PEDV in the US: Overview, history and lessons

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Outline of presentation

- PEDV – what we know about it
- History of introduction into the U.S.
- How and why it spread in the U.S.
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Porcine epidemic diarrhea virus (PEDV)

- Member of the Coronaviridae family ("Coronavirus") of viruses – same as TGEV

Not an "emerging" virus

- **1971:** First observed in feeder and fattening pigs in England (1971)
- 1982: Named porcine epidemic diarrhea virus (PEDV)
- 1970s and 1980s: Widespread epidemics and severe losses in suckling piglets in Europe
  - Now rare in Europe with occasional epidemics like the one in Italy in 2005-2006
- 1982: First reported in Asia
- 1990s and 2000s: Widespread epidemics and severe losses in Asia and continues to be a major problem

In Asia

- Sporadic outbreaks during the winter
  - Not reported to be a major problem in the summer
- Characterized by watery diarrhea
- Resembles transmissible gastroenteritis (TGE)

Clinical impact is primarily in suckling pigs

- Incubation period is very short (12-36 hours)
- Mortality rate in suckling pigs in a immunologically naïve herd in the 30-100% range
  - Usually most severe in first 2 to 4 weeks following the outbreak
- Pigs shed copious amounts of virus

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In the U.S.

- First case of PEDV was submitted to Iowa State University Vet Diagnostic Lab (ISUVDL) on April 29, 2013
- Initially thought to be transmissible gastroenteritis (TGE)
- Persistence of staff at ISUVDL led to confirmation of PEDV on May 17, 2013
- Retrospective testing of submissions that were saved found positive samples back to mid-April 2013, on a growing pig site in Ohio

Likely came from China

- Most closely related to virus isolate in Anhui Province in China
- Has some genetic features that are same as a coronavirus found in bats
  - Suggests virus strain that is now in U.S. may have originated from bats and crossed species

Source: Huang YW, Dickerman AW, Piñeyro P, Li L, Fang L, Kiehne R, Opriessnig T, Meng XJ. 2013. Origin, evolution, and genotyping of emergent porcine epidemic diarrhea virus strains in the United States. mBio 4(5):00737-13. doi:10.1128/mBio.00737-13.

And again!

- Second introduction from China
- Prior to January, 2014 all PEDV sequences (S1 region of the virus) were within 99-100% similar
- In late January, 2014 5 viruses were sequenced that were very different
  - Only 93.9-94.6% similar to the previous viruses
  - Closely matched a virus in the international database that was found in China
  - PEDV variants were retrospectively detected in US swine at least from early May 16, 2013

And again!!

- Deltacoronavirus first detected in Ohio
  - Feb 2014
- Distinct from PED and TGE viruses
  - Similar but less severe – mortality is lower
- Designated as porcine deltacoronavirus (PDCoV)
- Closely related to a coronavirus found in Hong Kong in 2012

Federal Order and Reporting Information for
Swine Enteric Coronavirus Disease (SECD)

- USDA issued a Federal Order on June 5, 2014 *(~14 months after introduction of the virus).*
- Two basic requirements of the Federal Order:
  - Mandatory reporting - Producers, veterinarians, and diagnostic laboratories are required to report all cases of novel SECD to USDA or State animal health officials
  - Herd management plan - Develop a plan to address the detected virus and prevent its spread

Federal Order and Reporting Information

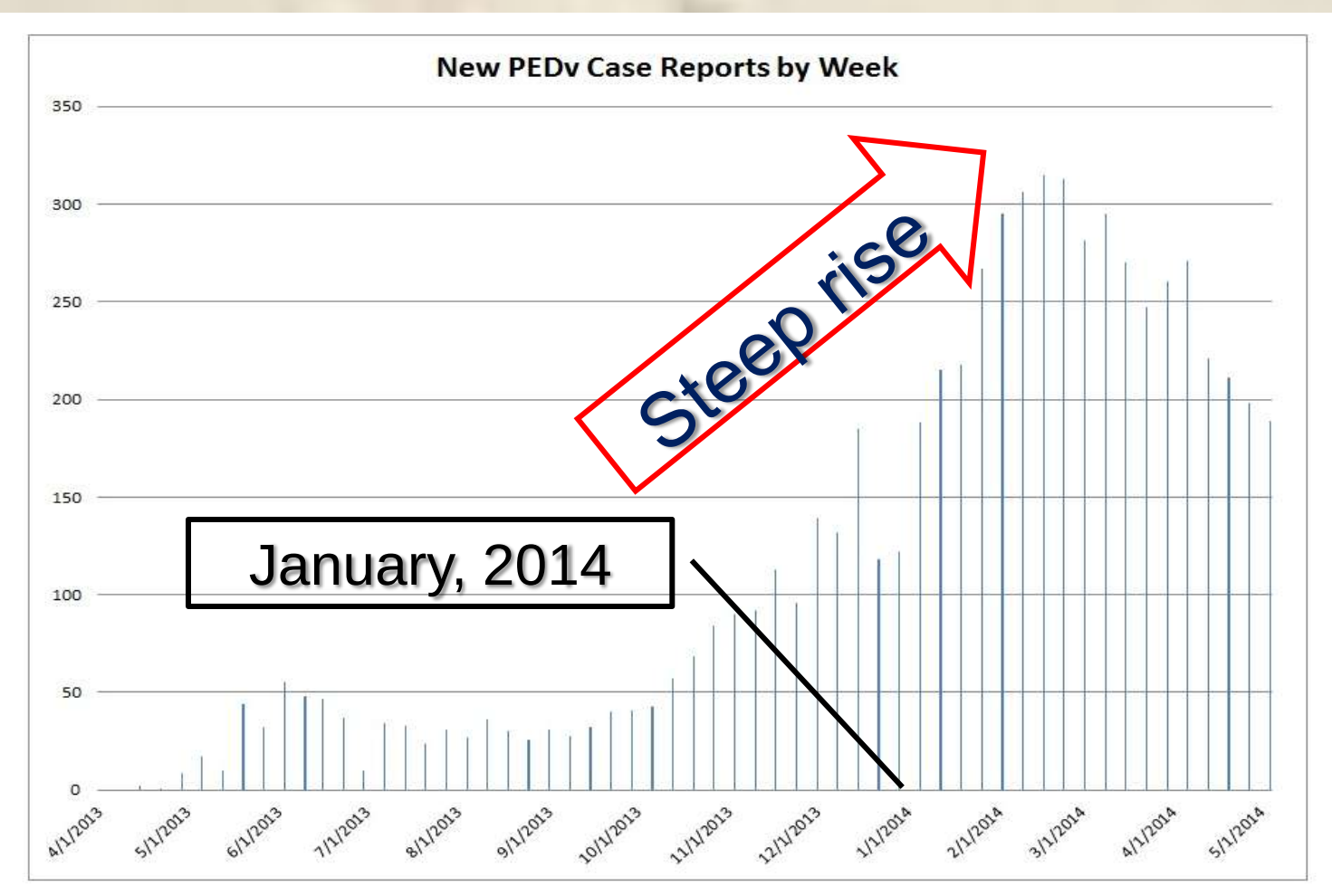
- For more information:

