Animals and Bioterrorism

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Definition

Bio-warfare – the deliberate use of microorganisms and toxins as weapons

CHAPTER XI. Western Front, 1917. Horses and driver wearing gas masks. *Imperial War Museum photo.*

Animals/Animal Toxins as Warfare Agents

300 BC Persian, Greek and Roman literature describe well contamination from animal cadavers.

400 BC Scythian archers contaminated their arrows by dipping them in decomposing cadavers or manure.

190 BC Hannibal won a naval victory over the King of Pergamon by firing earthen vessels full of venomous snakes onto the King's flagship.

Animals as Causalities of Biologic Warfare

WWI – Germans developed plans to innoculate:

Reindeer in Norway, Romanian sheep, Argentinian livestock with anthrax

Mules in Mesopotamia and horses of the French cavalry with glanders.

WWII – Japanese troops infected Russian livestock with anthrax

Incidences Where Animals were Targets for Biologic Terrorism

Date	Location	Perpetrator	Target	Agent
1915-16	U.S.	German	Horses, mules	Anthrax, glanders
1915-16	Romania	German	Horses, livestock	Glanders
1915-18	Spain	German	Horses, cattle	Anthrax, glanders
1916	Norway	German	Reindeer, cattle	Anthrax, glanders
1916-17	Argentina	German	Horses, mules	Anthrax, glanders
1917	France	German	Horses	Glanders
1952	Kenya	Freedom fighters	Cattle	Plant toxin
1978-80	Rhodesia	Security forces	Cattle	Anthrax
1982-84	Afghanistan	Soviet	Horses	Glanders
1997	New Zealand	Farmers	Wild rabbits	Viral dz. of rabbits

Animals and Bioterrorism

Definition

Bioterrorism - use of biological agents to intentionally produce disease or intoxication in susceptible populations to meet terrorist aims.

Agroterrorism - refers to biologic weapons targeting animals or crops with the purpose to disrupt local economies

Zoonotic Diseases

“Diseases and infections which are naturally transmitted between vertebrate animals and man”. (WHO 1959)

Not all zoonotic diseases cause substantial harm to animals but many are pathogenic to both humans and animals.

Ideal Characteristics for Potential Biological Terrorism Agent

- Inexpensive and easy to produce
- Can be aerosolized (1-10 μm)
- Survives sunlight, drying, heat
- Cause lethal or disabling disease
- Person-to-person transmission
- No effective Rx or prophylaxis

Challenges in Recognizing Bioterrorism Attack

- Biologic agents with delayed onset
- Medical community is unfamiliar with many of these diseases
- Current surveillance system may not be adequate to detect attack

The “Current Age” and Bioterrorism

- Perpetrators
- Availability of biological agents
- Methods of dissemination

Terrorism/Food

- Salad bars were contaminated with *S. typhimurium* in 10 restaurants
- Goal to prevent people from voting in a local election
- 751 cases

Perpetrators

- State-sponsored
- Rogue states
- Organized crime
- Militia groups
- Cult sects
- Disgruntled individuals
- Animal rights groups

Sources of Agents for Terrorism Use

- World Directory of Collections of Cultures and Microorganisms
  - 453 worldwide repositories in 67 nations
  - 54 ship/sell anthrax
  - 18 ship/sell plague
- International black-market sales associated with governmental programs

Methods of Dissemination of Biologic Agents

- Aerosol
  - Enclosed areas
  - Community-wide
- Ingestion
  - Mass produced food
  - Water Supplies

Biological Terrorism: Diseases/Agents

- **Bacterial:** ***Bacillus anthracis*** **(Anthrax)**
  Yersinia pestis **(Plague)**
  Francisella tularensis **(Tularemia)**
  Coxiella burnetii **(Q Fever)**
  Brucella sp**. (Brucellosis)**

- **Viral:** ***Variola major*** **(Smallpox)**
  Viral encephalitides
  Viral hemorrhagic fever

- **Toxin:** ***Clostridium botulinium*** **(Botulism)**
  Ricin

Category A Biological Agents

- **Easily disseminated**
- **High mortality**
- **Cause social disruption**

Category A Agents

Zoonotic:

