C . E . E . Z . A . D

Center of Excellence
for Emerging and Zoonotic Animal Diseases

Transportation: A Key Force in Spreading and Preventing Animal Diseases

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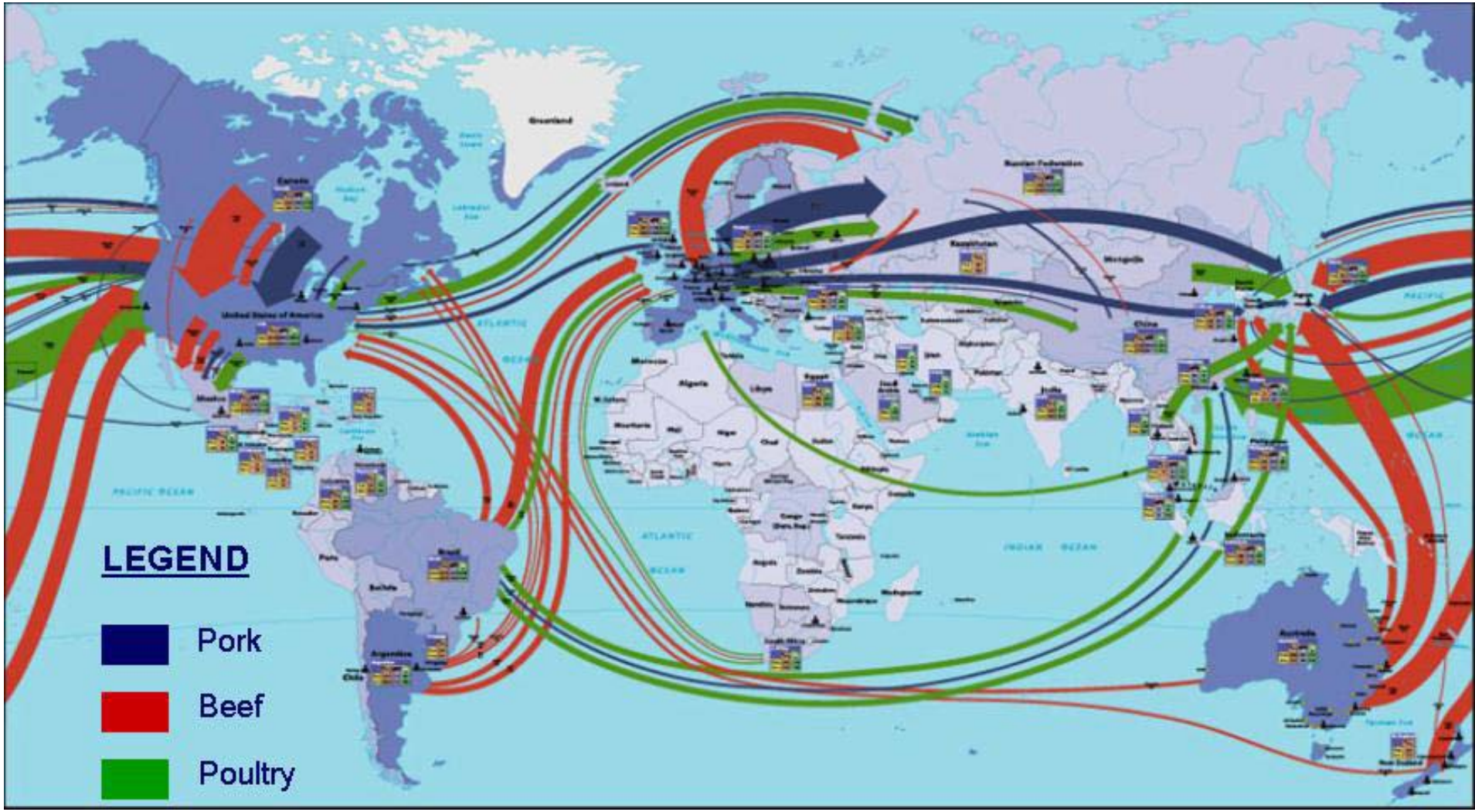
Outline of Lecture

- Introduction of selected Foreign Animal and Zoonotic Diseases
- Transportation as a vehicle to spread FAD/Zoonotic diseases
- Protection from Disease: Vaccines, Detection Tools, Biosecurity, Animal ID Systems