http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/animalhealth?1dmy&urile=wcm%3apath%3a%2Faphis_content_library%2Fsa_our_focus%2Fsa_animal_health%2Fsa_animal_disease_information%2Fsa_swine_health%2Fct_ped_info

Prior to the Federal Order it was difficult to track the disease incidence and spread

- NAHLN data
  - Reporting of positive accessions by 10 participating diagnostic labs
  - Many problems
    - Type of farm (breeding or growing pigs) not always reported
    - Submission of samples for diagnostics may not be done for every outbreak – not counted
    - More than one diagnostic submission may be reported for same farm for ongoing monitoring purposes

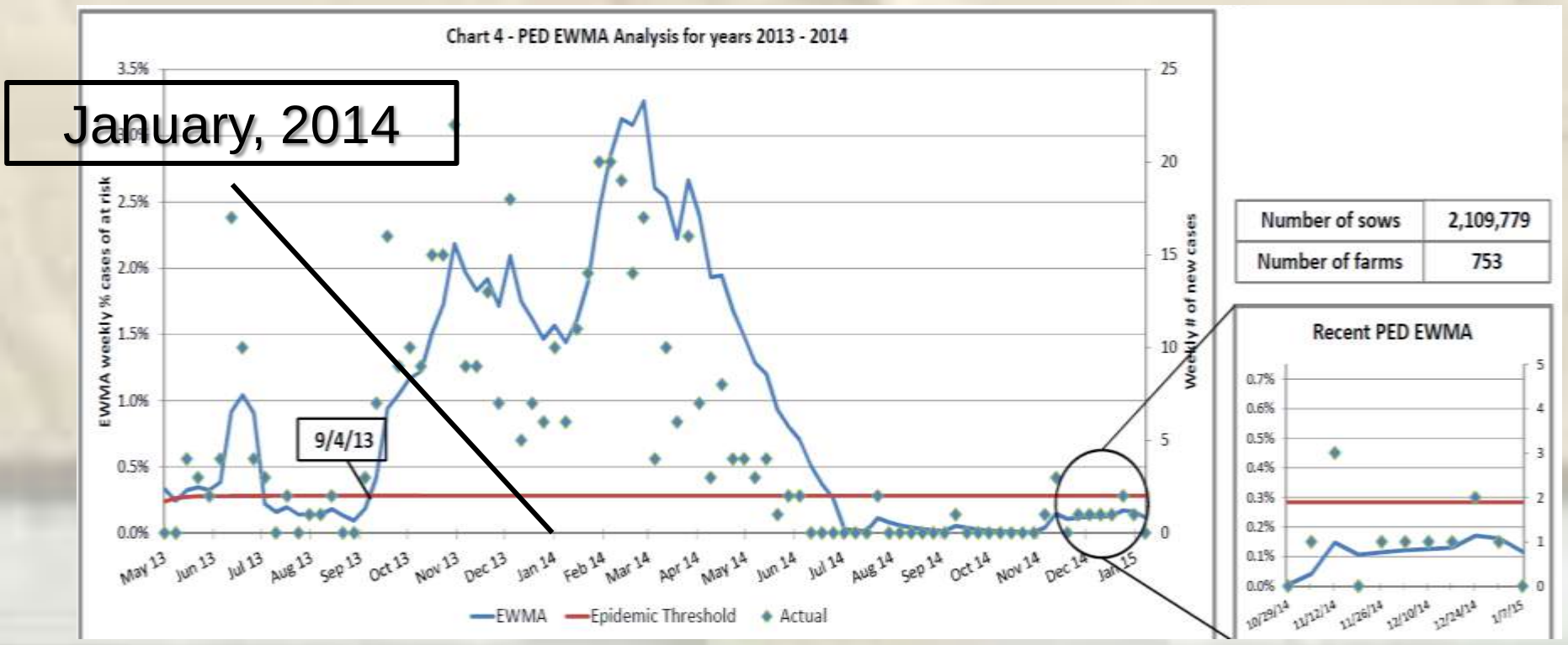
What was being reported by NAHLN



Source: USDA APHIS VS NVSL National Animal Health Laboratory Network (NAHLN), May 19, 2014

