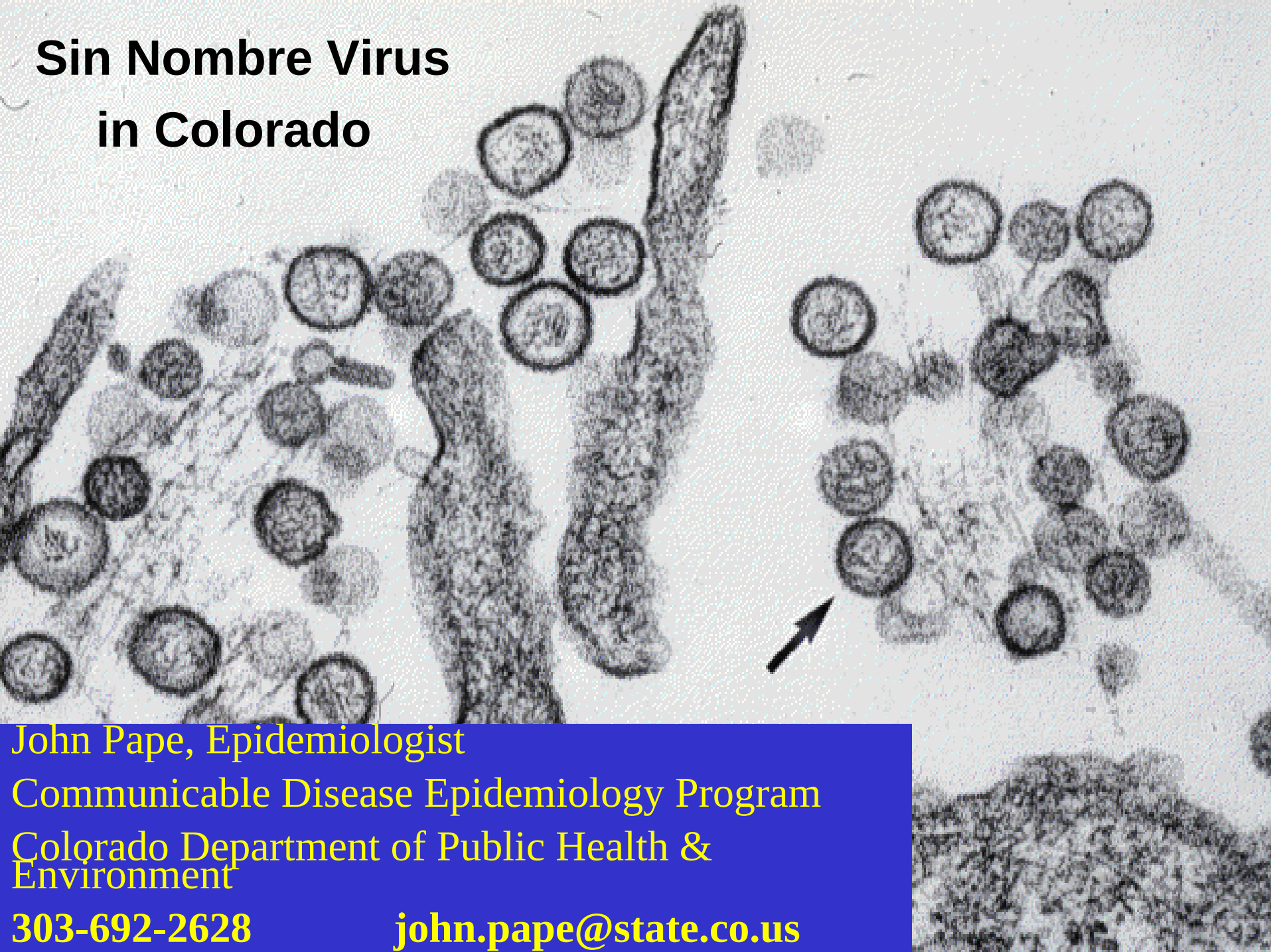
Colorado Department of Public Health and Environment

Positives N=28

Year of the Rodent

- Record year for HPS cases (n=11)
  - Only 1 fatality
    - First 28 cases – 14 fatal (50%)
    - Last 20 cases – 3 fatal (15%)
- Cases reported statewide
  - 3 from SLV
  - SLV accounts for 11/48 (23%) of CO cases
- Two study sites (LaPlata/Mesa counties) showed increased deer mouse populations and rising infection rates in Fall ’04 and Spring ’05

Sin Nombre Virus in Colorado



John Pape, Epidemiologist
Communicable Disease Epidemiology Program
Colorado Department of Public Health & Environment
303-692-2628 **john.pape@state.co.us**

Deer mouse

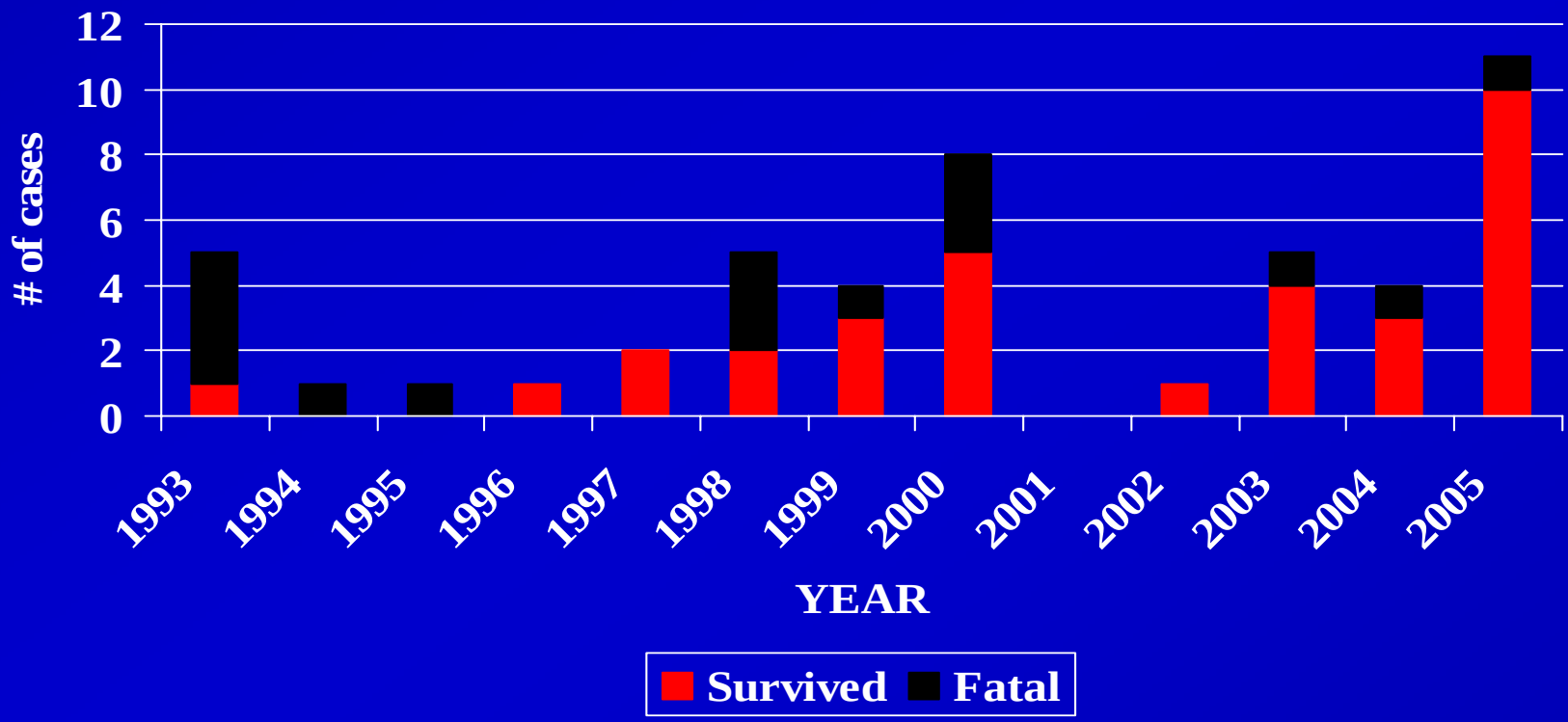
Cotton rat

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Year of the Rodent

- Record year for HPS cases (n=11)
  - Only 1 fatality
    - First 28 cases – 14 fatal (50%)
    - Last 20 cases – 3 fatal (15%)
- Cases reported statewide
  - 3 from SLV
  - SLV accounts for 12/49 (24%) of CO cases
- Two study sites (LaPlata/Mesa counties) showed increased deer mouse populations and rising infection rates in Fall ’04 and Spring ’05

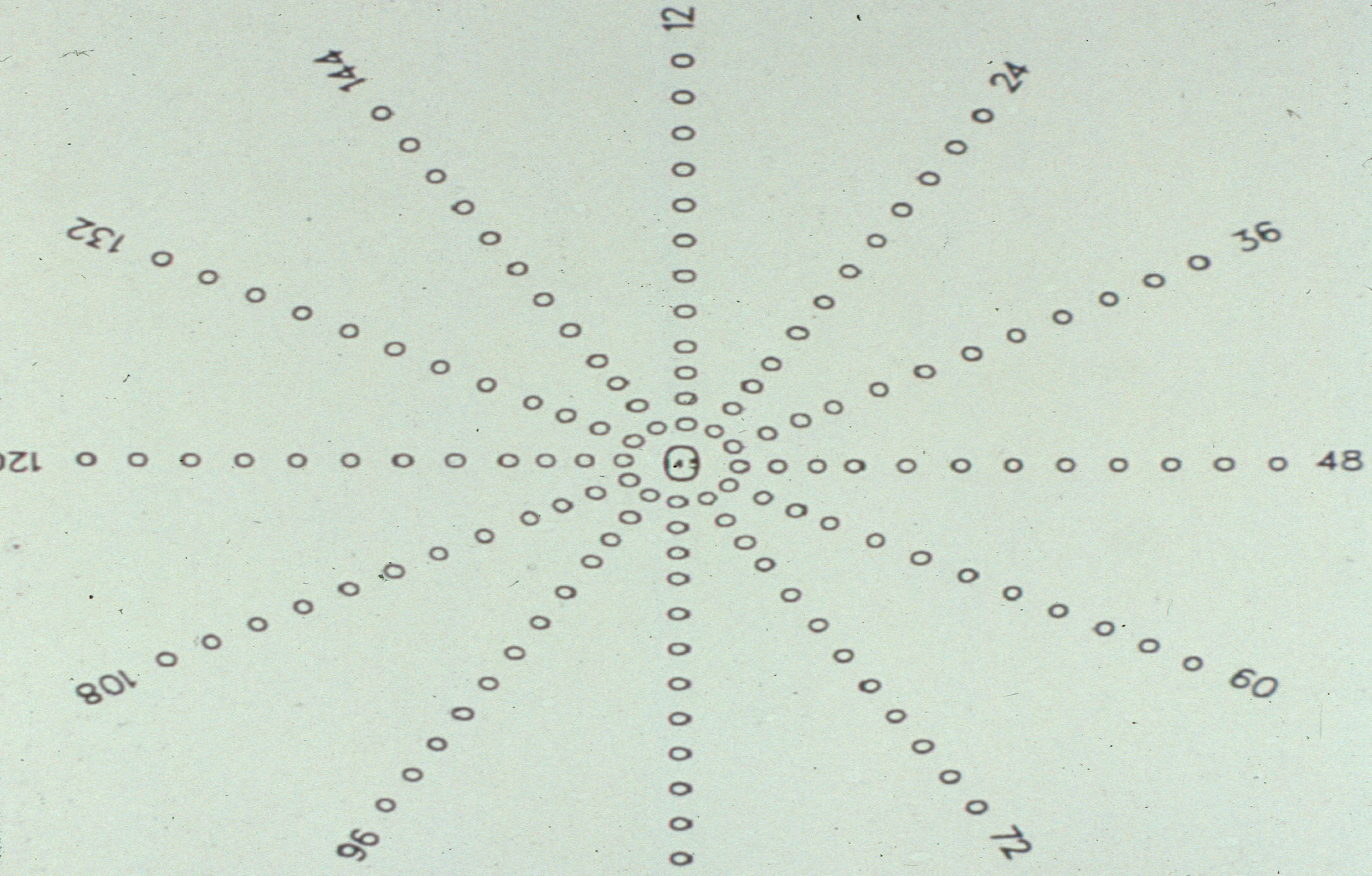
Hantavirus Pulmonary Syndrome (N=48[+]) by Year and Outcome, Colorado, 1993-2005