- ***Bacillus anthracis*** **(Anthrax)**
- ***Yersinia pestis*** **(Plague)**
- ***Francisella tularensis*** **(Tularemia)**
- **Filoviruses (Ebola)**
- **Arenaviruses (Lassa fever)**

Variola major (Smallpox)

Clostridium botulinium **(Botulism)**

Category B Biological Agents

- **Moderately easy to disseminate**
- **Cause moderate morbidity and low mortality**

Category B Agents

Zoonotic:

- ***Coxiella burnetti*** **(Q-Fever)**
- ***Brucella*** **sp. (Brucellosis)**
- ***Burkholderia mallei*** **(glanders)**
- **Alphaviruses (VEE, WEE, EEE)**
- ***Salmonella*** **sp.**
- ***Escherichia coli*** **O157:H7**
- ***Cryptosporidium parvum***

Category C Biologic Agents

Emerging pathogens that could be engineered for mass dissemination:

- **Zoonotic:**
  - **Nipah virus**
  - **Hantavirus**
  - **Tickborne hemorrhagic fever viruses**
  - **Yellow Fever**
- **Multidrug-resistant tuberculosis**

Anthrax in Minnesota

- From MBAH records, anthrax has been diagnosed on 192 Minnesota farms since 1909.
- Recent outbreaks have occurred in 1969, 1984, 1993, 1996, 1997, 2000, and 2001.

Anthrax in Minnesota

- Most farms diagnosed with anthrax are in Southwestern Minnesota and follow the Minnesota River.
- In 2000 and 2001, outbreaks involved animal producers in NW Minnesota counties
- Associated animals losses were 30 and 93 respectively
- No human cases, but several people were potentially exposed

Shopping Mall Scenario - Denver

- Anthrax aerosolized into shopping mall ventilation system: 10,000 people are present and 9,000 people are exposed; terrorist announces attack at 24 hours
- 90% of exposed started on antibiotics by end of day 2, 10% cannot be found initially
- Total number hospitalized 4,950, total requiring ICU care 2,925, total deaths 855, total ventilators required 2,601, total ICU beds 300 (only 150 available)

Shopping Mall Scenario - Denver
Continued

- Even a small scale biological terrorism event completely overwhelms city's medical care resources
- The 13,000 military beds deployed for the Persian Gulf War would STILL not provide enough ICU beds (only about 1,300)

Potential Impact of a Biologic Incident

- Scenario: 50 kg aerosolized anthrax spores dispensed by a line source 2 km upwind from a city of 500,000 persons under ideal weather conditions
- Impact: Cloud would travel > 20 km, and kill or incapacitate 220,000 persons