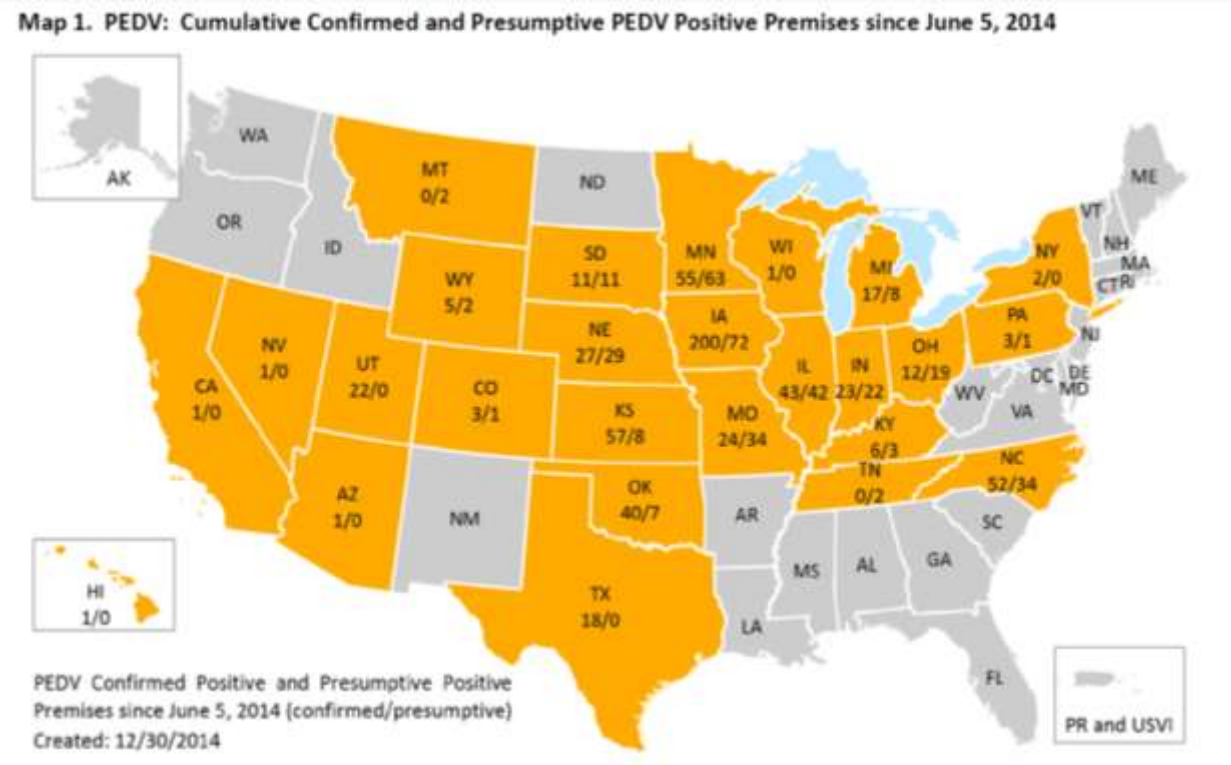
And the consequences of bad information

Incidence from swine health monitoring project at U of MN



Source: Swine Health Monitoring Report, University of Minnesota, College of Veterinary Medicine. January 9, 2015.

Now USDA is using information from the NAHLN labs (with PINs) and the mandatory reporting



What is a PIN?

- Premises identification number (7 characters)
- Part of the National Animal Identification System (NAIS)

Source: Swine Enteric Coronavirus Disease Testing Summary Report, USDA Animal Plant & Health Inspection Service, Dec. 31, 2014.

Economic impact

- PED is not a World Organization for Animal Health (OIE) reportable disease and is not considered a foreign animal disease by the United States Department of Agriculture (USDA)
  - **Has not affected export markets**
  - **No quarantines or movement controls**

Economic impact

It is not a public health concern

- Only infectious to swine
- Is NOT a food safety concern
  - **No apparent impact on demand for pork**