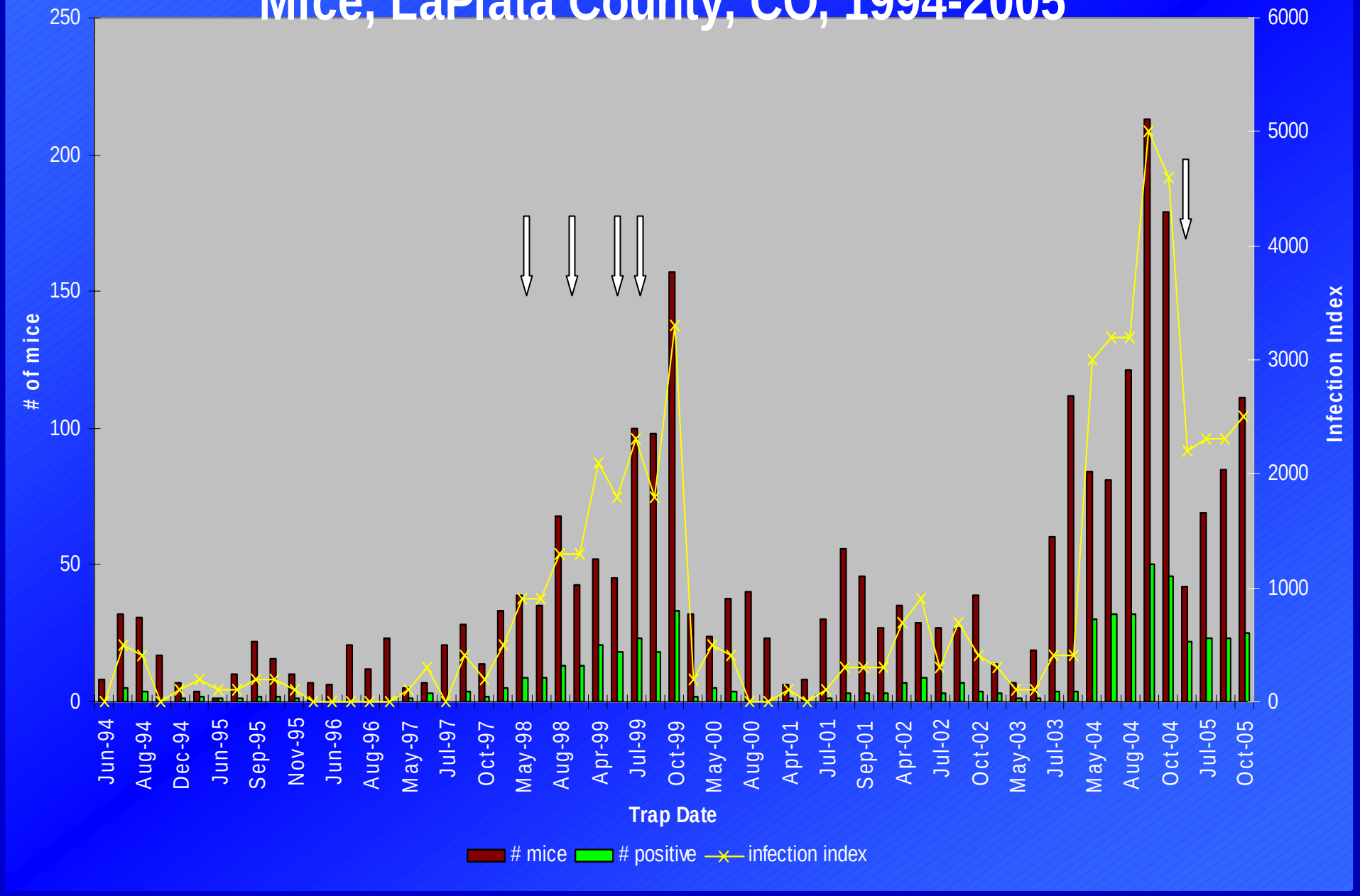
[+] fatal case from 1985 not shown

RODENT TRAPPING WEB

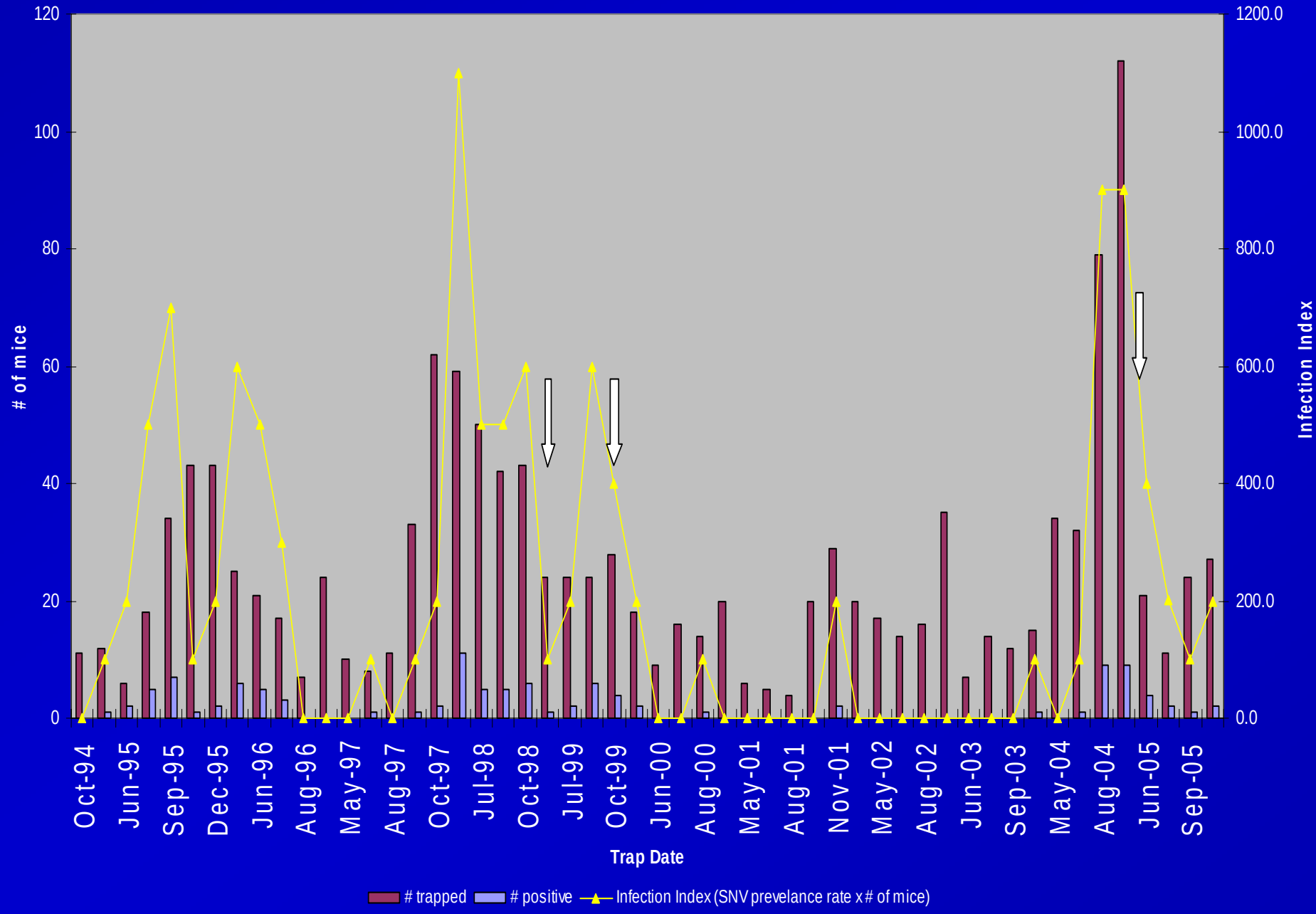
NORTH



Sin Nombre Virus Antibody Prevelance of Deer Mice, LaPlata County, CO, 1994-2005



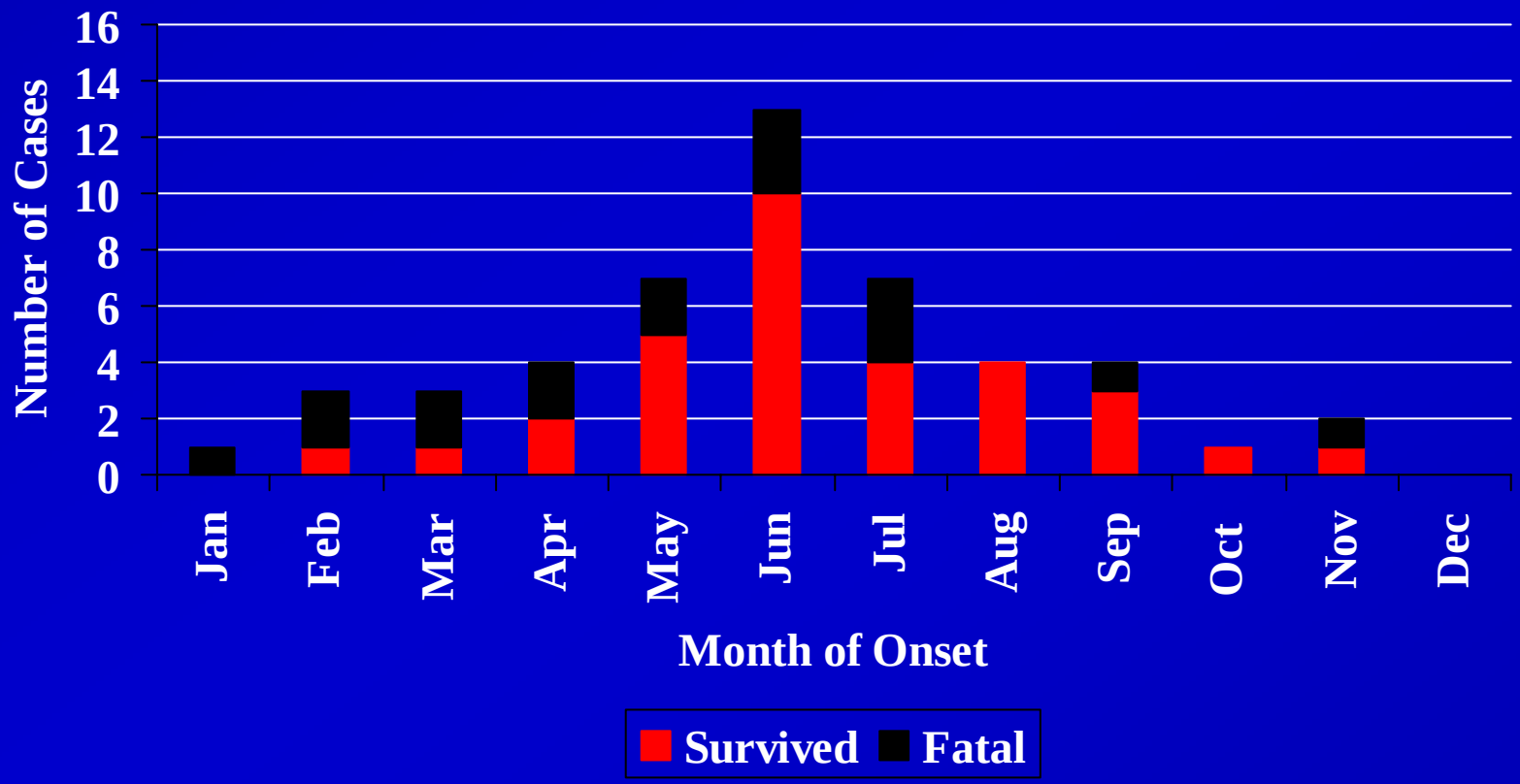
Sin Nombre Virus Antibody Prevelance of Deer Mice, Mesa County, CO