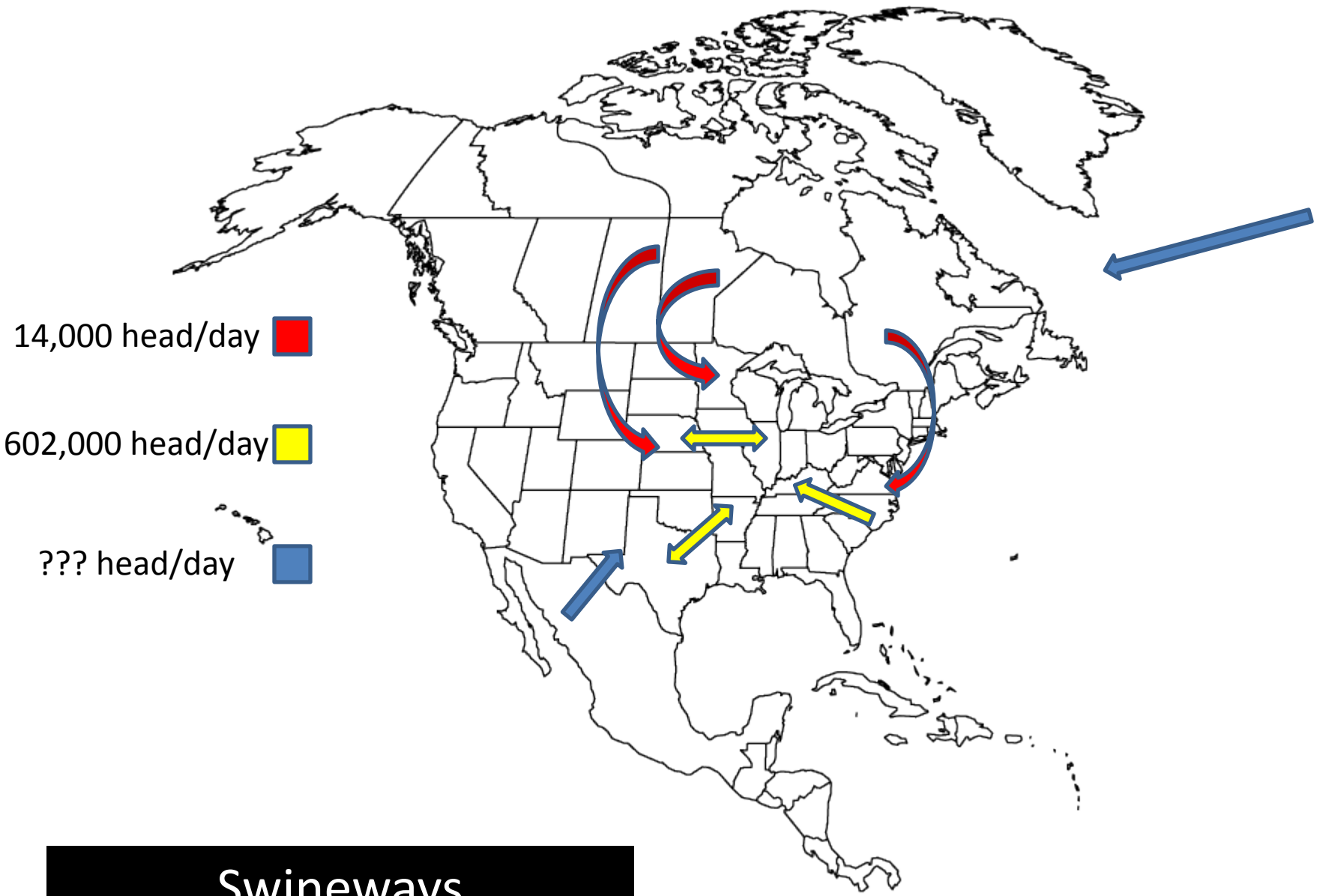
Global Trade



Source: Center for Global Food Issues

It has been estimated that a pound of meat (beef, chicken or pork) generally travels about 1,000 miles from farm to fork.