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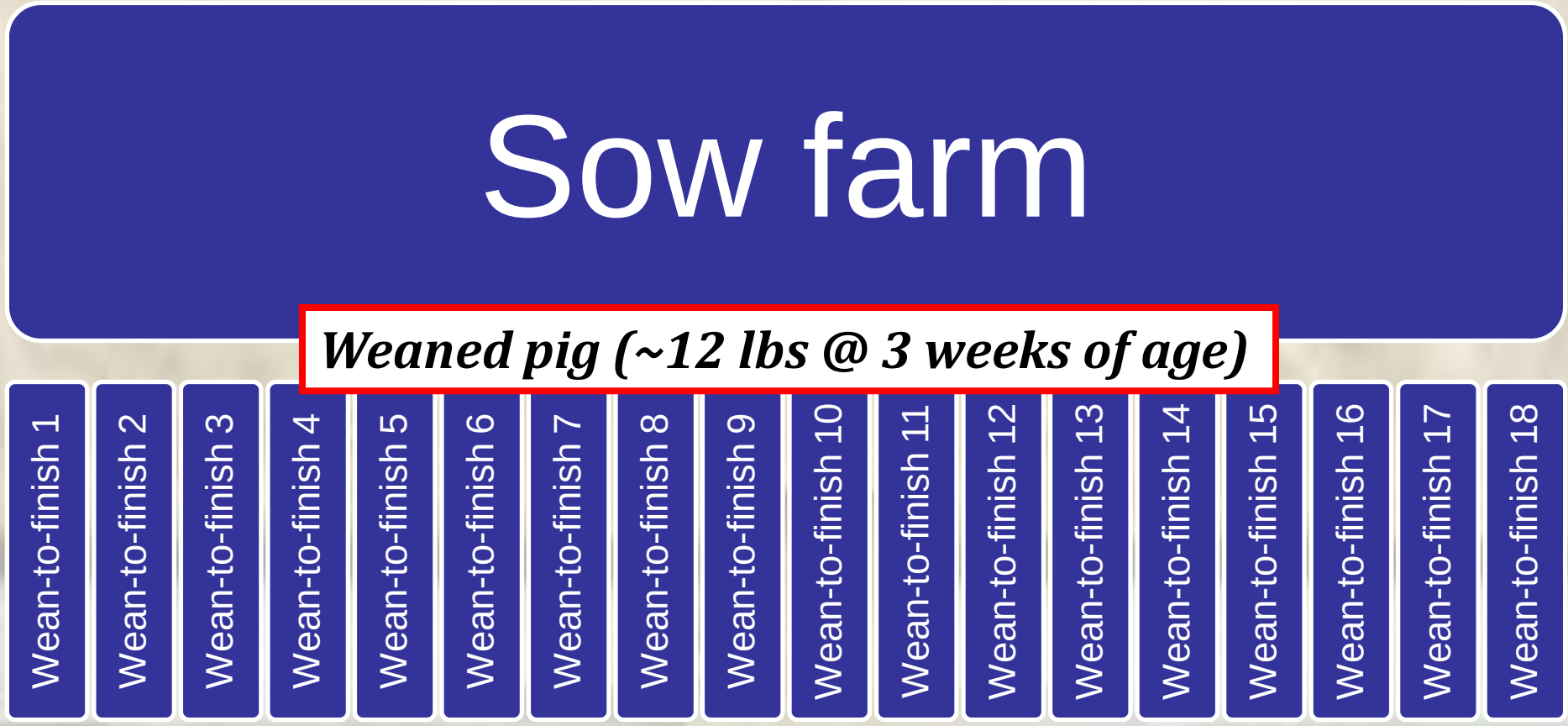
Production in the US. is geographically segregated

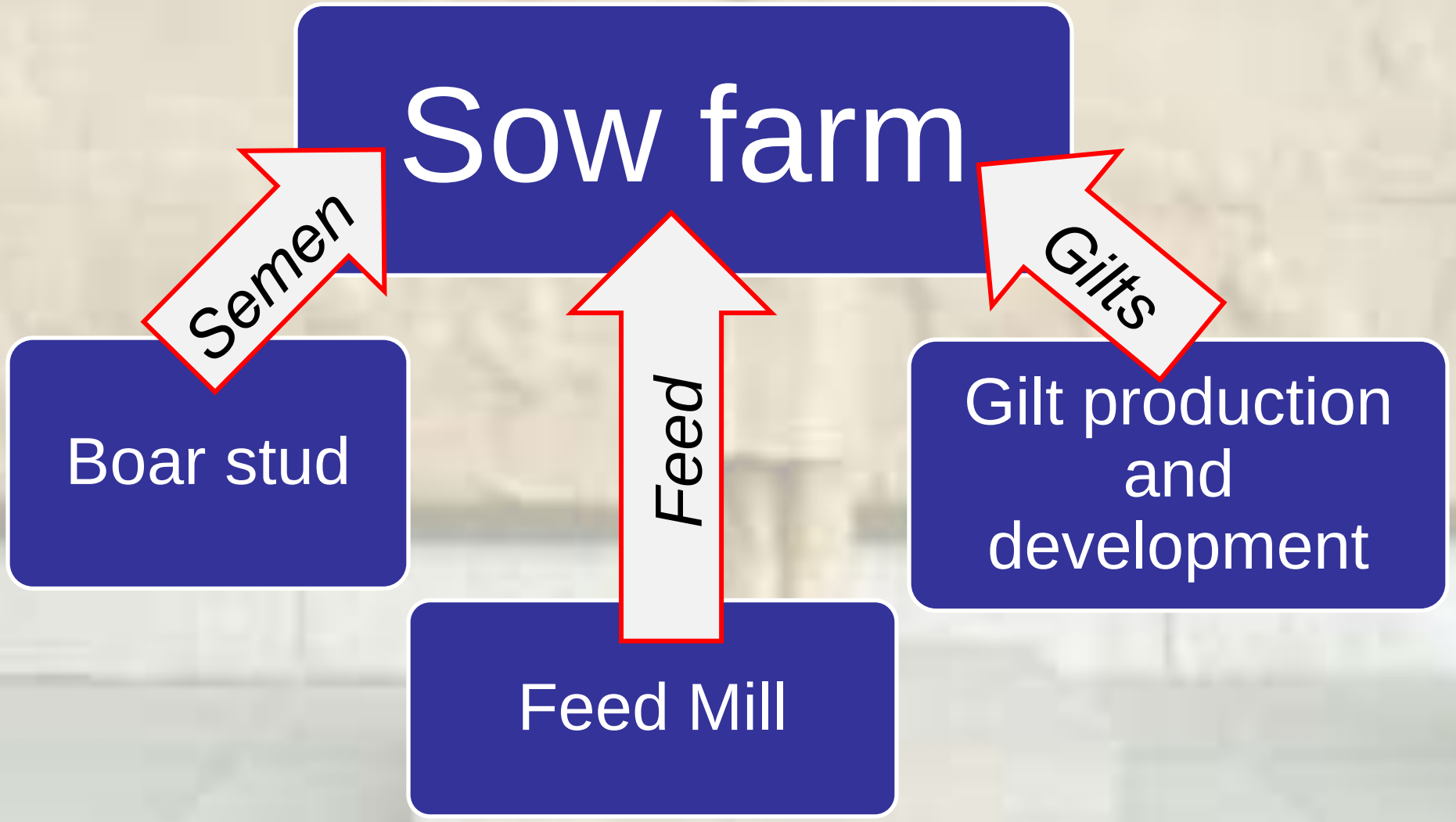
- Still have some old single site "farrow-to-finish" sites
- Anything built new in the last 25 years will be multi-site (ie. production is geographically segregated)
- Most common model today is a 2 site model
  1. Farrow-to-wean
  2. Wean-to-finish