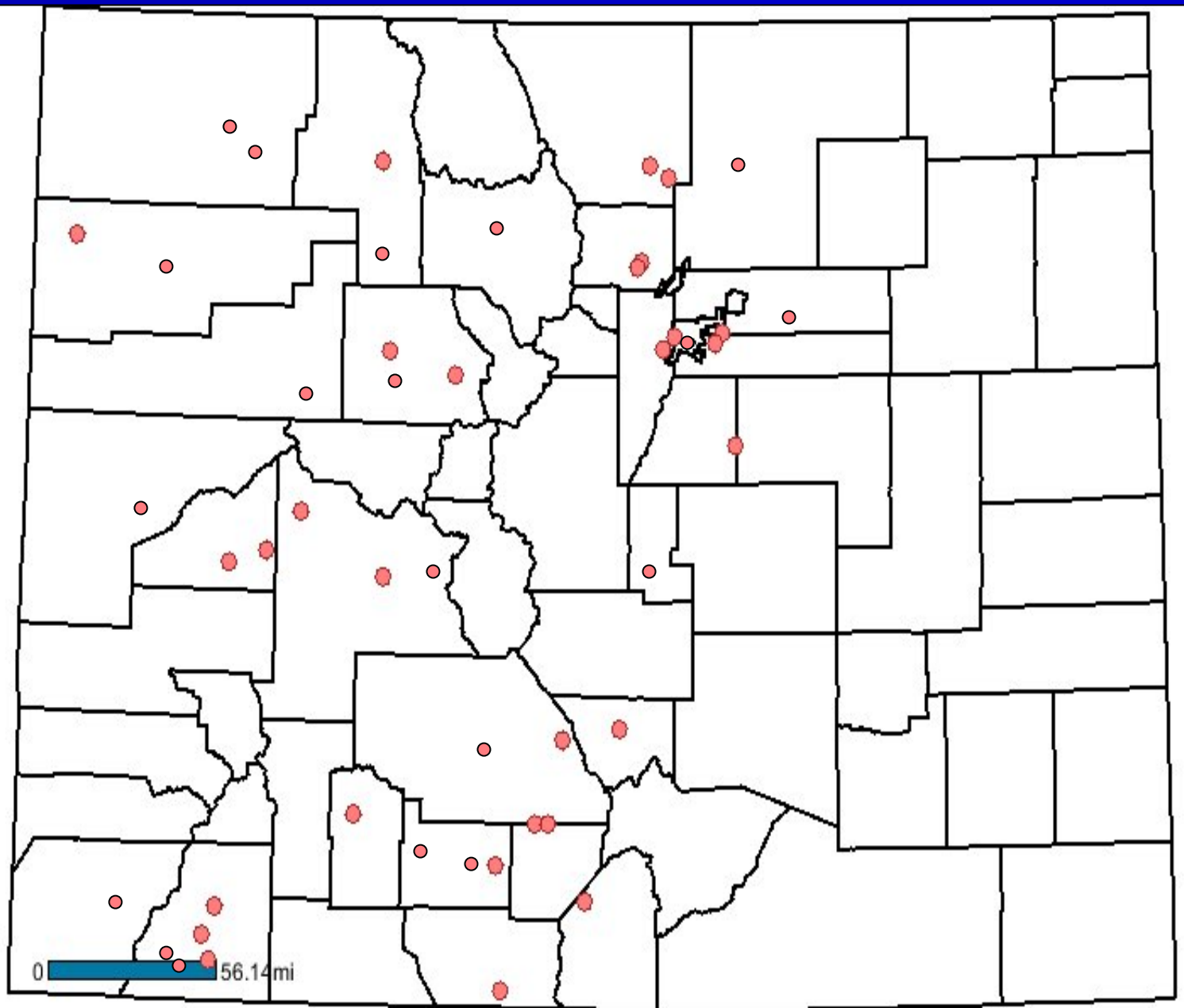
Case Demographics

- All Cases
  - Median age: 33 (range 12 – 69) years
  - 28 male (57%)
- Fatal Cases
  - Median age: 30.5 (range 15 – 69) years
  - 10 male (58%)

Hantavirus Pulmonary Syndrome Cases (n=49) by Month of Onset and Outcome, Colorado, 1985-2005



Colorado Hantavirus Pulmonary Syndrome Cases, By Residence, 1985-2005



Colorado Department of Public Health and Environment

Clinical Clues for HPS

How do you find rare HPS among thousands of flu syndromes?

- Flu syndrome without rhinorhea, otitis, sinusitis, congestion, sneezing
- Nausea, vomiting, abdominal pain are often severe if present
- Cough does not begin on the first day of symptoms; begins after two or more days, accompanied by progressive dyspnea and heralds the onset of pulmonary edema
- During the prodrome , thrombocytopenia is the only lab sign
- A rapidly falling platelet count helps differentiate HPS

CLASSIC HERMAN® Jim Unger

"Did it ever cross your mind that maybe you're being outsmarted by a mouse?"

Hantavirus Pulmonary Syndrome Prevention Recommendations

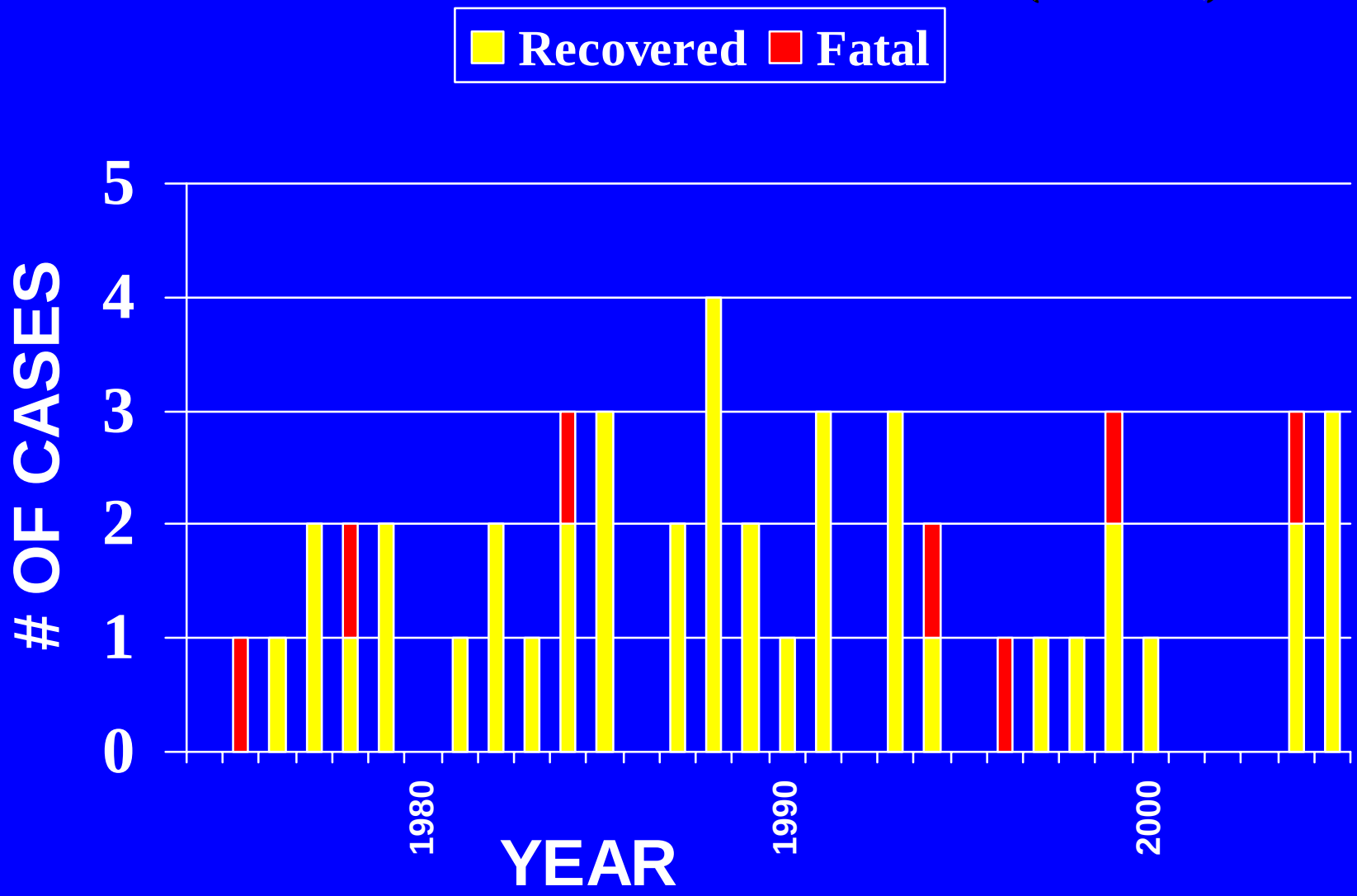
- Rodent-proof homes, barns and outbuildings
- Eliminate rodent harborage and food supplies
- Conduct ongoing rodent population reduction
- Use special precautions when working in or cleaning rodent-infested environments

Year of the Rodent

- First significant state-wide plague activity since 1992-94
  - Six human cases (1 fatal) since August ’04
    - 2 rabbit hunters, 4 flea bite
  - 65 /265 (25%) plague specimens positive
    - 16 cats, 1 dog, 20 flea pools, 21 rodents,

    2 rabbits, 7 coyotes

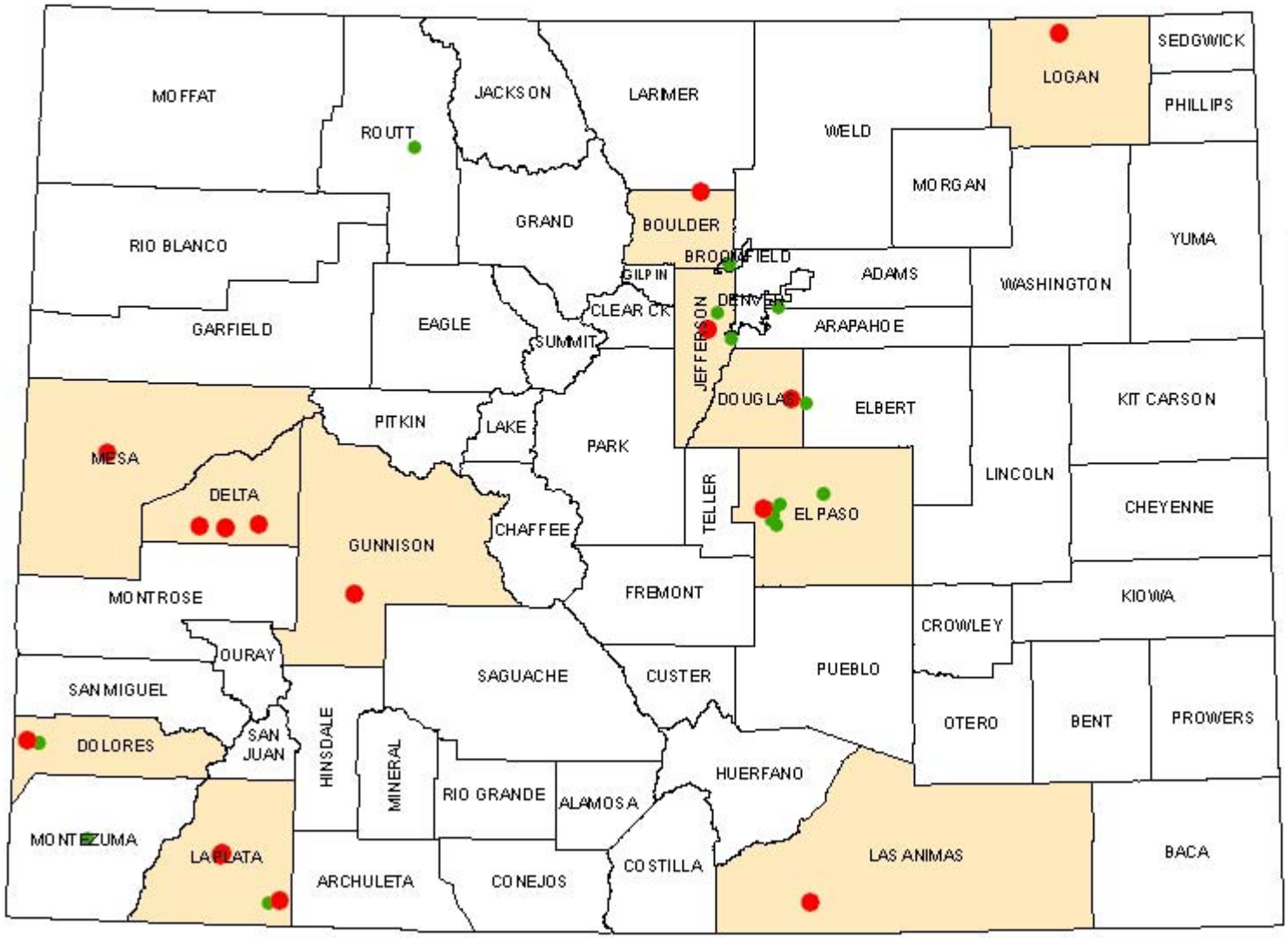
Human Plague Cases
Colorado, 1974-2005 (n=48)*