-Chalk, *Hitting America's Soft Underbelly,* 2004

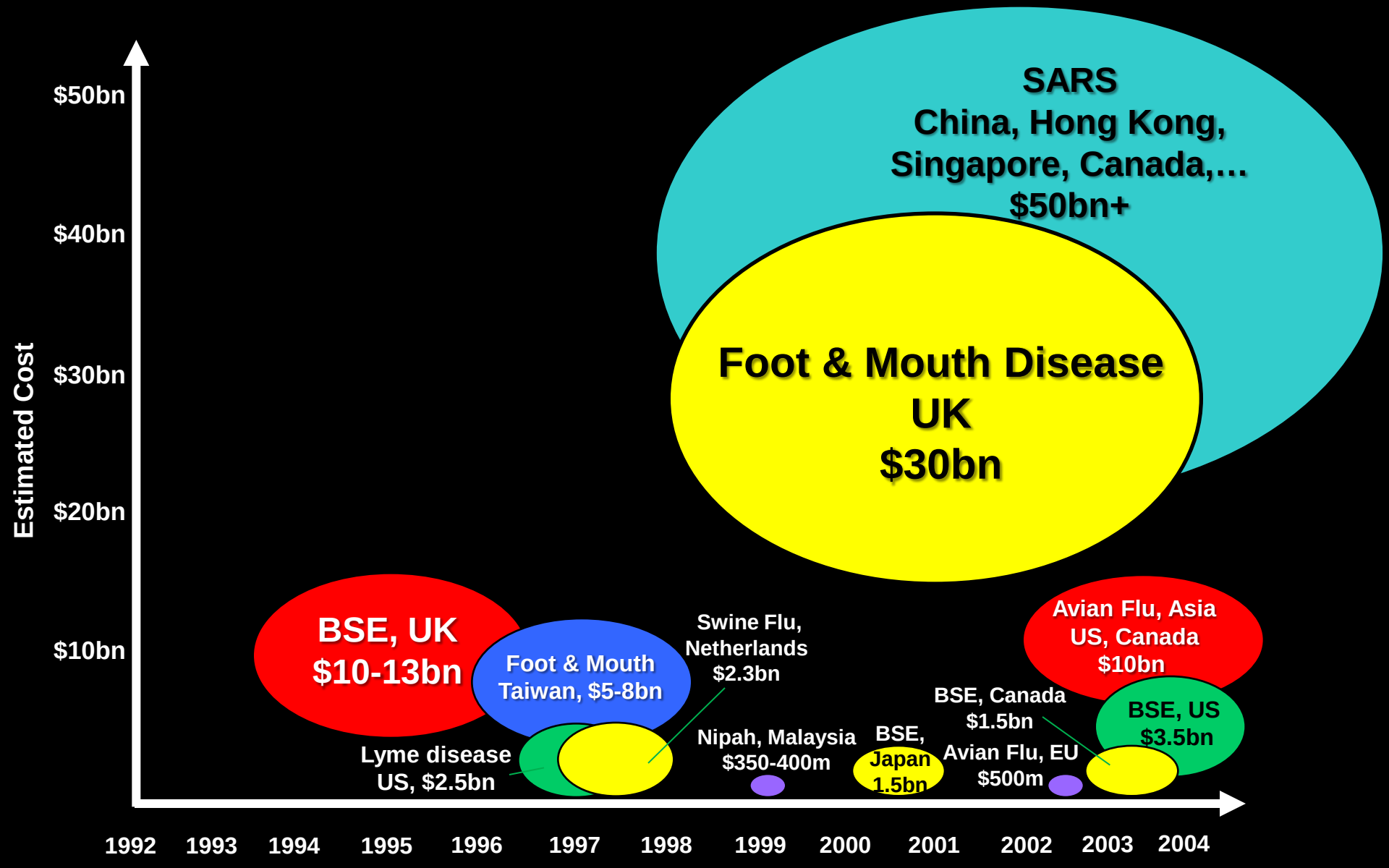


Swineways

Courtesy of K. Lager

I. The Confrontation with Disease

Economic Impact of Selected Infectious Diseases



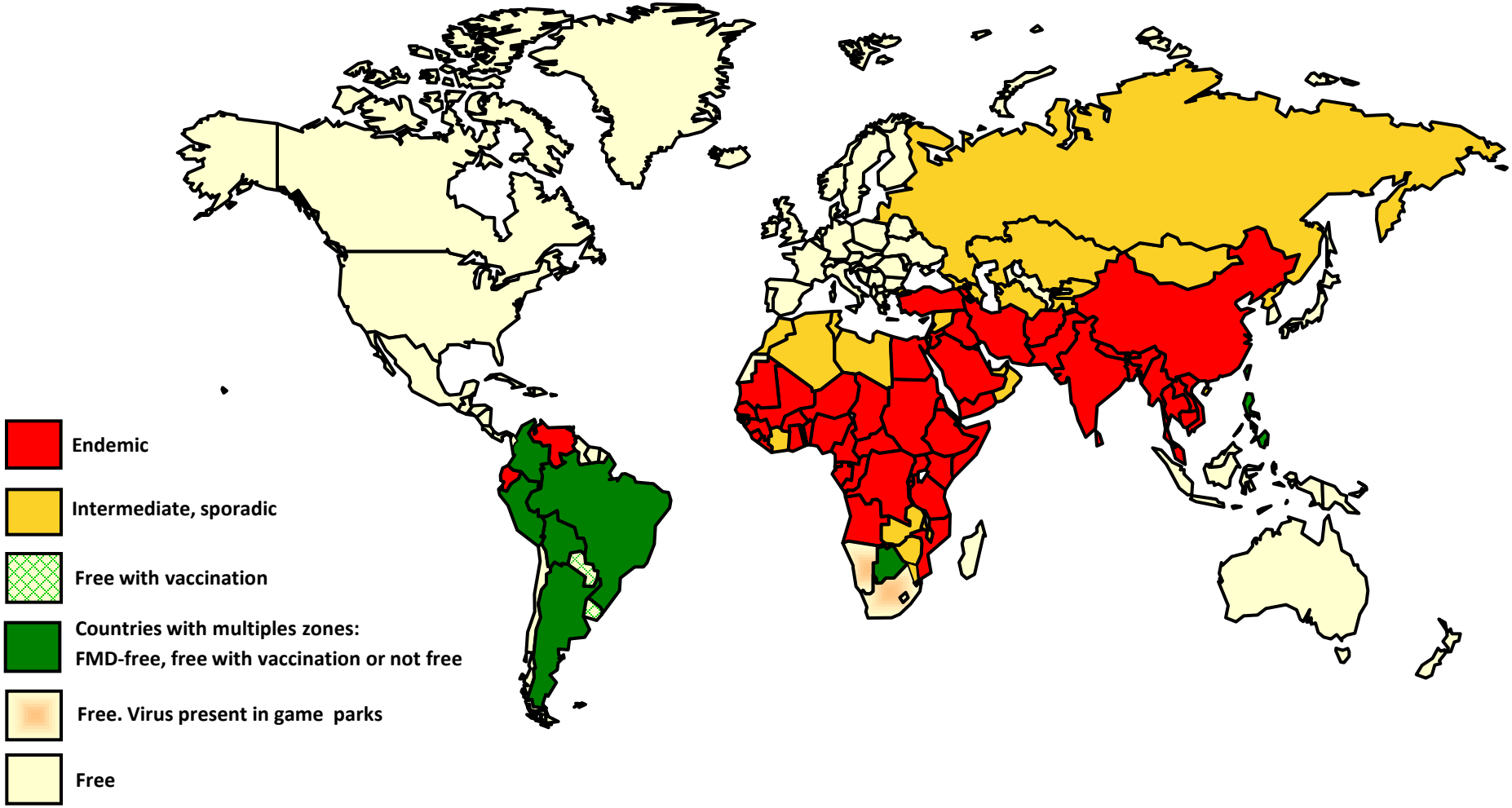
BIO-ERA

FMDV

Foot and Mouth Disease

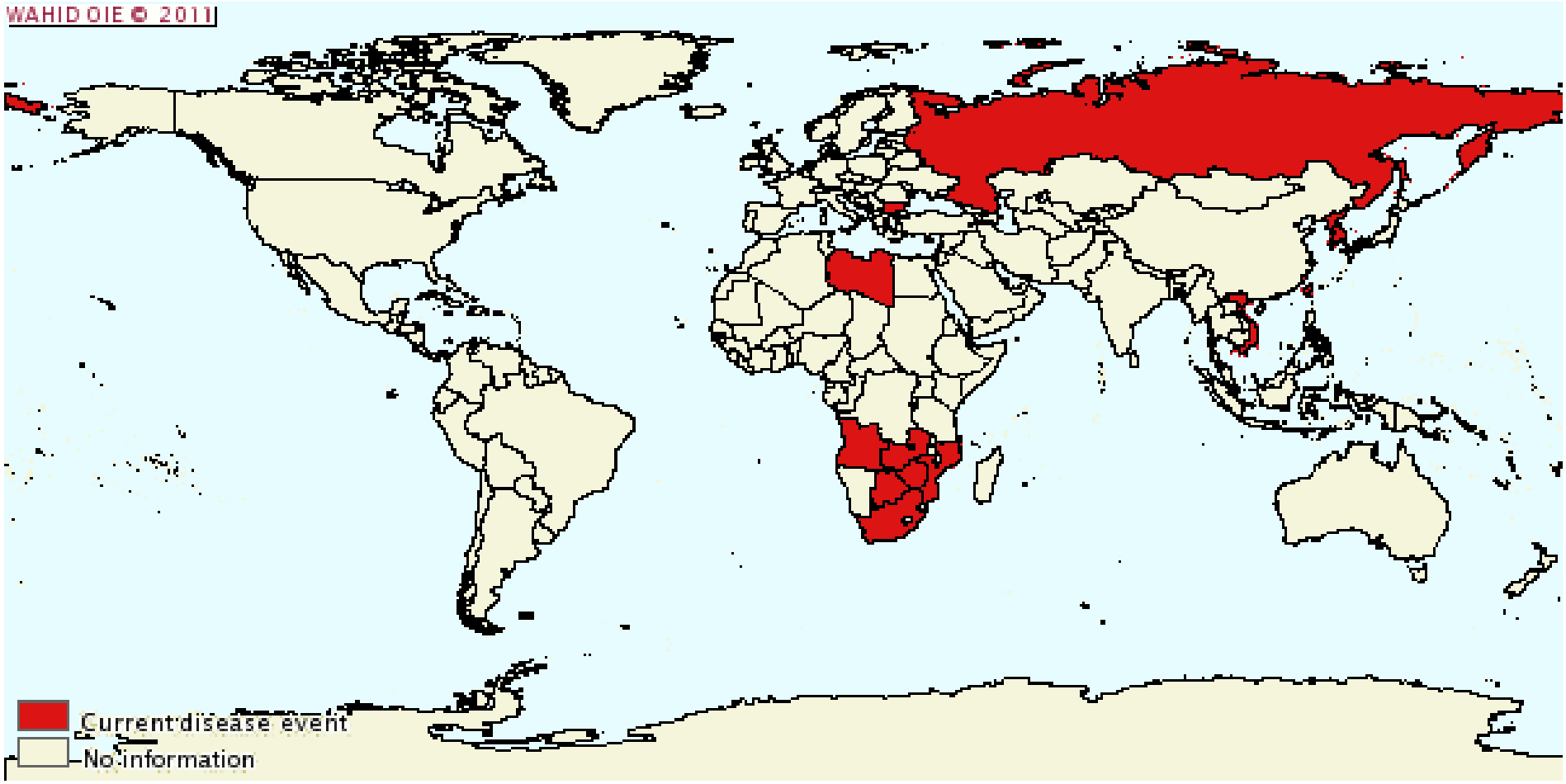
- Picornaviridae, Genus *Aphthovirus*
  - 7 distinct serotypes*: A, O, C, Asia, Sat1, Sat2, Sat3*
  - Not cross protective
- Affects cloven-hoofed animals
- Survives in milk, milk products, bone marrow, lymph glands, fresh meat, etc.
- 1929: Last case in U.S.
- Morbidity 100%, Mortality less than 1%

Foot-and-Mouth Disease:
infected countries by frequency of epidemics 2007 - 2009



Regions with most food insecurity are also those endemic to FMD

FMD situation in 2011



FMDV Transmission

- Aerosols
- Infected Animals - Direct contact

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- Untreated animal products (milk, etc.)