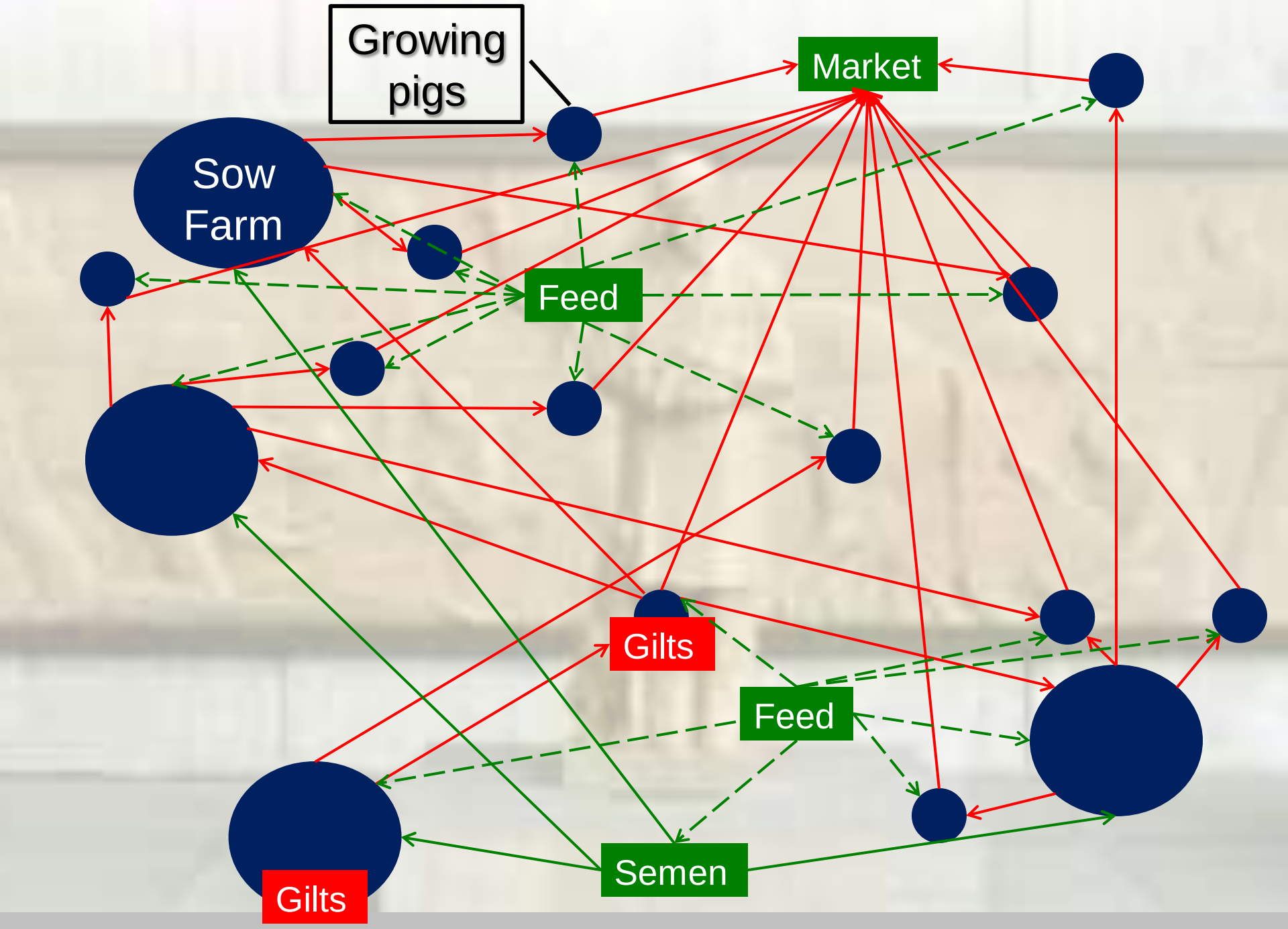
Production is geographically segregated

2 site model

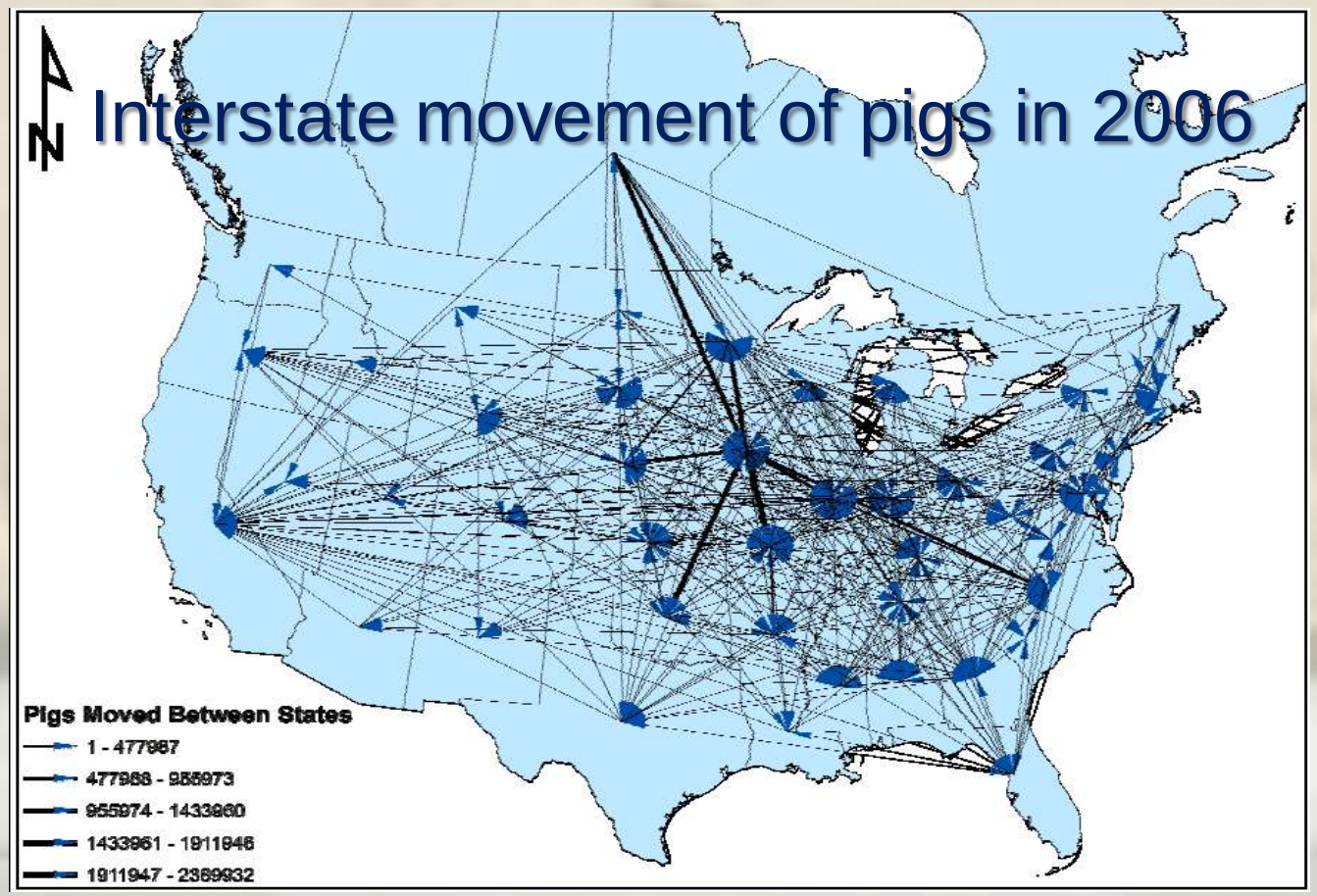


Production is geographically segregated and specialized



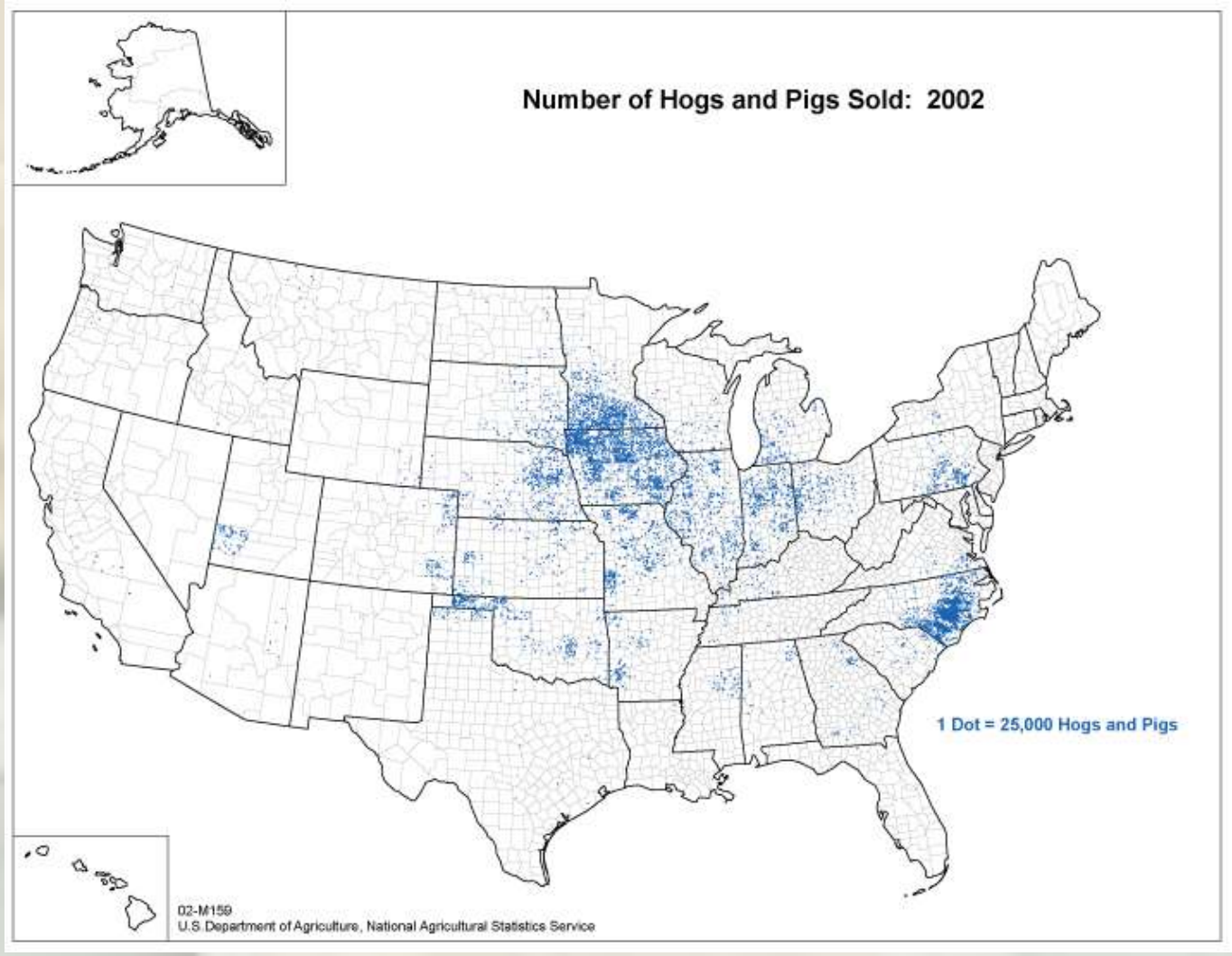

Growing pigs
Market
Sow Farm
Feed
Gilts
Feed
Semen
Gilts

Geographic segregation and specialization are efficient BUT…

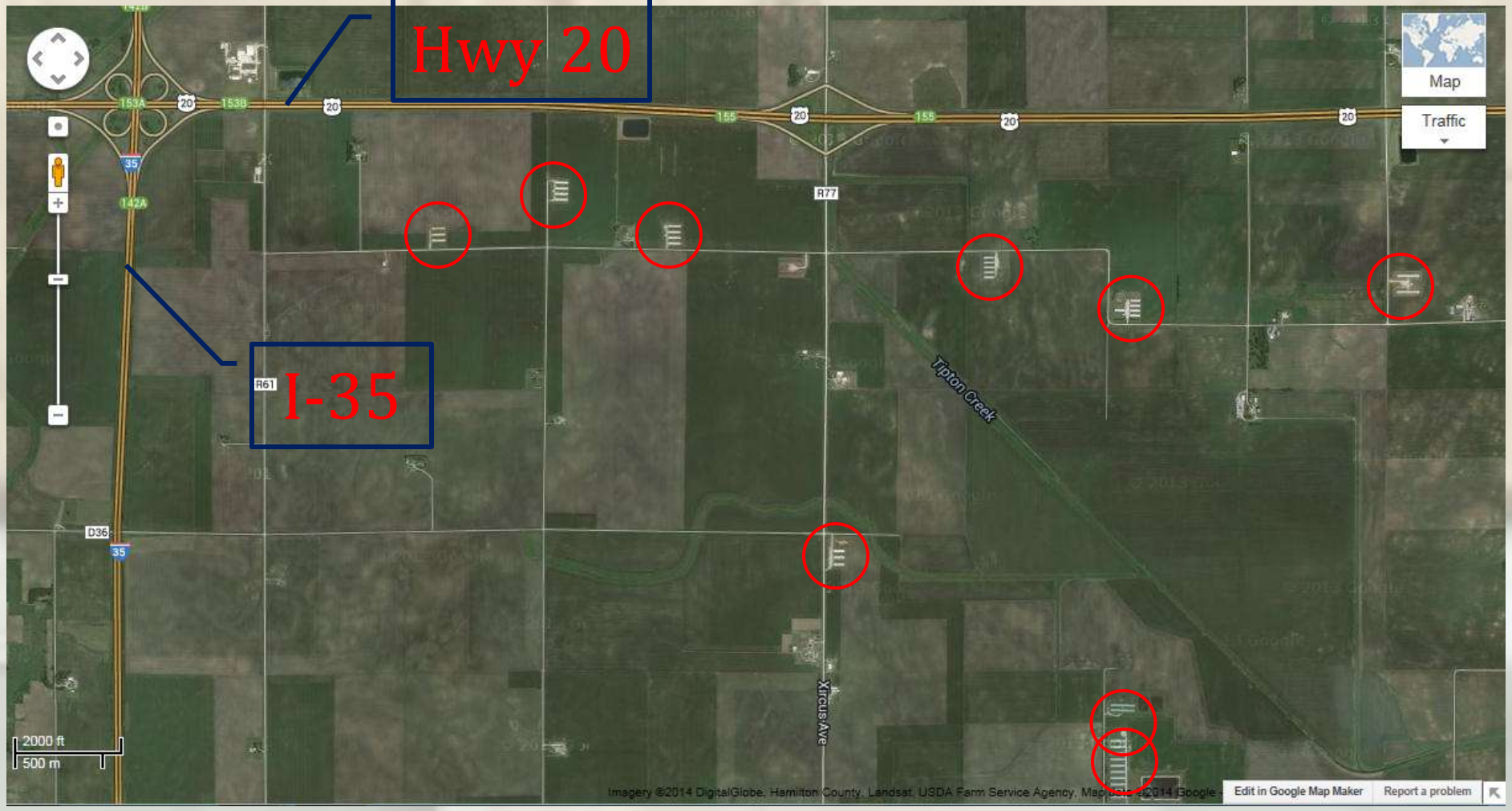


Source: Wayne S. Assessment of the demographics and network structure of swine populations in relation to regional disease transmission and control. Dissertation; University of Minnesota. June 2011. p. 91.

Pigs are concentrated in Midwest and North Carolina



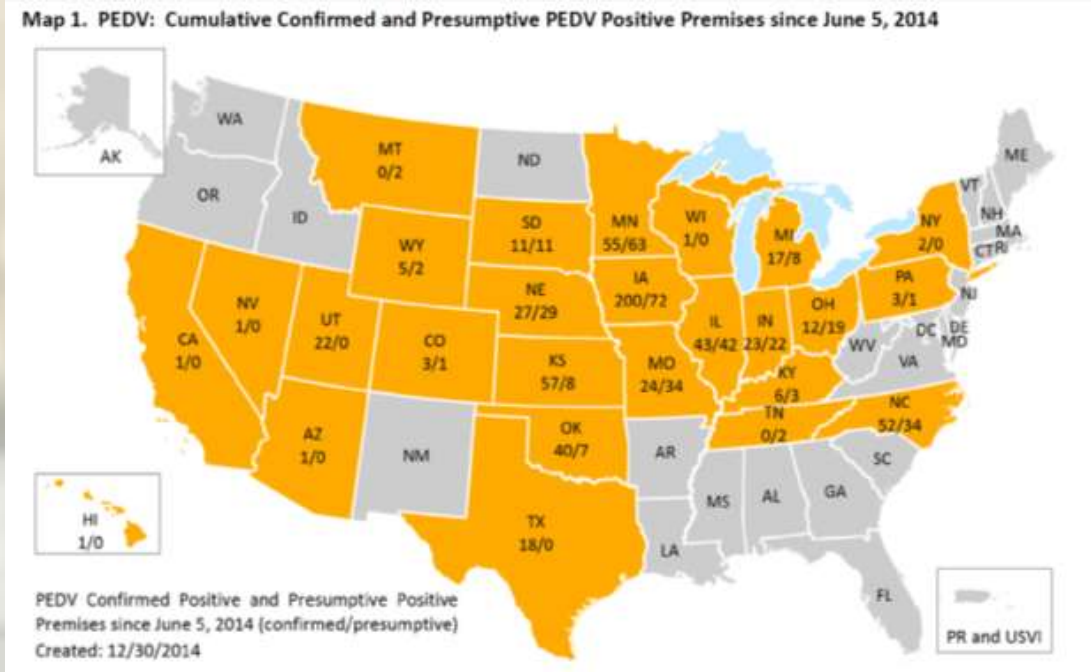
What a pig dense area looks like



Herd size has increased - Large herds are big targets