* Not included are 5 cases (2 fatal) occurring between 1957-1973

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before May 20, 2005

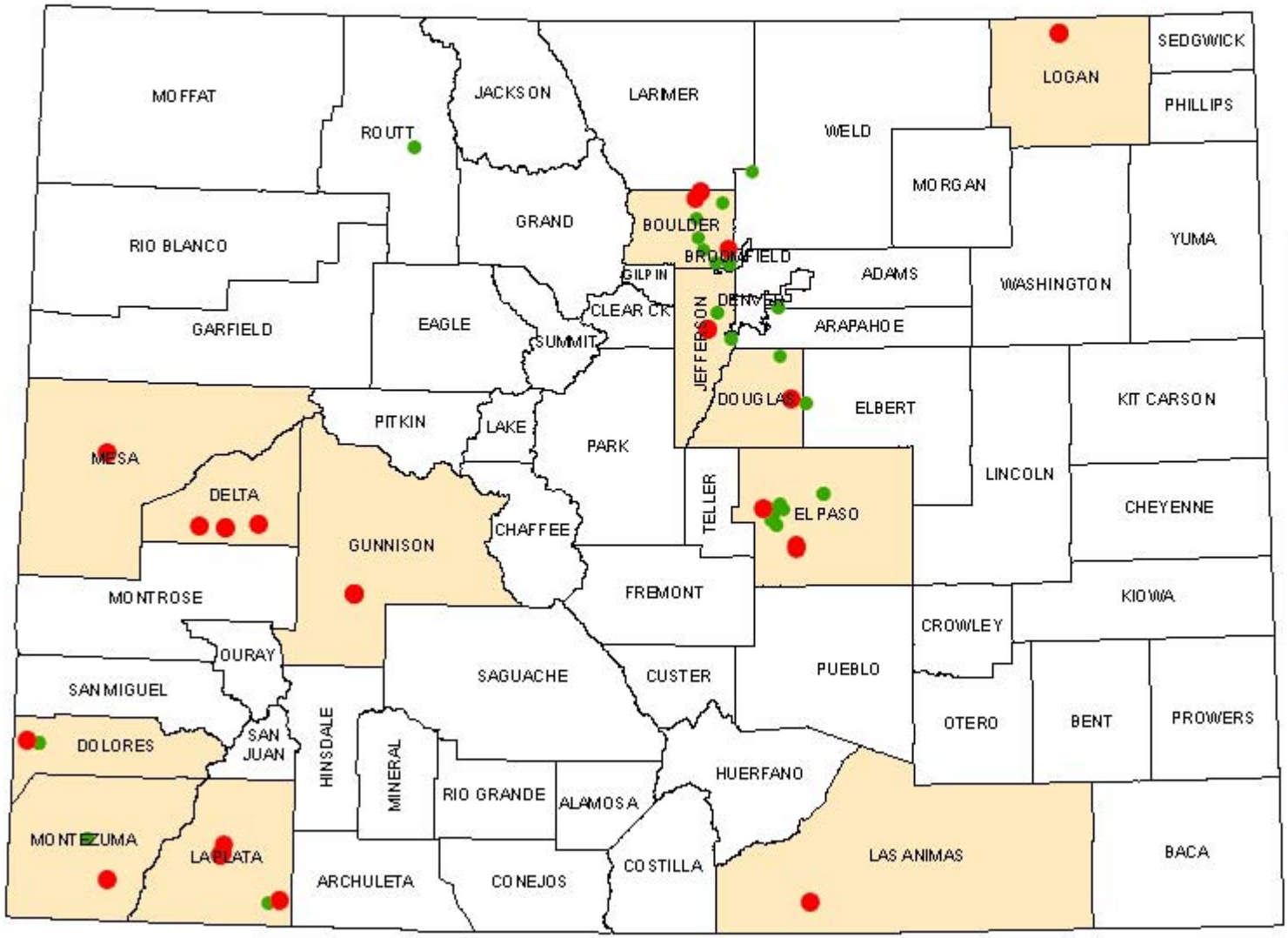


Positives N=19

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before June 3, 2005

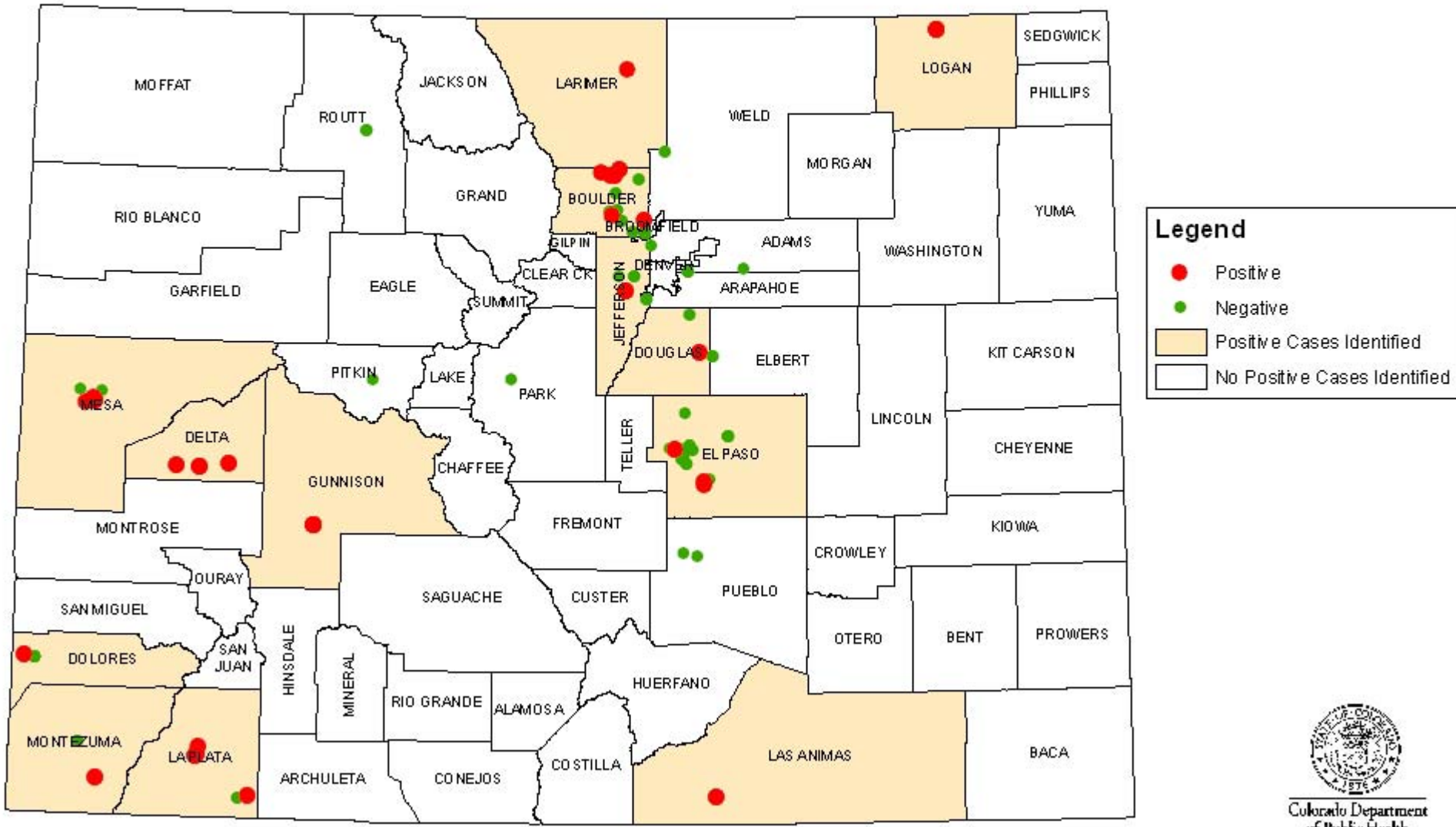


Positives N=33

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before June 17, 2005

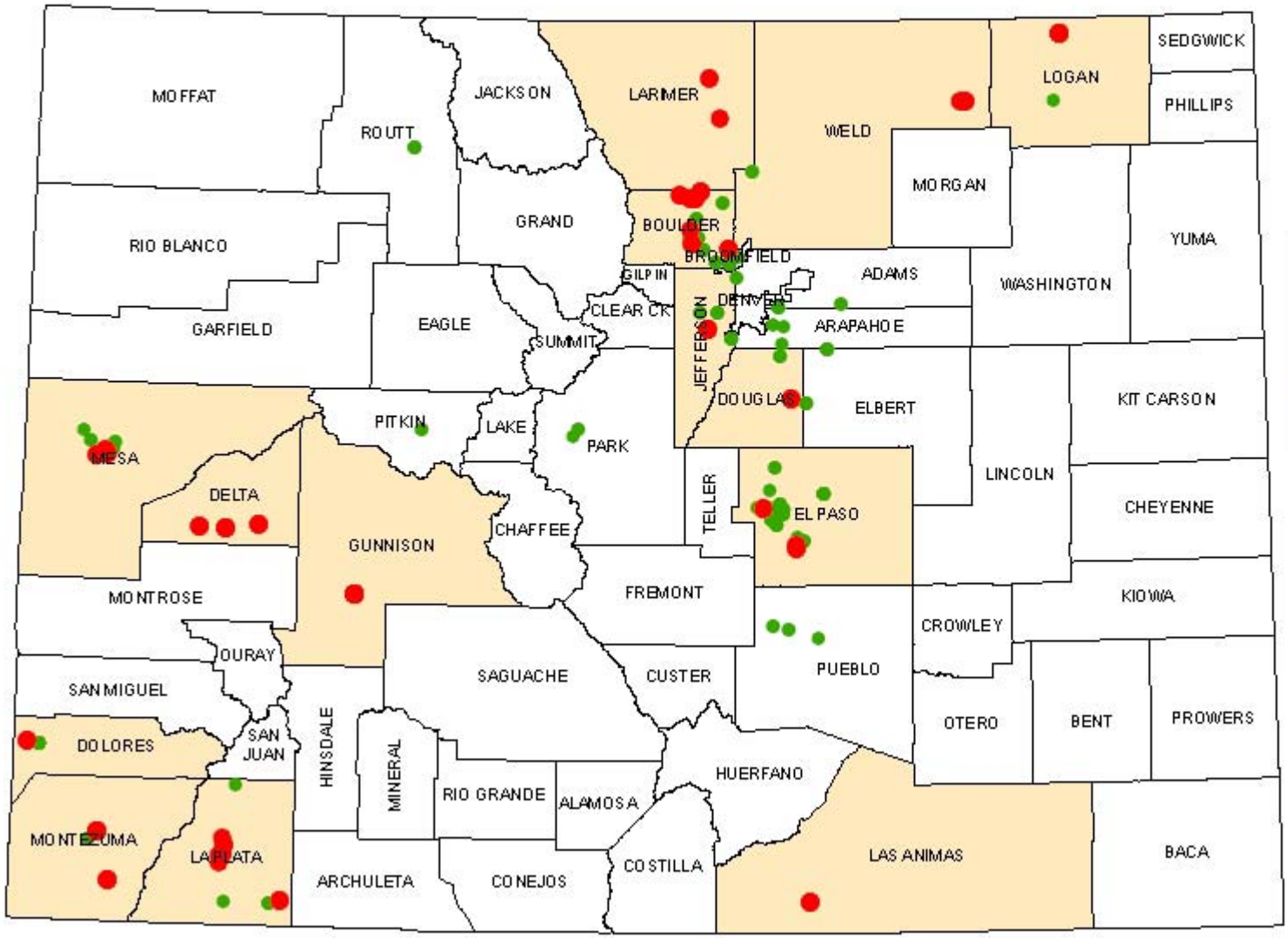


Positives N=39