Prevention in the US

Strict import restrictions:

– Prohibit live ruminants, swine, and their products from FMD-affected countries

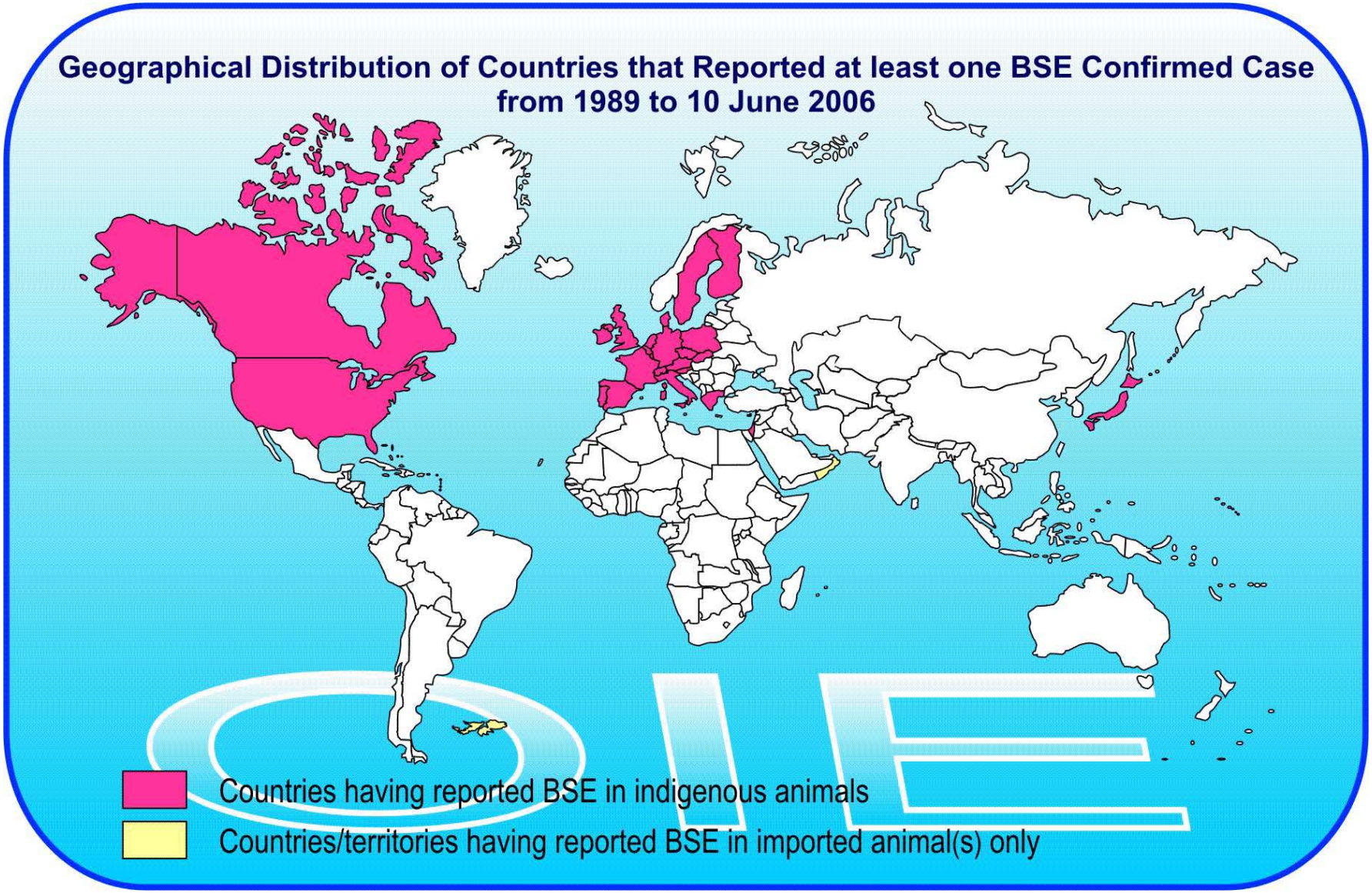
– Monitor travelers and belongings at ports of entry

In case of introduction:

– Stop animal and product movement
– Slaughter infected and susceptible in-contact animals
– Disinfect contaminated areas
– Demonstrate freedom of FMDV – no vaccination

Bovine Spongiform Encephalopathy (BSE)

- **BSE is a prion disease of cattle, popularly known as “mad cow disease.”**
- **There is no evidence that BSE is transmitted through direct animal-to-animal contact.**