1970 WHO report

Animals as Sentinels for Acts of Bioterrorism

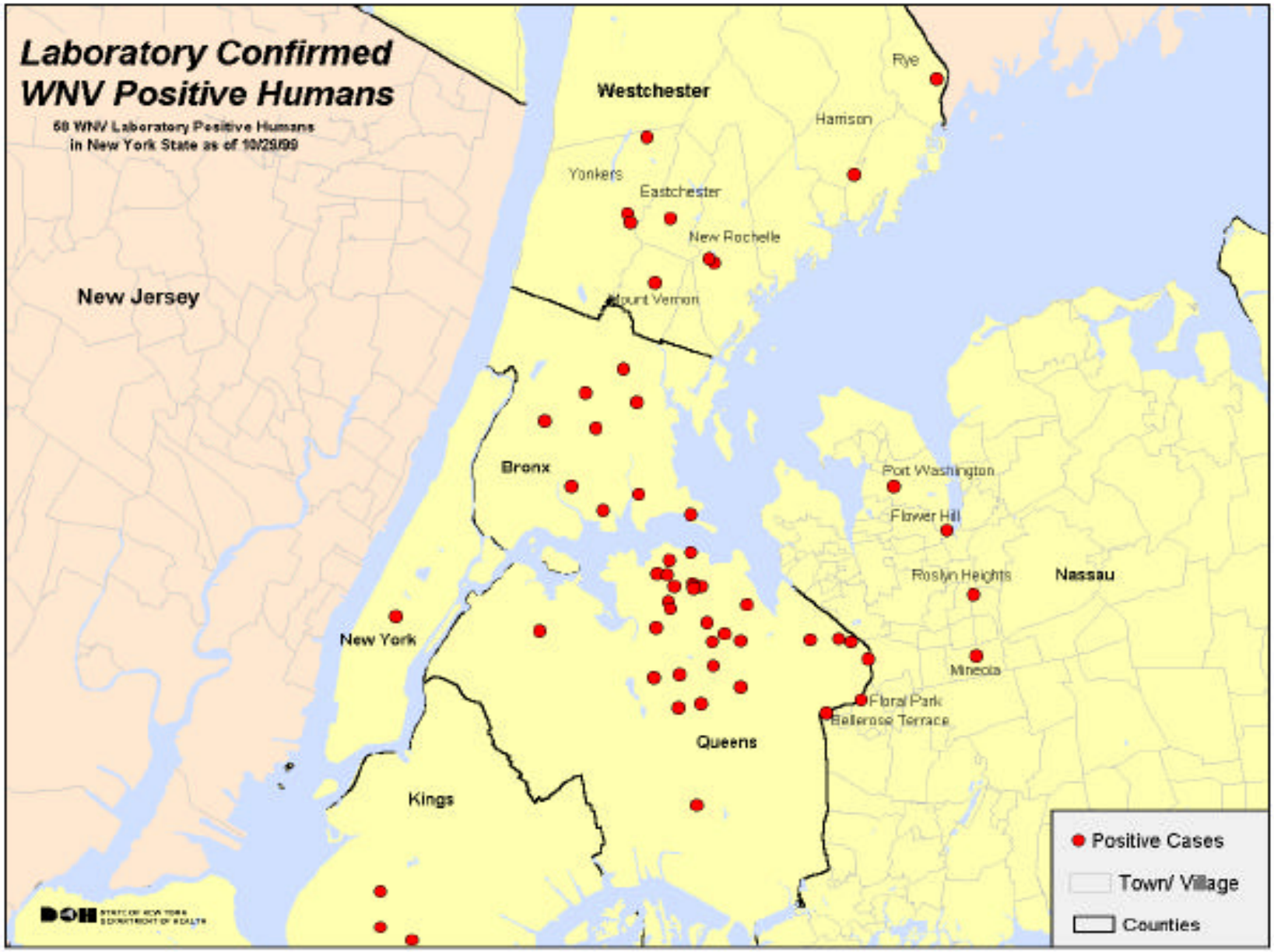
Chickens are used in many parts of the country to monitor arboviral activity