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before July 1, 2005



Legend

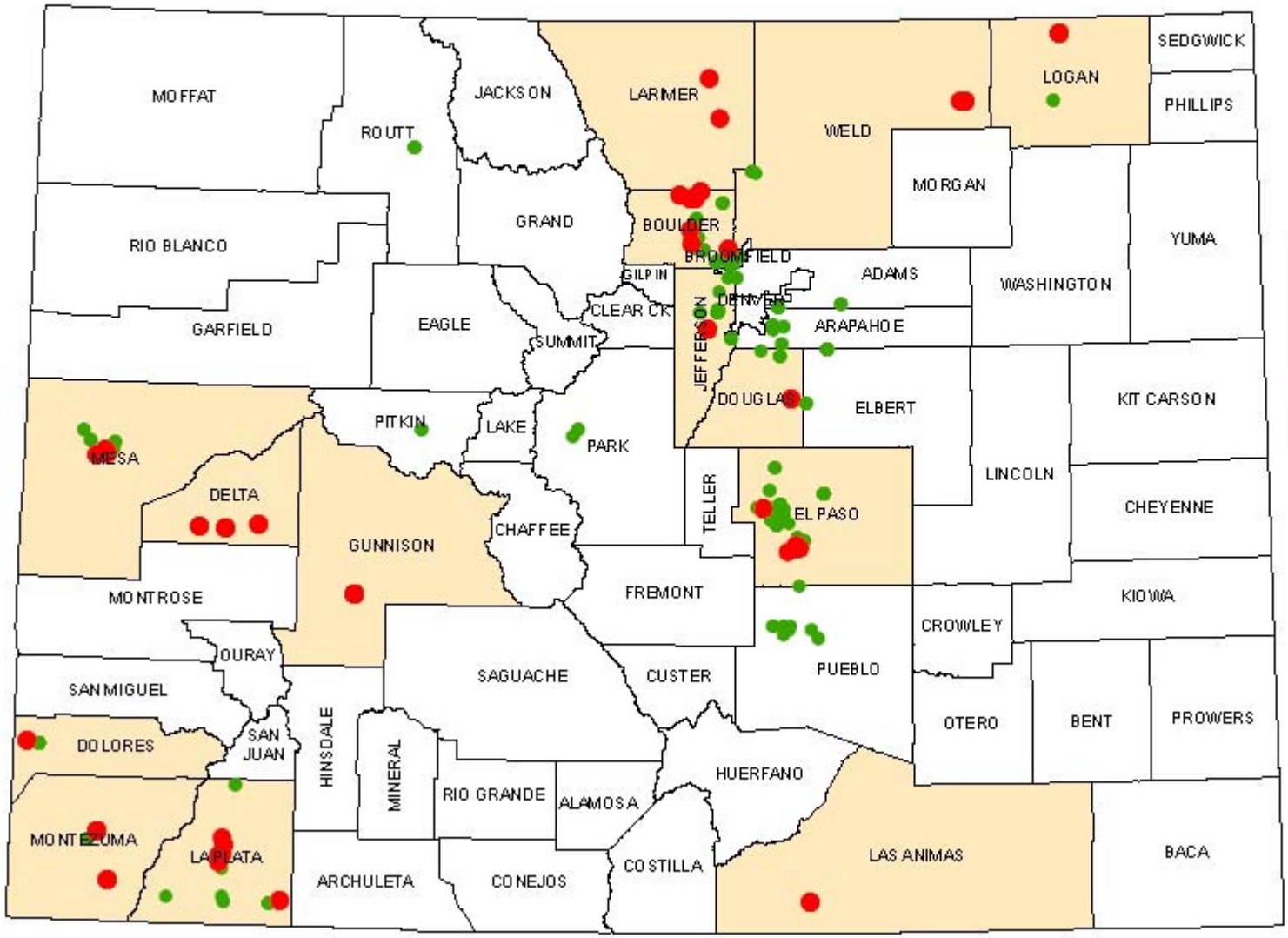
- Positive
- Negative
- Positive Cases Identified
- No Positive Cases Identified

Colorado Department of Public Health and Environment

Positives N=61

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before July 15, 2005



Legend

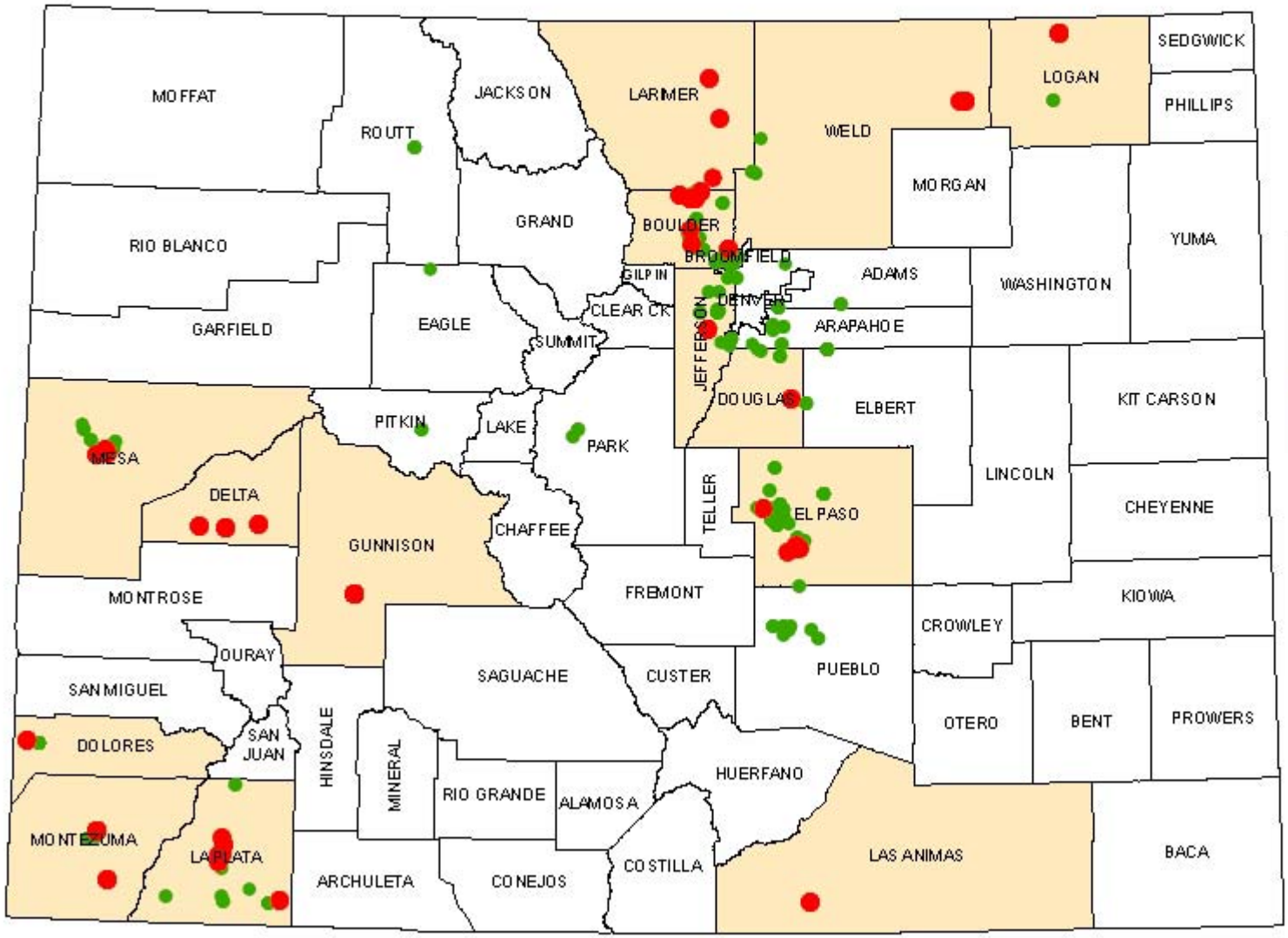
- Positive
- Negative
- Positive Cases Identified
- No Positive Cases Identified