http://www.oie.int/Cartes/BSE/a_Monde_BSE.htm

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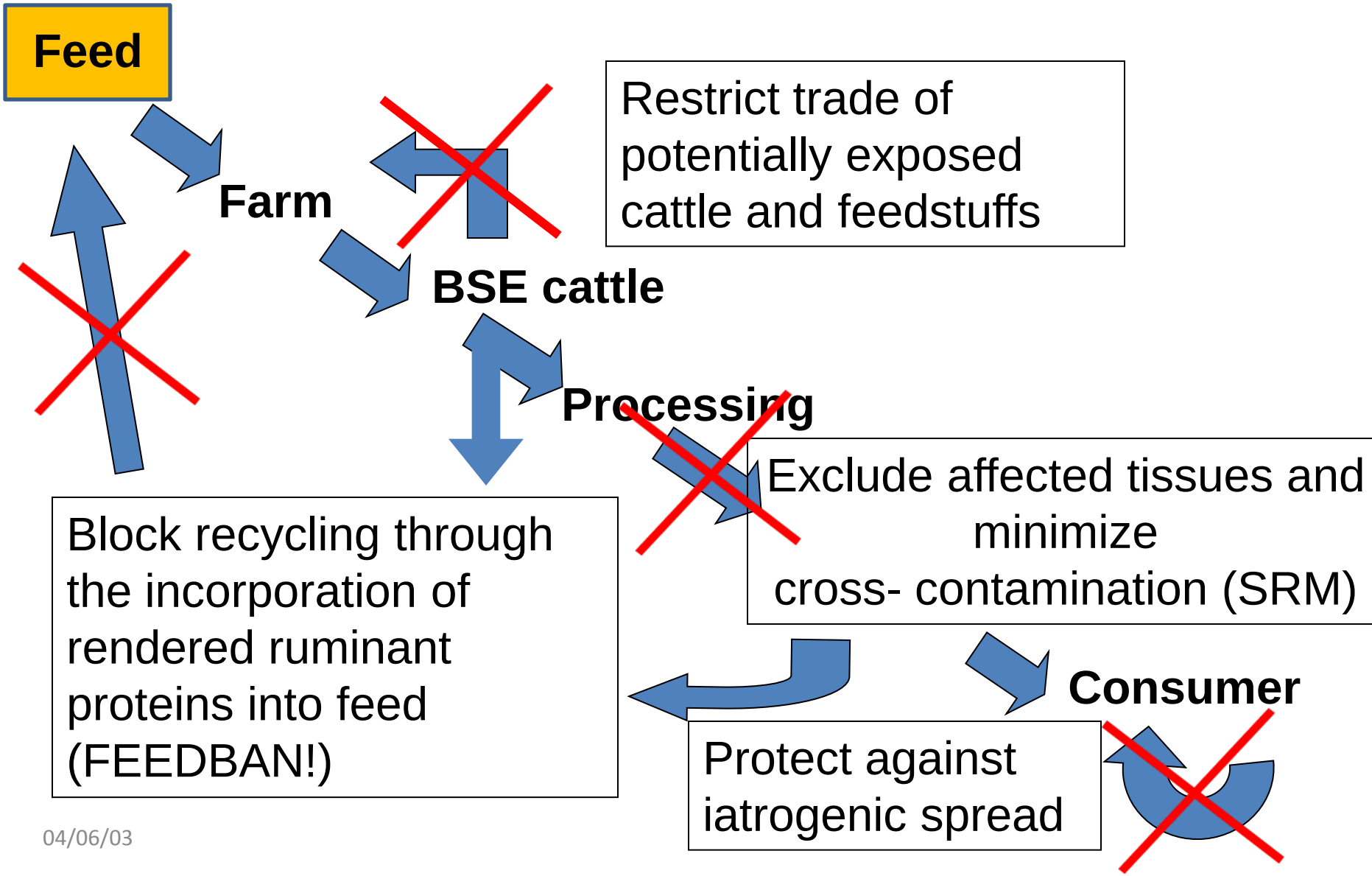
- **BSE itself with its link to a new form of human Creutzfeldt-Jakob Disease—vCJD—has almost been eradicated world-wide after twenty-five years of intensive scientific research, new legislation on the quality of animal feeds and numerous practical precautions.**

BSE Prevention



African Swine Fever

- *Asfarviridae*
  - Enveloped DNA virus
  - Only DNA virus transmitted by arthropods (ticks)
- Affects domestic and wild pigs
  - Produces inapparent infection in two species of wild African swine
    - Wart hog
    - Bush pig
- **High mortality in domestic pigs**

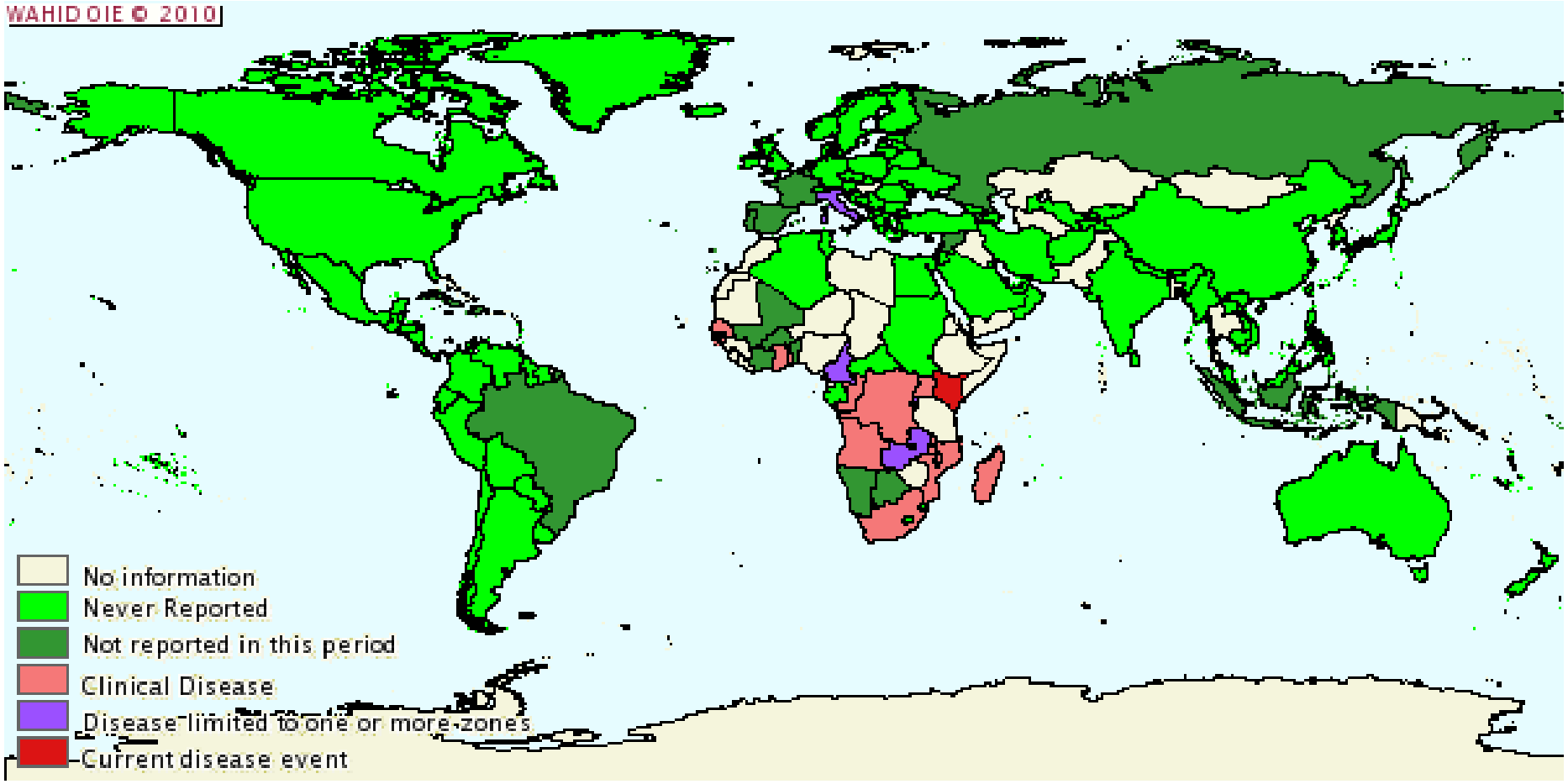
African Swine Fever Virus

- **Stable in the environment**
  - Resistant to wide pH range (3.9 - 11.5)
  - It can survive for a year and a half in blood stored at 4º C, and at least a month in contaminated pig pens
  - Remains infectious for 150 days in boned meat stored at 39º F, 140 days in salted dried hams, and several years in frozen meat