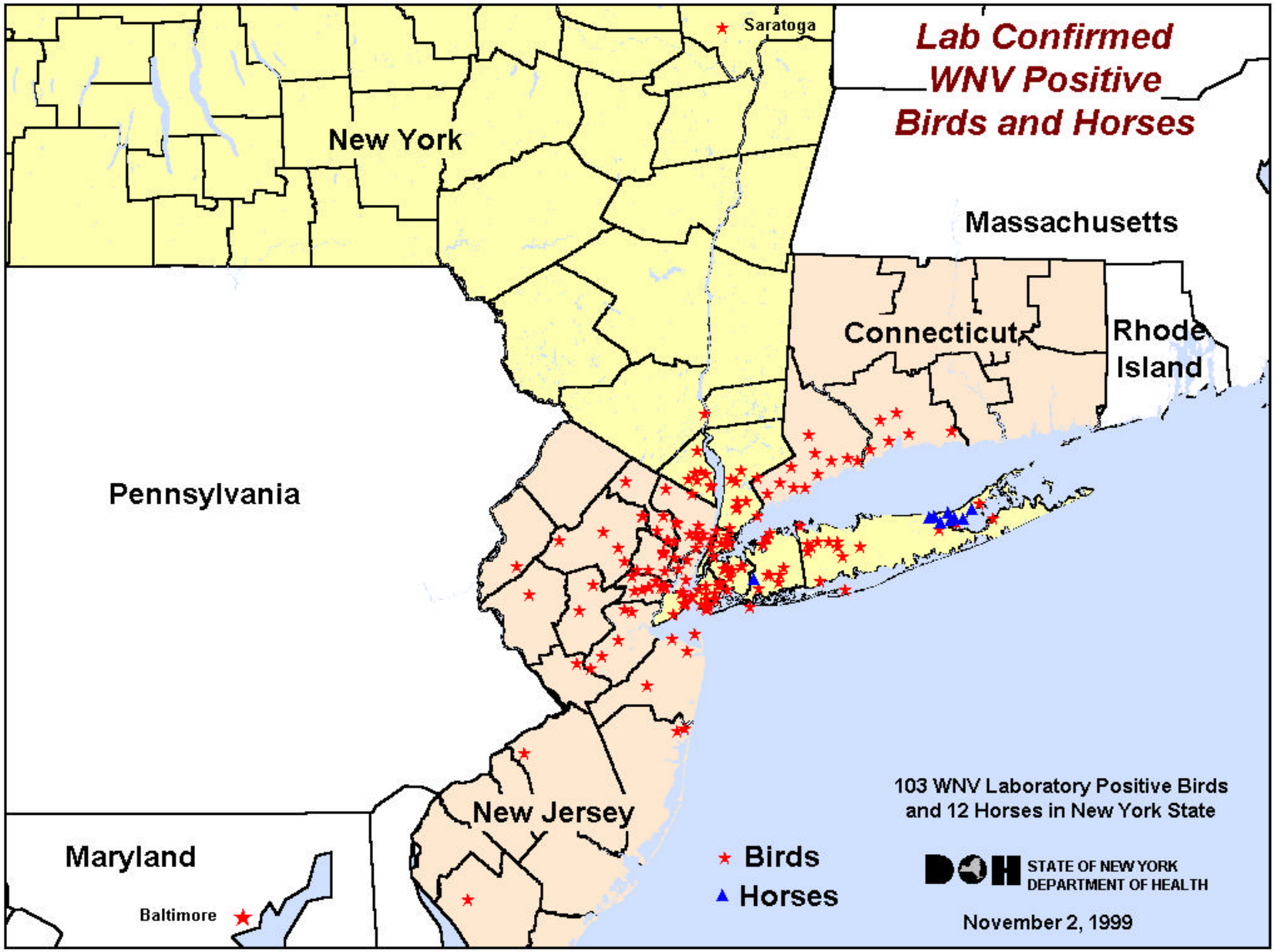
In Minnesota, we have 3 sentinel flocks on the western part of the twin cities


Sverdlovsk
A
B
C
D
E
F
10 km

West Nile Viral Encephalitis
New York, 1999

- Physician awareness of several cases of encephalitis in the same community
- Initially suspected to be St. Louis encephalitis
- Concurrent mortality of crows noticed in the same area
- Deaths of several exotic birds from the Bronx Zoo were noted and sent to NVSL for testing


Laboratory Confirmed
WNV Positive Humans
68 WNV Laboratory Positive Humans
in New York State as of 10/29/99
Westchester
Rye
Harrison
Yonkers
Eastchester
New Rochelle
Mount Vernon
New Jersey
Bronx
Port Washington
Flower Hill
Roslyn Heights
Nassau
New York
Mineola
Floral Park
Bellerose Terrace
Queens
Kings
Positive Cases
Town/ Village
Counties


Lab Confirmed
WNV Positive
Birds and Horses
Saratoga
New York
Massachusetts
Connecticut
Rhode
Island
Pennsylvania
New Jersey
Maryland
Baltimore
Birds
Horses
103 WNV Laboratory Positive Birds
and 12 Horses in New York State
DOH
STATE OF NEW YORK
DEPARTMENT OF HEALTH
November 2, 1999

Agroterrorism

Animal/Agricultural Targets

With the dissolution of the Soviet Union and intelligence operations following the Gulf War in Iraq, it was confirmed that bioweapons were being developed against animals and agricultural crops.