Positives N=65

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before July 29, 2005

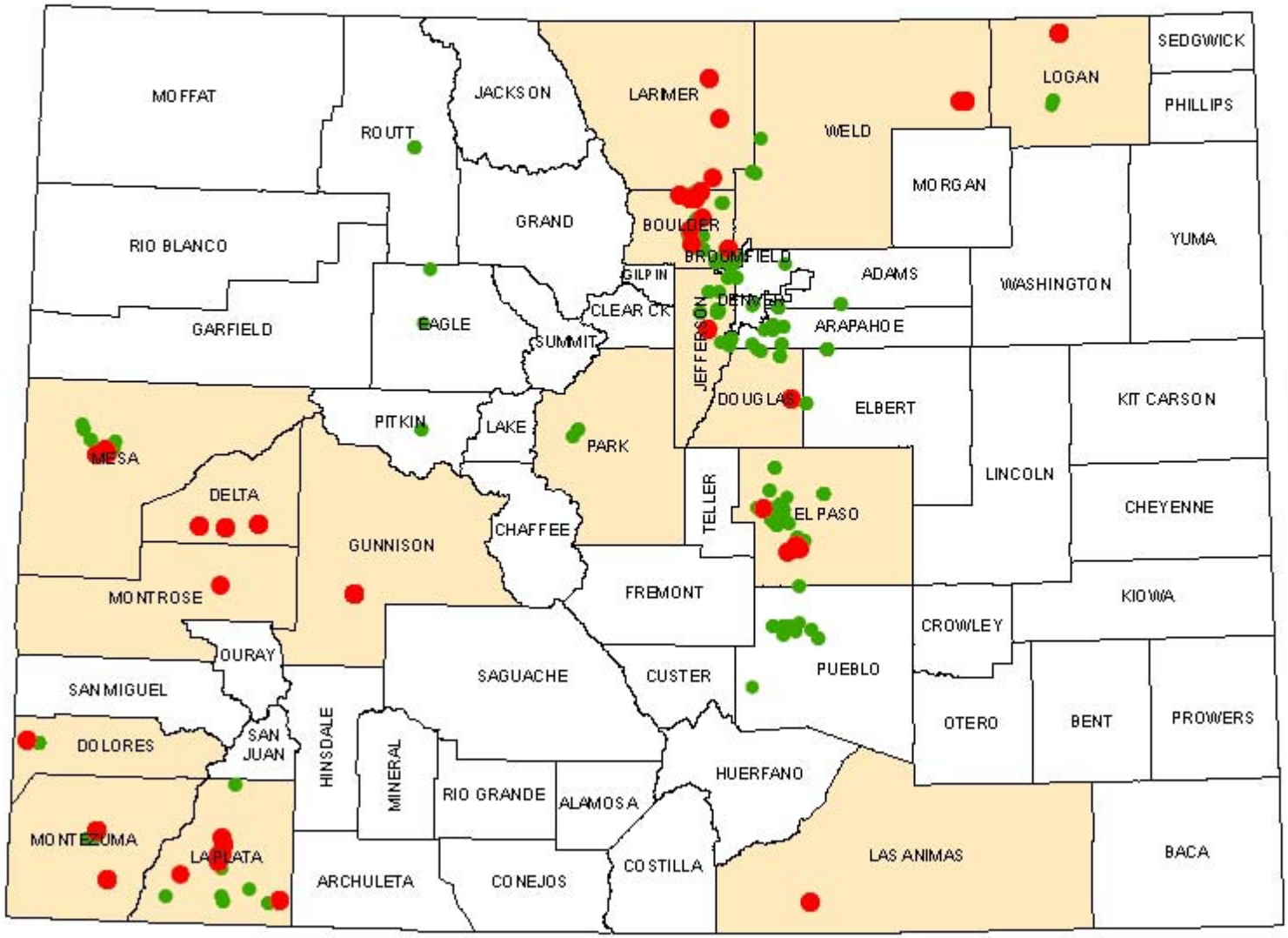


Positives N=67

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before August 12, 2005



Legend

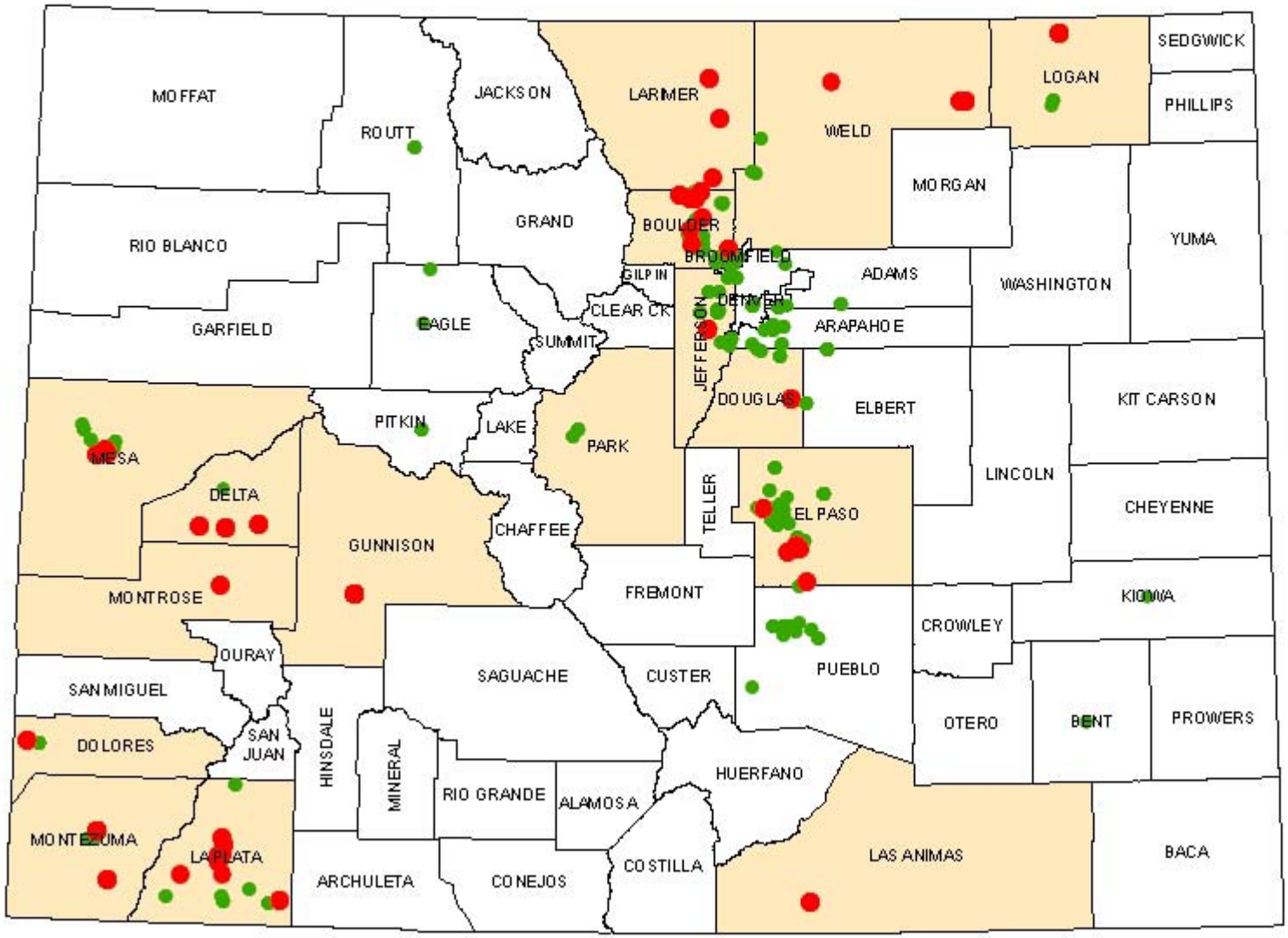
- Positive
- Negative
- Positive Cases Identified
- No Positive Cases Identified

Positives N=73

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before August 26, 2005

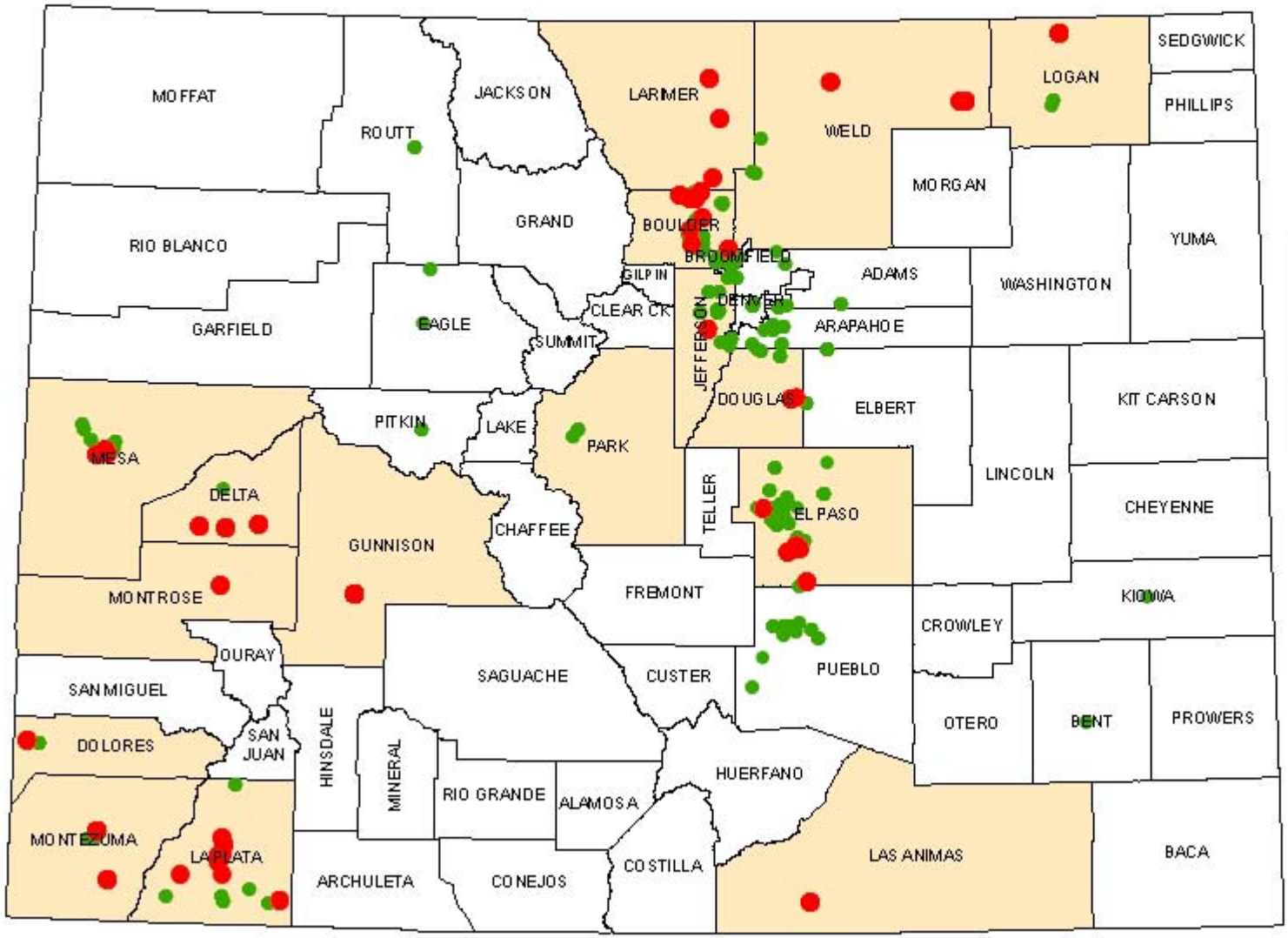


Positives N=78

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before September 2, 2005

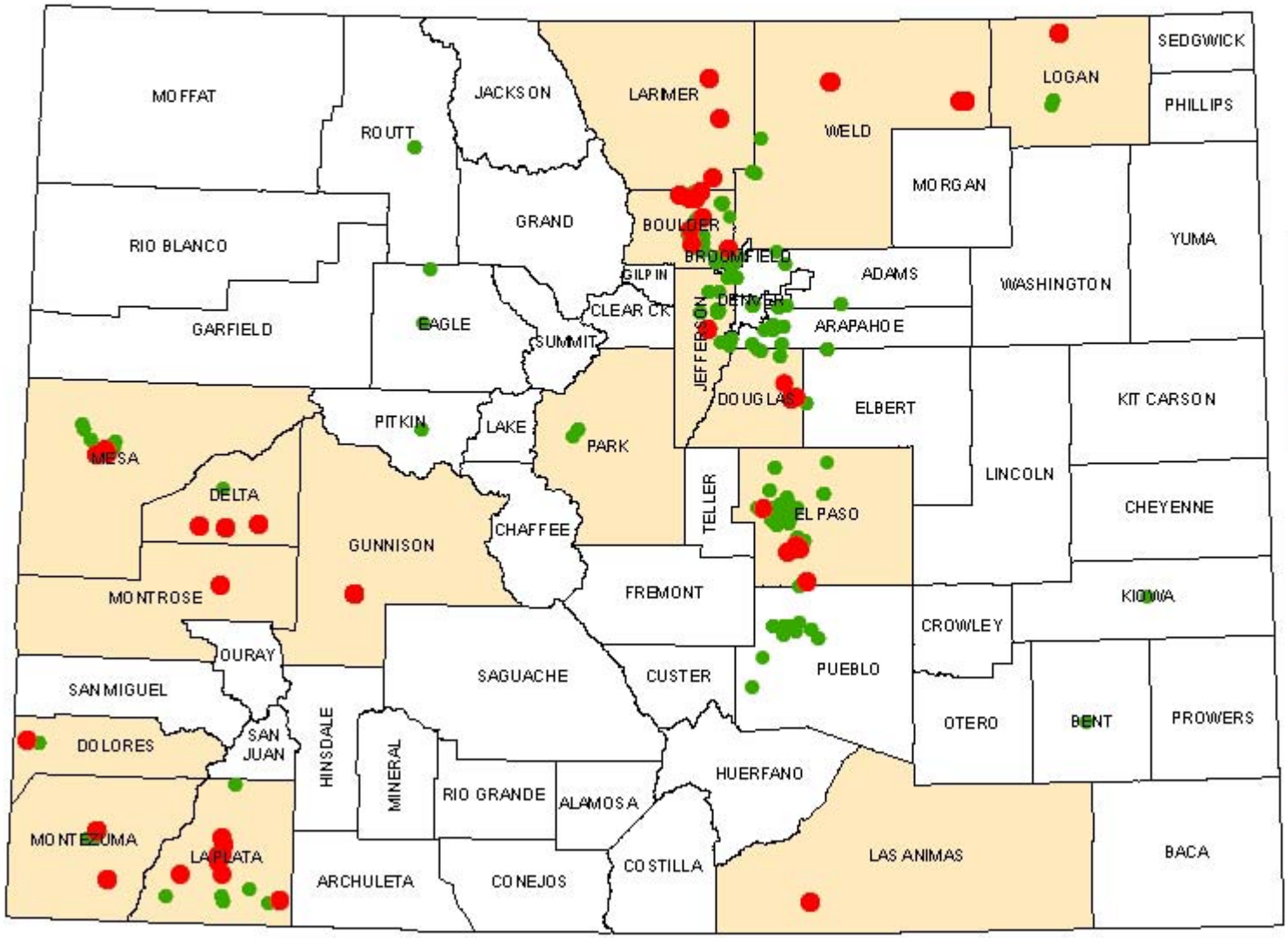


Positives N=80

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before September 16, 2005



Legend

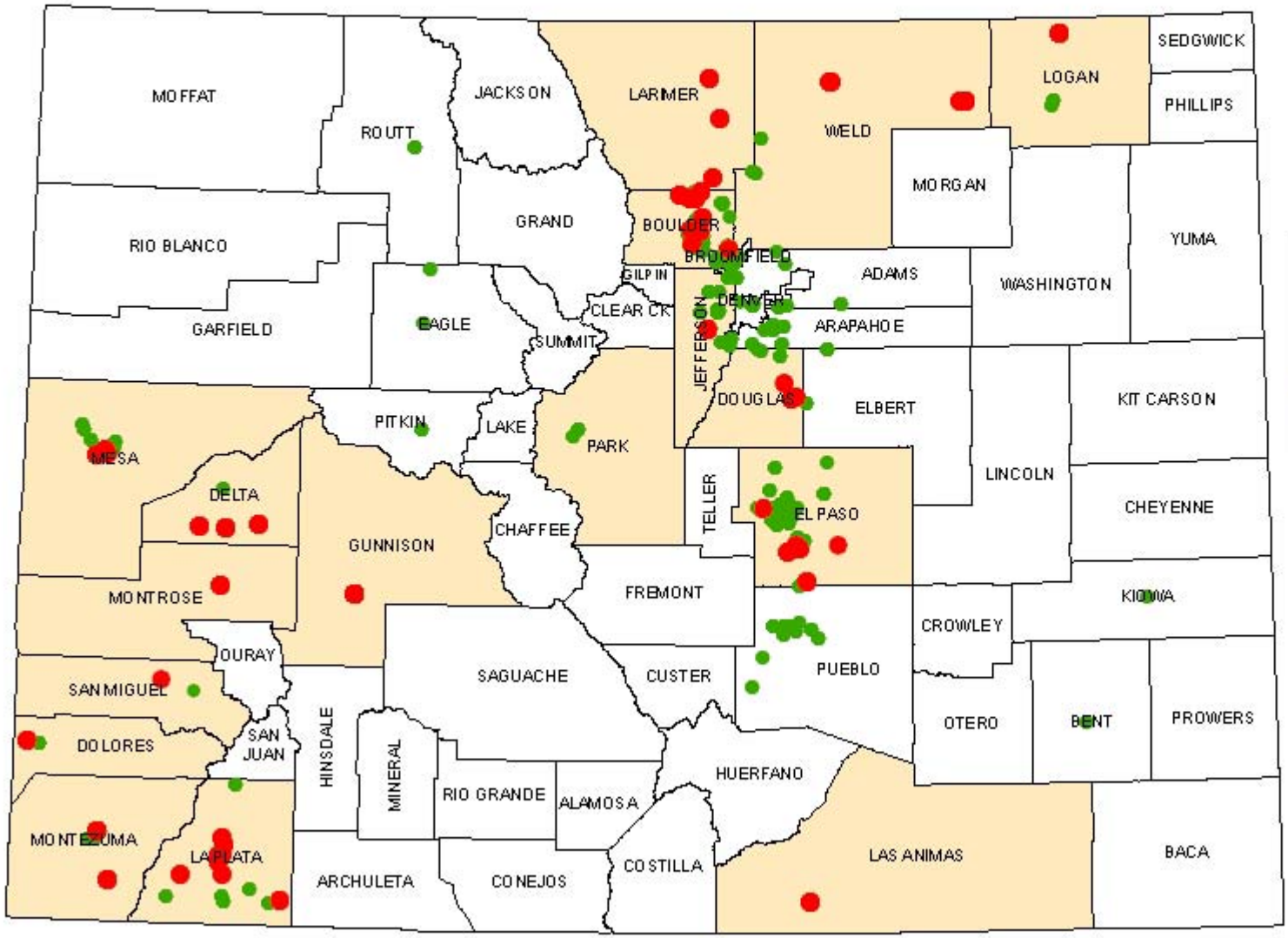
- Positive
- Negative
- Positive Cases Identified
- No Positive Cases Identified