Transmission

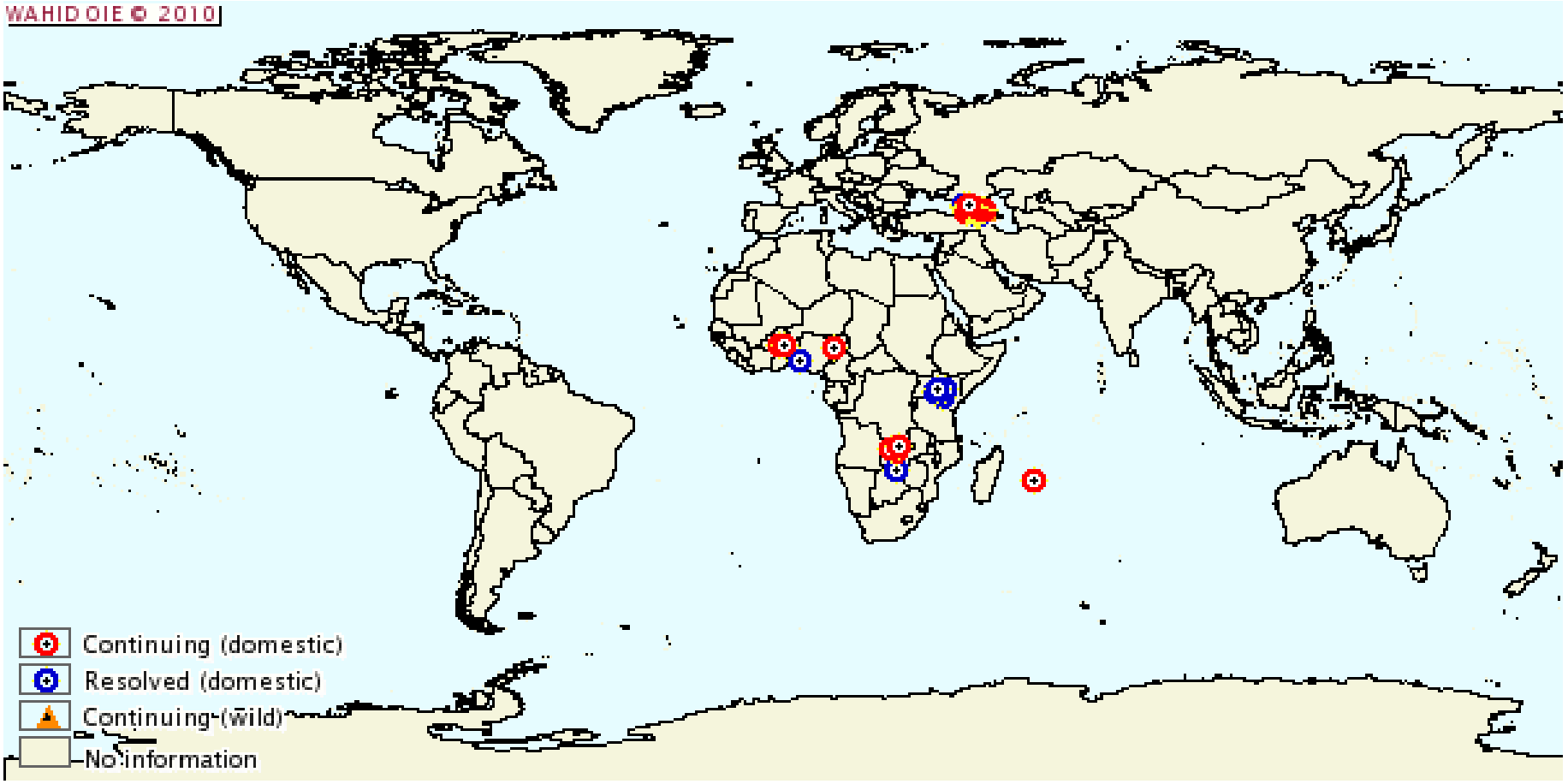
- Direct
  - Infected animals
- Indirect
  - Feeding of uncooked swill (restaurant leftovers, etc.)
  - Fomites (clothing, footwear, equipment, vehicles, feed)
  - Infected ticks

ASF Distribution 1990-2006



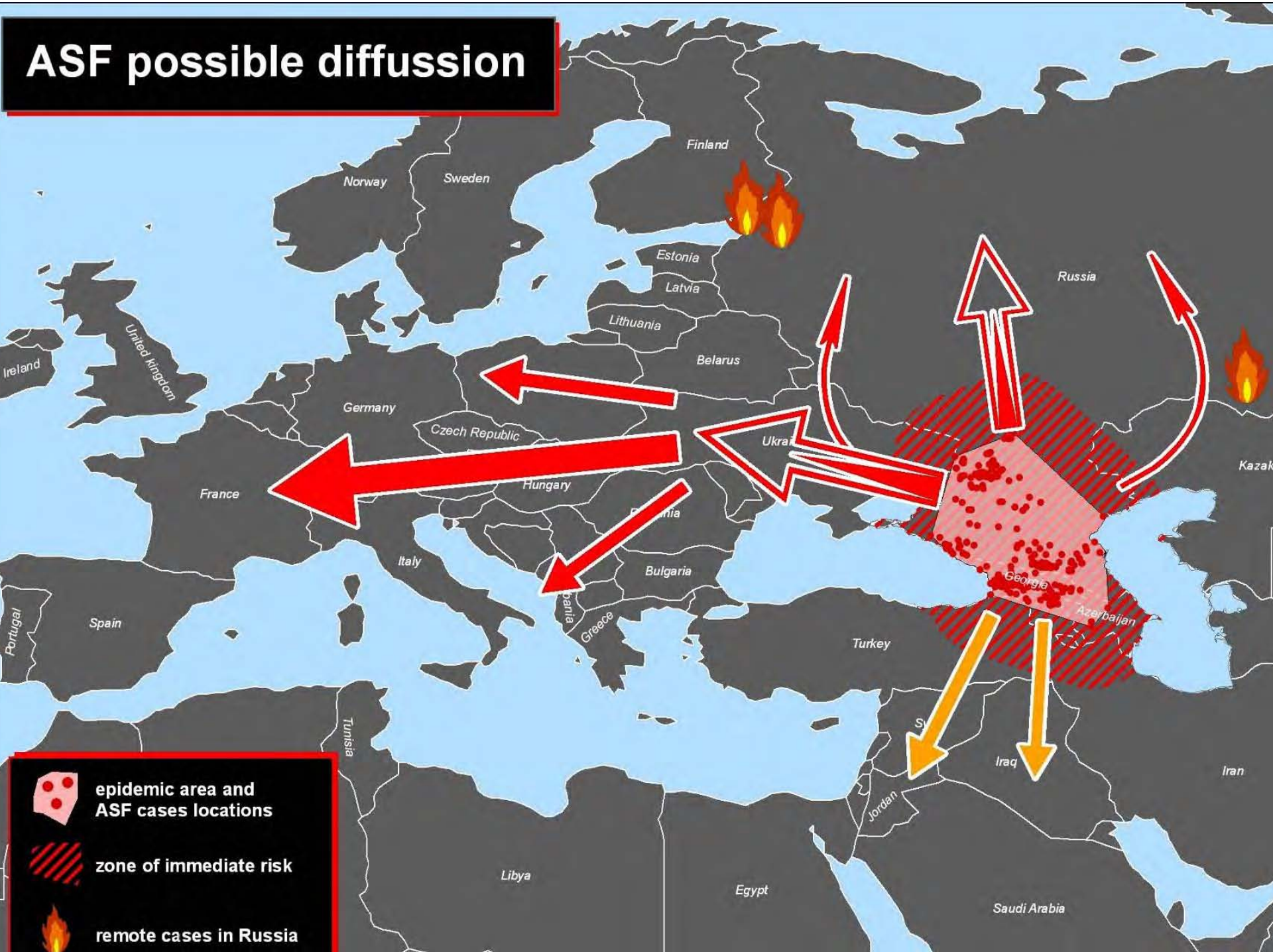
ASF restricted to Africa and Is. Sardinia