Given the structure and organization of the pork industry

Biosecurity and surveillance as currently practiced in the U.S. was NOT effective at slowing the spread of the virus



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PEDV was a GENTLE reminder of how unprepared we are for:

- Reportable foreign animal diseases
- Emerging diseases like porcine circovirus type 2 (PCV2)
- New introduction of transboundary diseases like PEDV

- What else could have come from China?
  - Foot and mouth disease virus (FMDV)
  - Classical swine fever virus (CSFV)
  - Pseudorabies virus (PRV)

Plan in place - who does what

- Immediately after the confirmation of PEDV in the U.S. there was a lot of confusion and finger-pointing about who was (or should) do what
  - USDA
    - Federal Order requiring mandatory reporting was issued 14 months after introduction of the virus
  - Producers
    - National Pork Board (NPB)
    - National Pork Producers Council (NPPC)
  - American Association of Swine Veterinarians (AASV)
- Need to pay more attention to potential threats worldwide
  - Too many swine veterinarians were not aware that PEDV existed until it was in the U.S.

Surveillance

- Early detection
  - By the time the arrival of PEDV in the U.S. was confirmed and announced on May 18, 2013, there were 31 cases
    - Determined by retrospectively testing submitted samples
  - 74 cases 3 days later
- More coordinated diagnostics to potentially contain an epidemic or to monitor its progress
  - Information management systems
    - Premises ID numbers (PIN)
    - Electronic diagnostic submissions

Need better diagnostics, vaccines and vaccine technologies

- Development of diagnostics for PEDV was rapid but all of the tests available at diagnostic labs in the U.S. were developed after May 2013
- Currently 2 conditionally licensed vaccines in the U.S.
  - Harris Vaccines
    - First to market
    - Granted a conditional license in June of 2014 (19 months after the introduction of the virus in the U.S.)
  - Zoetis

Need to improve biosecurity and rethink how production is organized

- Risk Assessment
  - Production Animal Disease Risk Assessment Program
- Outbreak investigations
  - NPB rapid response teams

Questions

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