Positives N=85

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before September 30, 2005

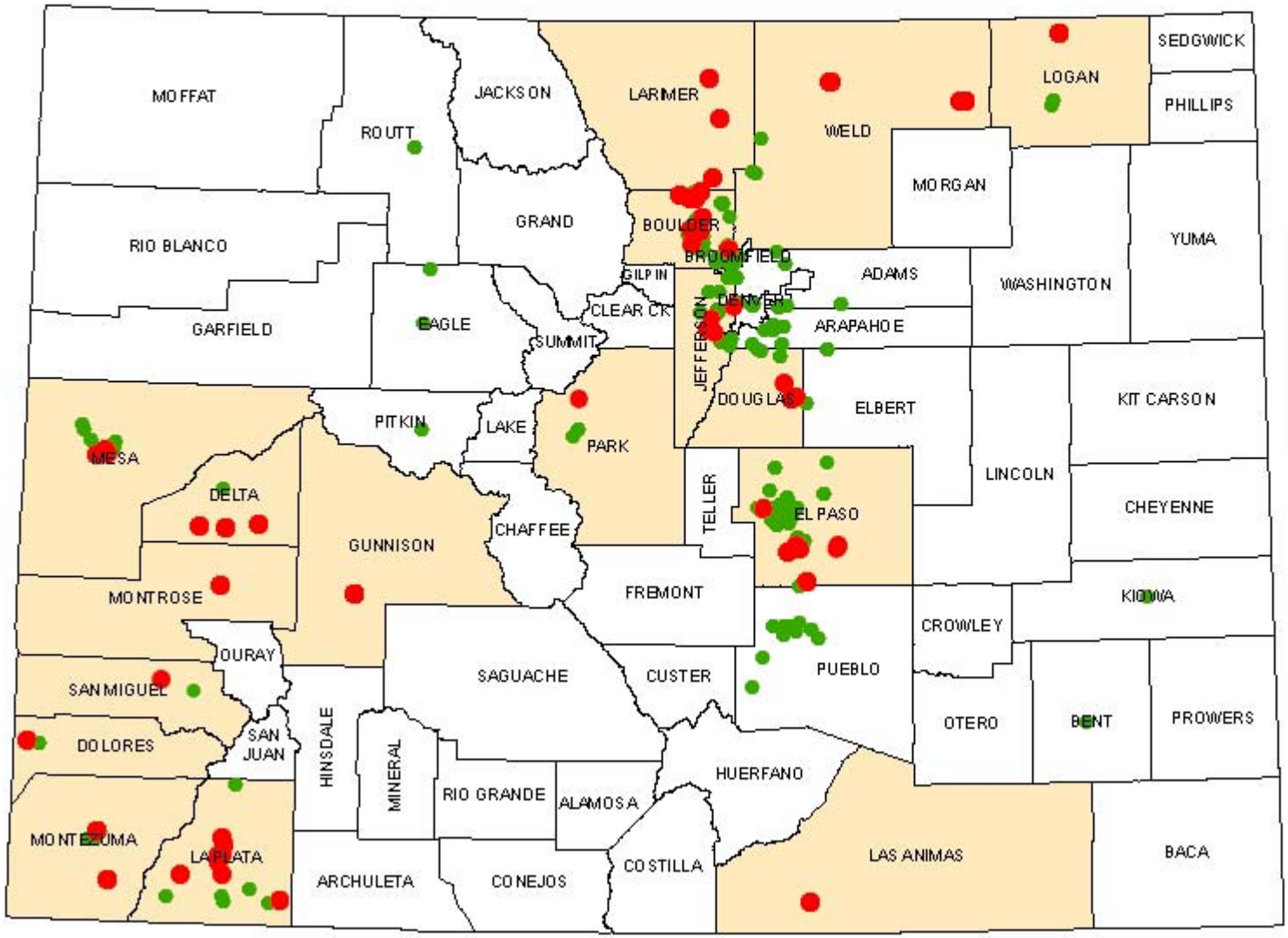


Positives N=89

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before October 14, 2005



Legend

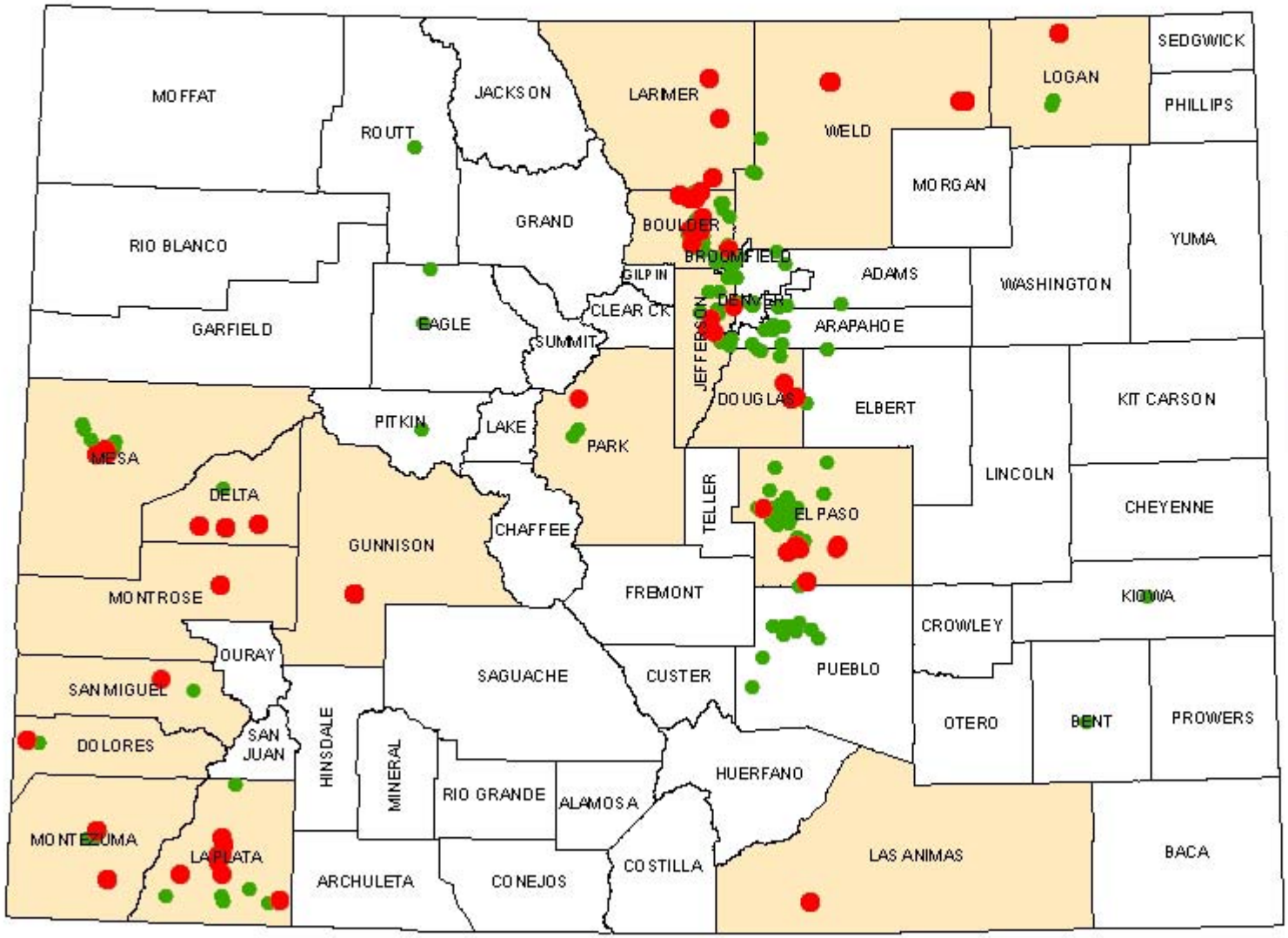
- Positive
- Negative
- Positive Cases Identified
- No Positive Cases Identified

Positives N=96

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before October 28, 2005



Legend

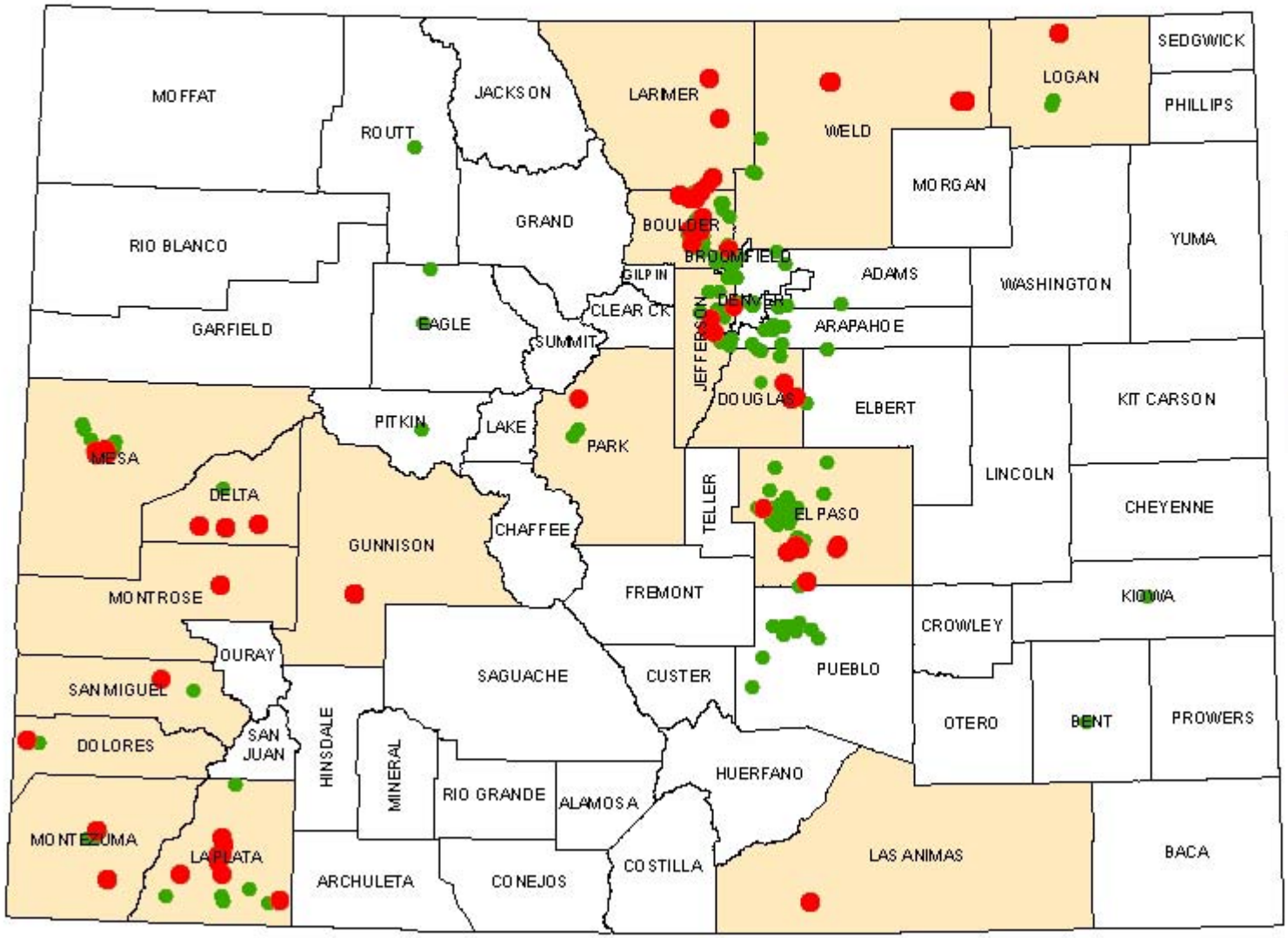
- Positive
- Negative
- Positive Cases Identified
- No Positive Cases Identified