2007 ASF outbreak in the Caucasus



Emergence in Republic of Georgia

ASF possible diffussion



Prevention

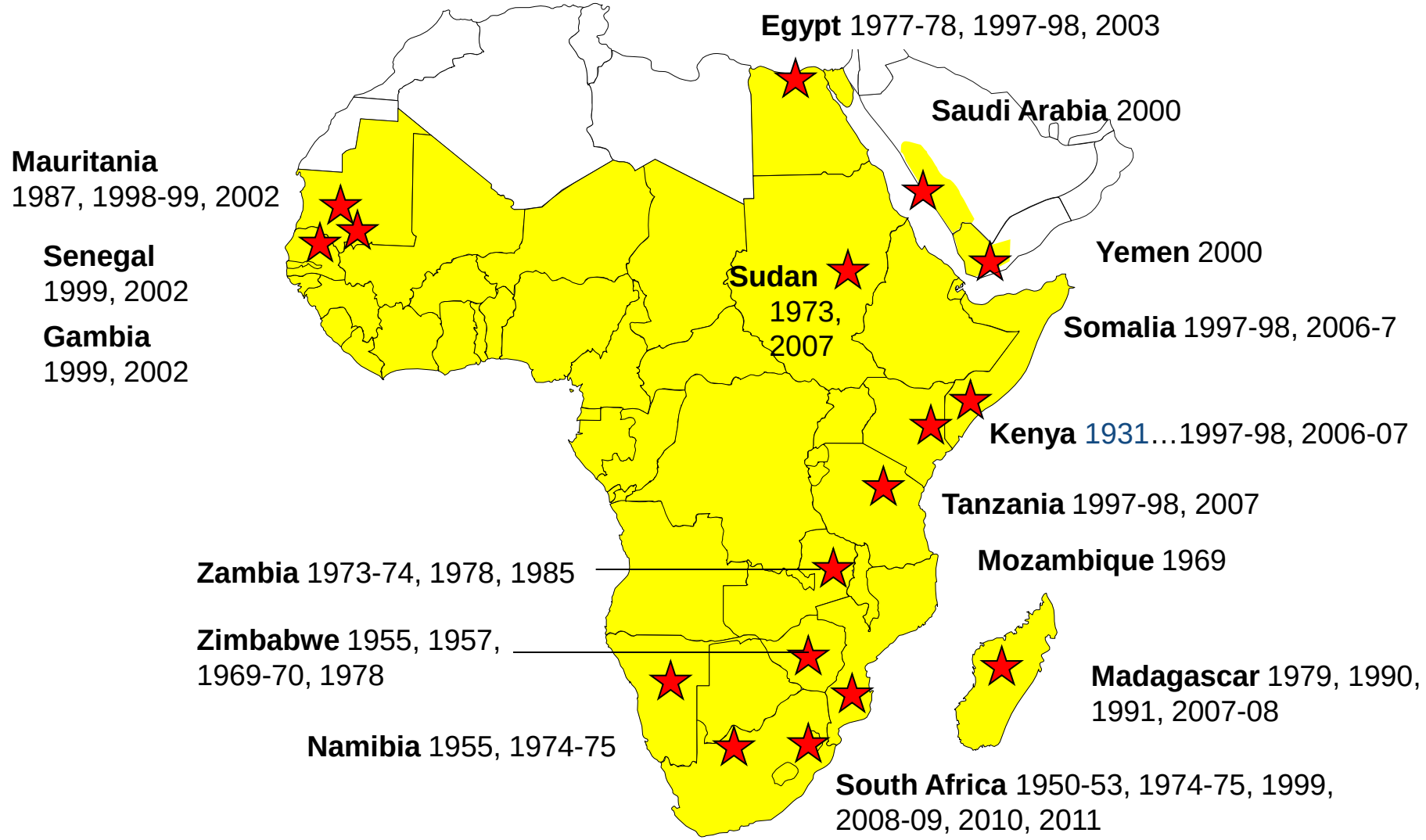
- Swill (restaurant leftovers etc.) fed to pigs must be cooked
- Treat tick vectors (acaricides)

- Eradication (similar to FMDV):
  - Slaughter of infected and in-contact animals

Rift Valley Fever

- Family Bunyaviridae, genus Phlebovirus, RNA virus
- Vector-borne (mosquitoes)
- BSL 4 or 3-Ag agent
- Acute febrile disease:
  - Sheep, cattle, goats
  - High abortion rates and death in young
- Incubation 2-6 days
- Zoonosis
- Case Fatality Ratio 1-20%

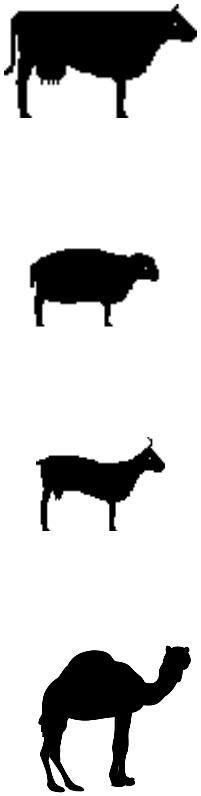
Rift Valley Fever distribution, outbreaks and spread