Value of U.S. Agriculture

- Agriculture is one of the single largest sectors of our economy (13% of the GNP)
- 24 million employed in agriculture-related jobs.
- In 1999, 19 billion dollars in crop, livestock and poultry cash receipts
- Leading exporter of agricultural products ($54 billion annually)

Selection Criteria for Antilivestock/ Antipoultry Biological Weapons

- Highly infectious/contagious
- Ability to survive
- Pathogenic
- Available and easy to acquire and produce
- Appearance looks like natural outbreak
- Not harmful to perpetrator
- Easily disseminated

Animal Agents that Pose the Greatest Threats

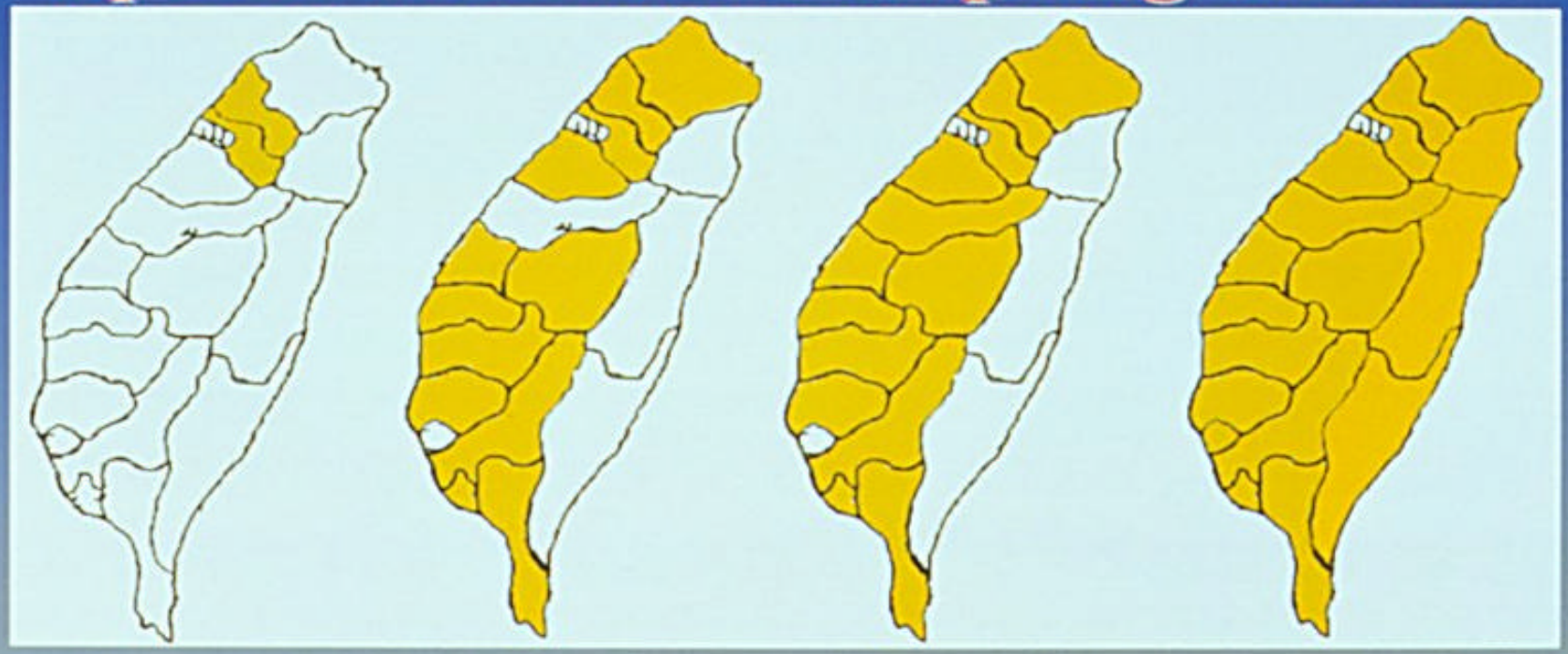
- Foot and Mouth Disease virus
- Classic Swine Fever virus
- African Swine Fever virus
- Rinderpest virus
- Rift Valley Fever virus
- Avian Influenza virus
- Newcastle disease virus
- Venezuelan Equine Encephalitis
- Blue Tongue virus
- Sheep and goat pox viruses
- Pseudorabies virus