Positives N=96

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before November 11, 2005

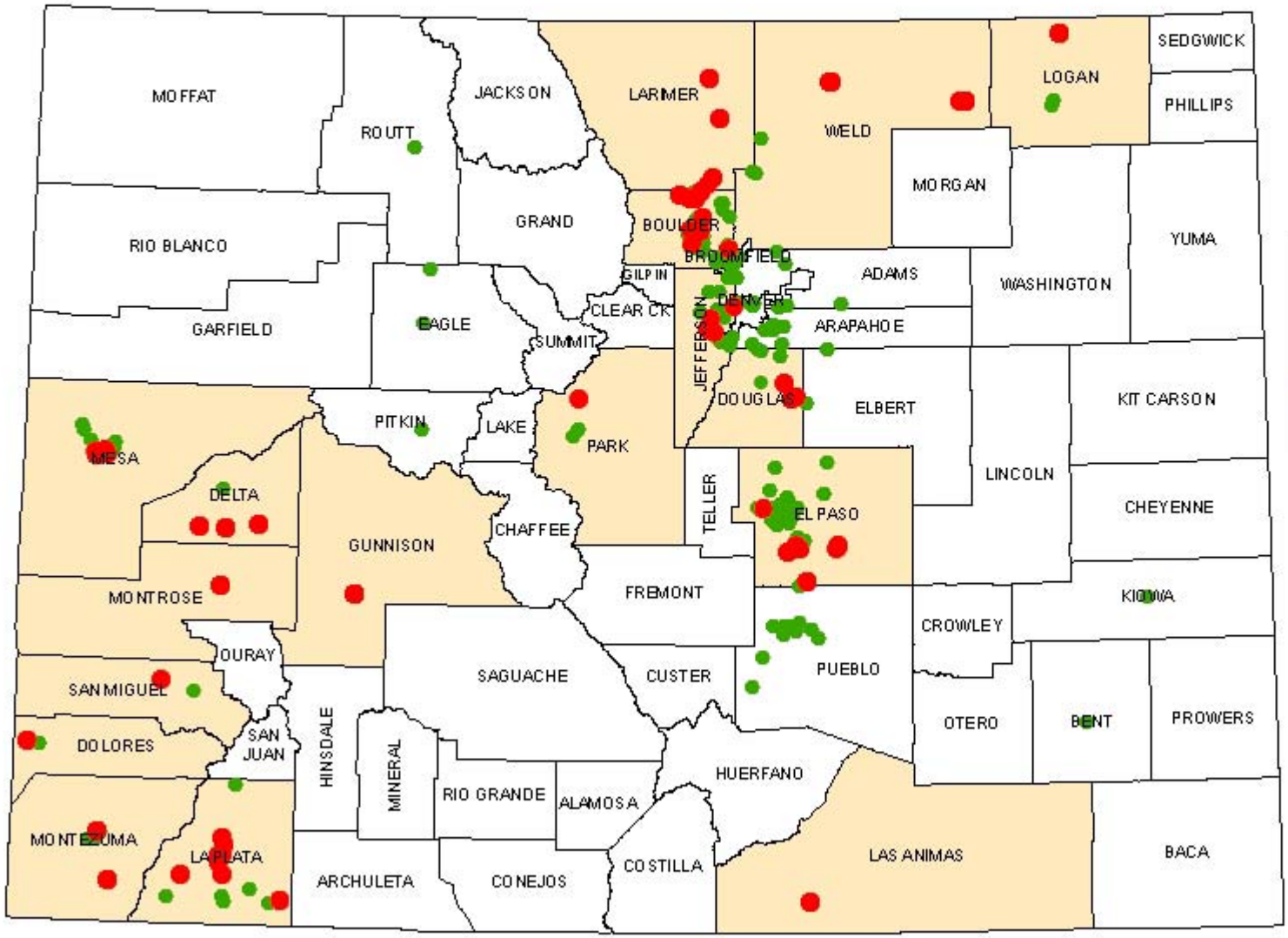


Positives N=98

Colorado Department of Public Health and Environment

Animal Plague Surveillance
Colorado, 2005

Samples Collected on or Before November 25, 2005



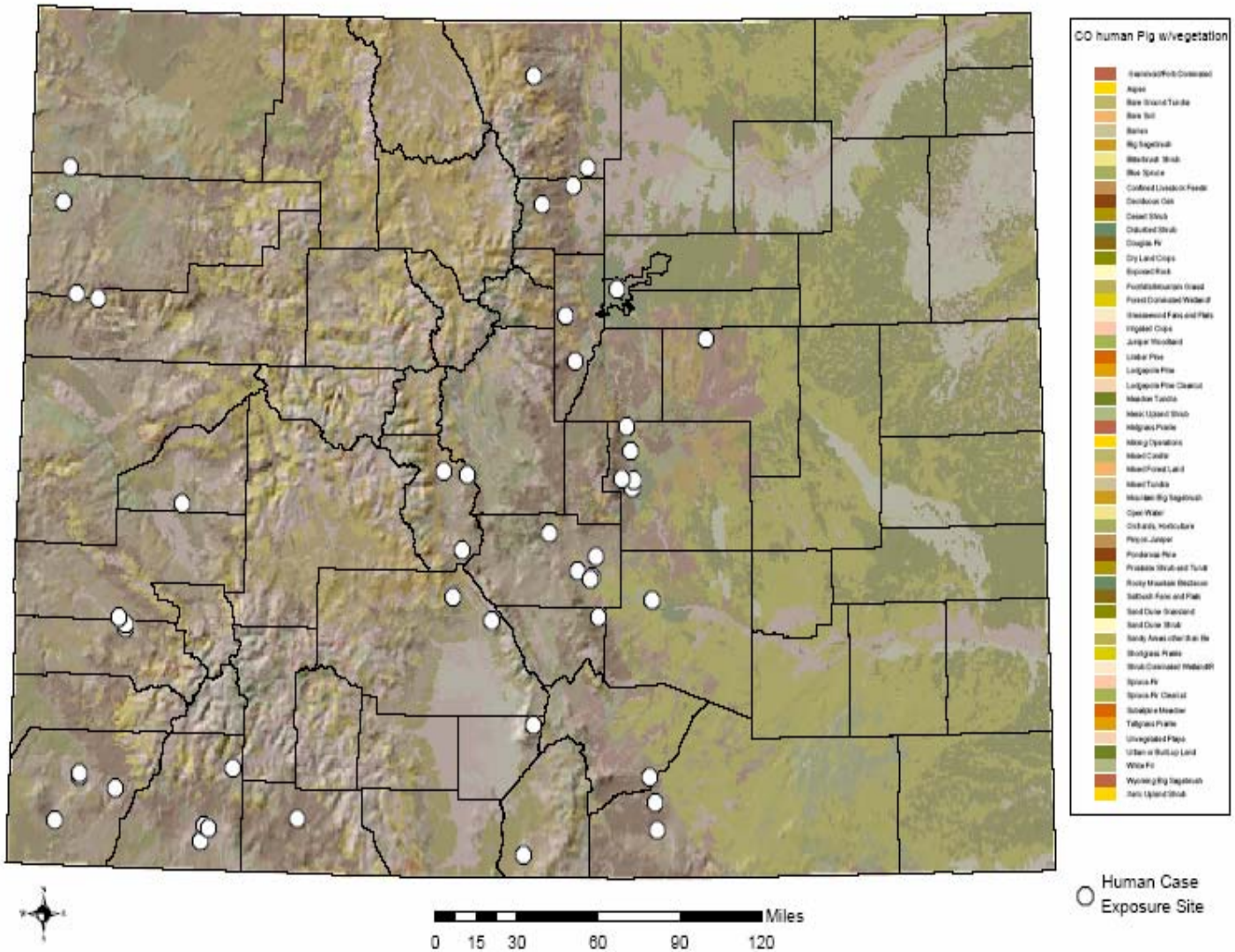
Legend

- Positive
- Negative
- Positive Cases Identified
- No Positive Cases Identified

Colorado Department of Public Health and Environment

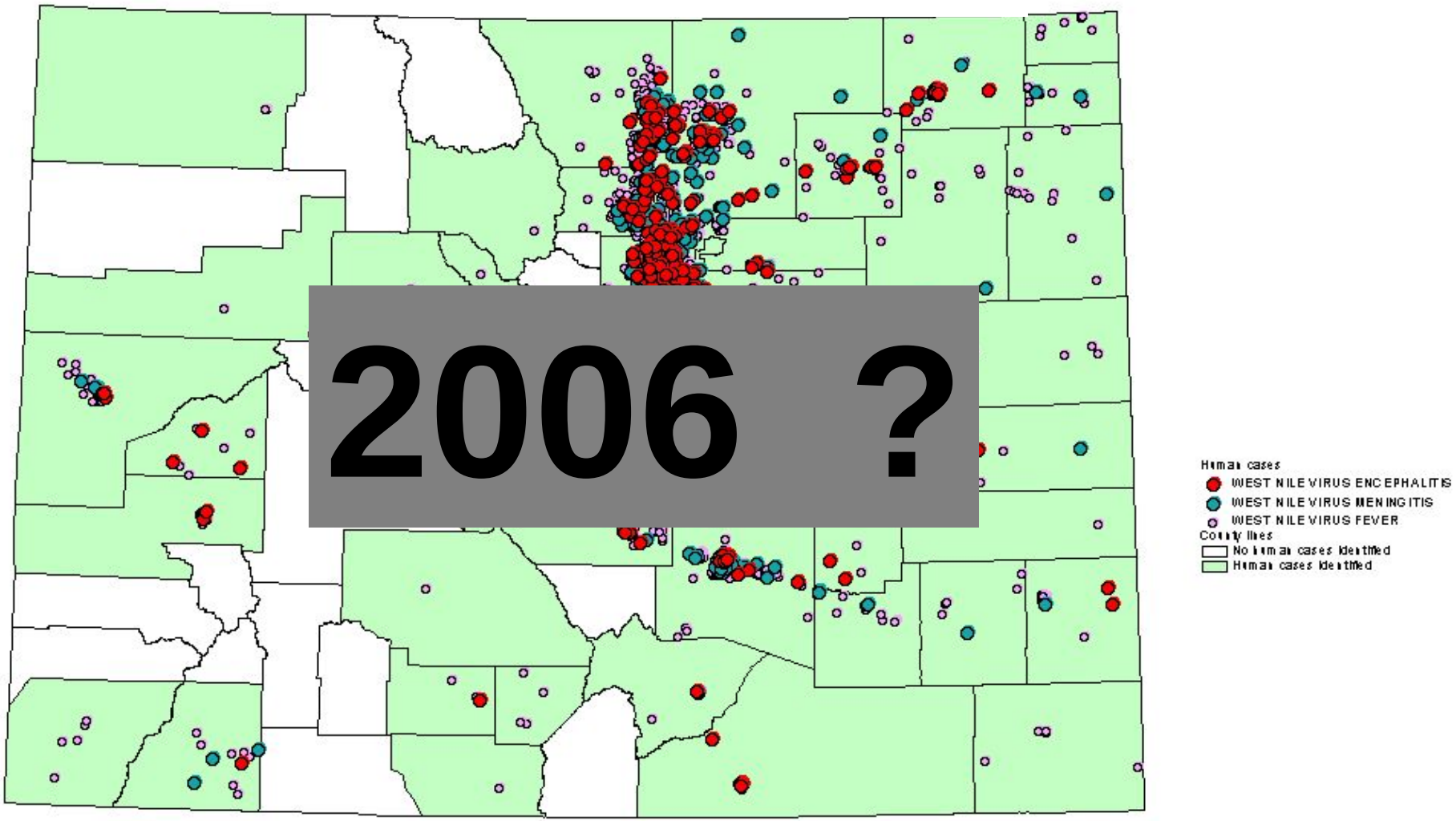
Positives N=98

Human Plague Cases, (1957 - 2002)



Colorado West Nile Virus
Human Cases

2003



N = 2,944