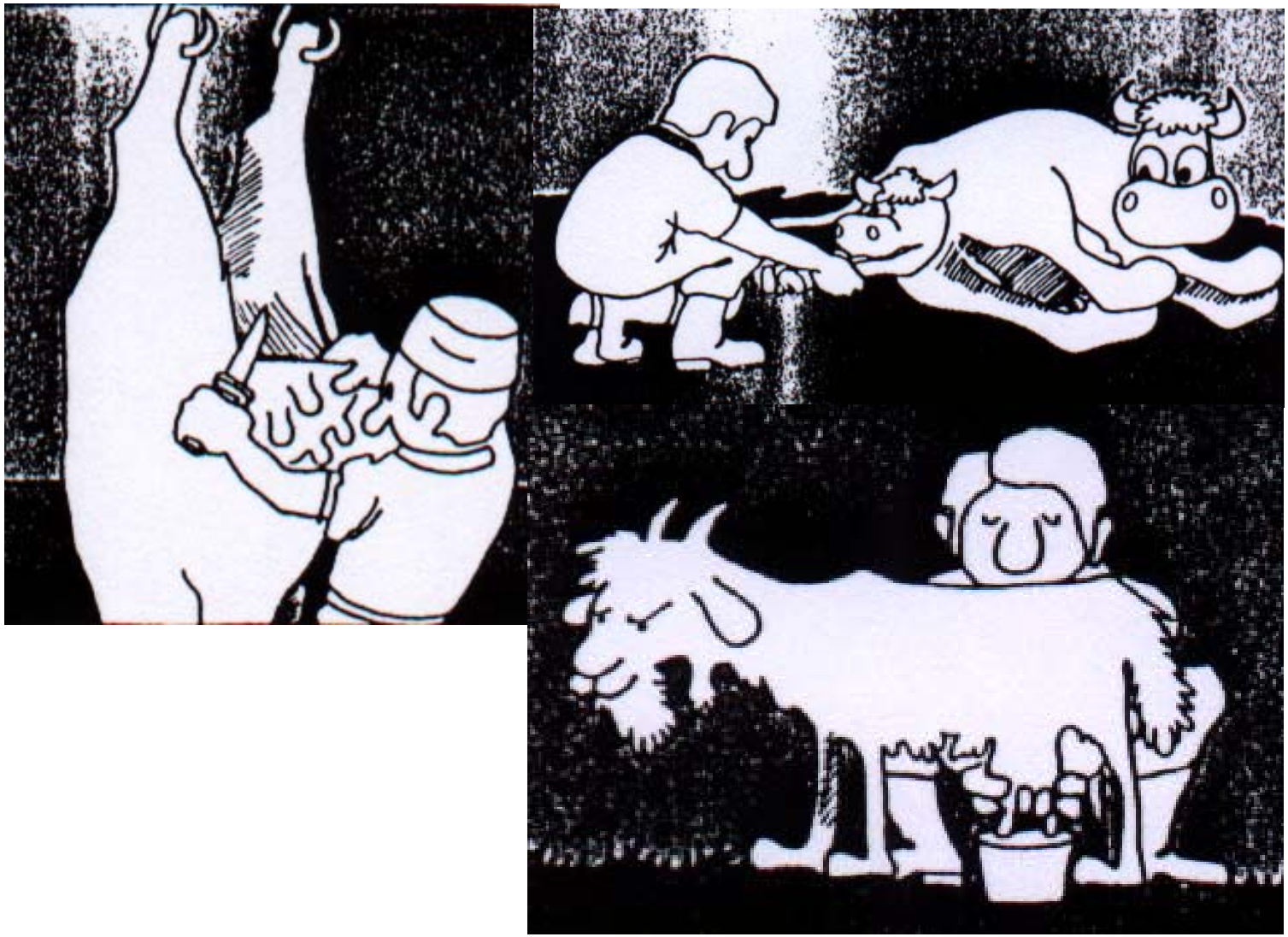


Transmission

- Arthropod vector
  - Mosquitoes (*Aedes, Anopheles, Culex)*
- Mosquito species in the U.S. could serve as vectors
- Direct contact or Aerosol
  - Tissue or body fluids of infected animals
    - Aborted fetuses, slaughter, necropsy
- No person-to-person transmission

Suspected modes of transmission to humans





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E.R. SHANGHAI

II. Protection from Disease

Protection from Disease:
Vaccine and Detection Tools

Ideally, the U. S. should have sufficient amounts of animal vaccine, antiviral drugs and therapeutic products to respond appropriately to the most damaging animal diseases affecting animal health and the economy, with these agents available and capable of deployment within 24 hours of an outbreak. <u>The reality, however, looks very different:</u>

FMDV: inactivated vaccine, not U.S. made; ASFV: no vaccine; BSE: no vaccine; RVFV: no vaccine in U.S.

<u>Prior to the use of a vaccine control or eradication program, the early detection of the introduction of an agent is needed</u>.

It is therefore essential to develop innovative, multi-modal and field-deployable devices for detecting and diagnosing threat agents like Rift Valley Fever virus, Foot and Mouth Disease virus and African Swine Fever virus.

COE ZADD (FAZD/CEEZAD) develops novel vaccines and diagnostic systems against threat agents

General Biosecurity Practices: Transportation

- Use reliable transport companies with biosecurity plan in place
- Minimize the flow of vehicles, materials, people and animals with potential to introduce diseases
- Limit access to the delivery vehicles and to the place of destination, implement system for scheduled deliveries
- Provide facilities for disinfection of vehicles before they enter livestock areas
- Clean and disinfect vehicles after delivery of livestock
- Develop, implement and enforce respective SOPs

Animal Identification System/ Traceability

- **Unpredictability of emerging diseases necessitates the introduction of an effective system of animal identification in the United States in order to ensure animal traceability**.
- U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) has now taken the lead in **a new effort to codify federal regulations and require an interstate certificate of veterinary inspection for all livestock moved interstate.**
- **Although producers and distributors of livestock are concerned by the costs of implementing an animal identification system in the United States, such costs are minimal compared to the costs of a major animal disease outbreak in the U.S.**
- **Efficient control and eradication of FADs cannot be achieved without traceability data to identify the location of infected animals**

Conclusions

- Foreign animal and zoonotic diseases are imminent threats to U. S. agricultural systems with potentially devastating consequences.
- Vaccines and detection tools for many of these diseases are not readily available.
- Basic biosecurity measures and practices during the transportation of feed, animals and animal products, if implemented and enforced, will significantly reduce the distribution of pathogens
- An animal ID system for US livestock is clearly needed
- **We are confronted with many challenges: given sufficient determination and funding we believe these challenges can be met.**

“It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness….”

- Charles Dickens, *A Tale of Two Cities,* 1859

Best of Times = Transportation with effective biosecurity prevents disease spread

Worst of Times = Transportation with poor biosecurity spreads disease

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