List based on economic trade impact and ease of transmission

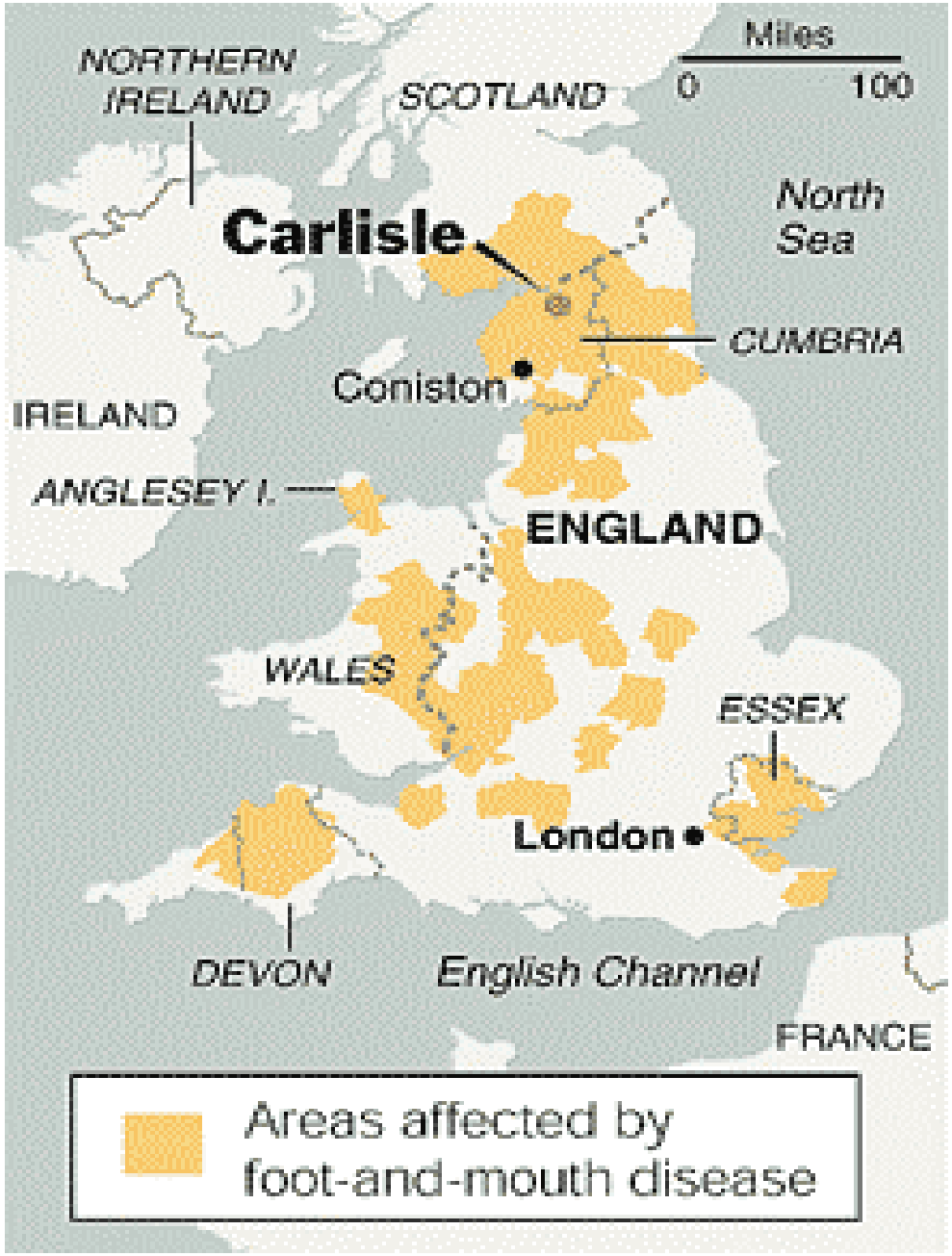
Impact of Exotic Animal Disease

Year	Country	Agent	Cost
1999	Malaysia	Nipah	human/animal
1997	Taiwan	FMD	15 billion
1997	Hong Kong	Influenza	human/animal
1993	Italy	FMD	120 million

Spread in Taiwan in spring of 1997



March 19 March 22 March 26 May 4

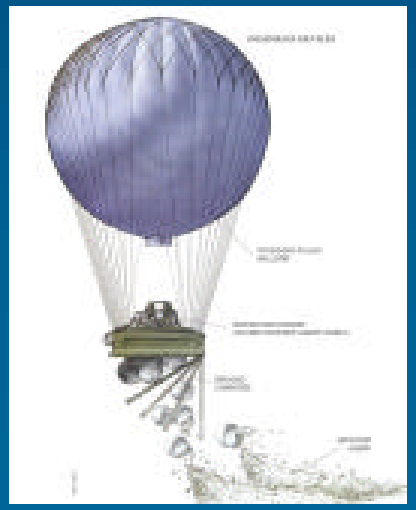

Miles
0
100
NORTHERN IRELAND
SCOTLAND
North Sea
Carlisle
CUMBRIA
Coniston
IRELAND
ANGLESEY I.
ENGLAND
WALES
ESSEX
London
DEVON
English Channel
FRANCE
Areas affected by foot-and-mouth disease

United Kingdom (1940's)
Operation Vegetarian

British anti-livestock program stockpiled 5 million anthrax cakes to be delivered by parachute over grazing cattle in Germany.

United States

- During the Cold War, hog cholera and Newcastle's diseases were weaponized
- These agents were to be dispersed by bombs containing virus-coated feathers



Soviet Union Program (Ecology)

- Employed 10,000 staff targeting livestock, poultry and crops.
- Goal was to weaponize: FMD, Rinderpest, CSF, ASF, sheep and goat pox, *Chlamydia psittaci*.
- Anti-crop agents included wheat rust, rice blast, karnal bunt and fusarium.

Iraq Program

Had under development the following agents:

Bacillus anthracis

Clostridium perfringens

Botulinum toxin

Yellow Fever

FMD

Aflatoxin

Ricin

Trichothecenes

Camel pox

Issues

- Minimal security – Auction/Sale Barns
- Large Animal production units

Feedlots	50,000 – 500,000 cattle
Swine operation	1,000 – 7000 hogs
Dairies	3,000 – 10,000 milking cows
Poultry	1 million birds

- Inadequate bio-security protocols
- Movement of animals/people across U.S. borders

Feed Vulnerability

- 110 million tons of feed manufactured annually
- Not guarded and perpetrators have easy access
- Widely distributed

Availability of Agents

- FMD currently diagnosed in 25 countries
- Few safeguards for shipment/detection of pathogens
- Ease of acquisition
- Technology available to deliver

CHRIS BRITT/COPLEY NEWS SERVICE

Recommendations

- Recognize that we are vulnerable
- Improve surveillance activities to detect outbreaks.
- Develop an intelligence system that can address the needs of Agriculture.
- Educate producers to be cognizant of biosecurity protocols.

Better Surveillance Tools

- Improve communication and information flow
- Faster outbreak analysis tools
- Expand available personnel

Future Efforts

- Clinical recognition
- Encourage prompt reporting
- Maintain clear lines of communication between animal producers, veterinarians and public health officials

Future Efforts

- **Improve on-farm biosecurity**
- **Improve Feed Security**

Partners to Detect/Respond to Issues of Animal Health

- Office of International des Epizootics (OIE) – inform governments of the occurrence of animal diseases throughout the world.
- United States Department of Agriculture – Animal and Plant Health Inspection Service (APHIS) – will respond to intentionally or naturally introduced foreign animal diseases.

Regional Emergency Animal Disease Eradication Organization (READEO)

- Act as a disease control and eradication force, coordinating Federal, State and industry.
- Purpose is to confirm the presence of an exotic disease and take steps to control infection.
- Duties include: euthanasia, animal and animal product disposal, and cleaning and disinfection.

Survey of State Animal Health Officials

- **Animals diagnosed with high priority Category A bioterrorism agents are not reportable in all states**
- **39% of State Animal Health Officials have not been involved in planning or coordination**

JAVMA 2000;217:1315-17

Survey of State Animal Health Officials

Few states have educated veterinarians about the importance of disease reporting and clinical presentation of animals infected with potential bioterrorism agents

JAVMA 2000;217:1315-17

Reportable Animal Diseases in Minnesota

- **Anthrax (*Bacillus anthracis*)**
- **Avian influenza**
- **Brucellosis (*Brucella* sp.)**
- **Equine encephalitis**
- **Plague (*Yersinia pestis*)**
- **Psittacosis (*Chlamydia psittaci*)**
- **Tularemia (*Francisella tularensis*)**