Spatial Assessment of Domestic and Feral Swine Population Data to Identify Information Gaps and Areas of Potential Contact Between Populations

Feral swine populations are widely distributed across the United States and pose disease risks to both domestic livestock and humans. At least 41 of the 48 contiguous States have feral swine populations, with the largest populations in Texas, California, Oklahoma, and Florida (personal communication). An estimated 1 to 4 million feral swine inhabit these States (Witmer et al., 2003).

Feral swine can transmit diseases such as pseudorabies or brucellosis by direct contact with other animals, via airborne pathways, and through contamination of substances such as feed (Wyckoff et al., 2009). In Texas, Wyckoff and others (2009) determined that 7 of 37 feral swine equipped with GPS collars had nighttime contact with domestic swine on a regular basis. In North Carolina, the 16 counties with the highest number of commercial swine operations had feral swine (Engeman et al., 2011).

In 2012, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted Swine 2012, a national study of the U.S. swine industry. As part of the study, data were collected on producer-reported feral swine sightings on operations with fewer than 100 pigs. The study also collected data on swine housing practices, such as whether pigs were confined or not. These data variables offered a unique opportunity to compare feral swine data collected during the Swine 2012 study with data from the National Feral Swine Program (NFSP).

Spatial analyses

For this information sheet, spatial analyses were conducted on U.S. feral swine populations using data from the NAHMS Swine 2012 study and data from the NFSP. Objectives of the spatial analyses follow:

- Identify geographic areas or hot spots (clusters) where domestic swine have outdoor access, which may lead to domestic and feral swine interaction.
- Identify potential gaps in the NFSP dataset on the range of feral swine populations using data from the NAHMS 2012 swine study.

NAHMS study data on operations with fewer than 100 pigs were used for the spatial analyses, and producer responses to the variables listed below were summarized:

- Outdoor access: producers who answered affirmative to providing outdoor access for domestic swine. Outdoor access includes swine in open buildings and/or lots and pastures.
- Feral swine sightings on operation: producer-reported number of feral swine sightings on the operation in the past year.
- County has feral swine: producer responded that feral swine existed within the producer's county.

Affirmative responses from producers were totaled by county. Data for weaned pigs and breeding animals (sows and gilts) were combined into a single total by county.

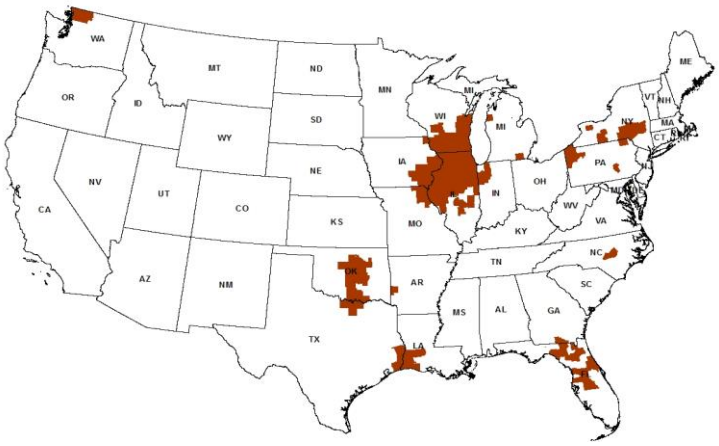
Methods and results

For this project, the United States was divided into four regions—North Central, Northeastern, Southern, and Western—as defined by the Sustainable Agriculture Research and Education organization. Swine operations were located across all 4 regions in 30 States. All spatial analyses were performed by region.

A hot-spot analysis identifies clusters of statistically significant high and low values for a variable of interest. Geographic areas with a concentration of high values are called hot spots, and areas with a concentration of low values are called cold spots. For this project, ESRI's Optimized Hot-Spot Tool was used to identify clusters of counties where domestic swine had outdoor access.

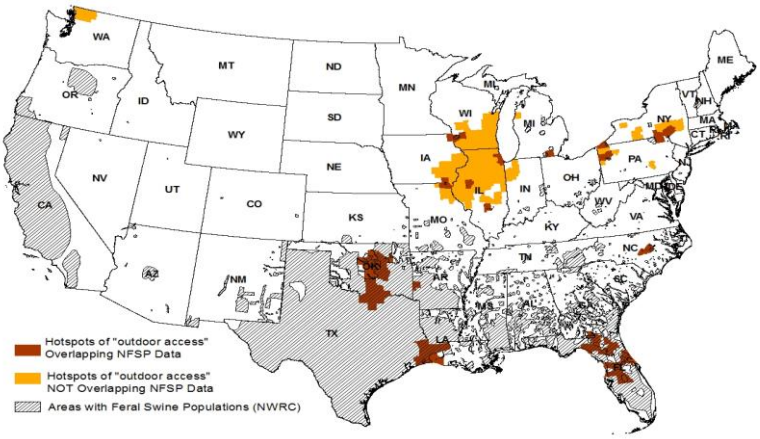
Overall, 74 percent of the 320 surveyed counties had swine operations that allowed their pigs outdoor access. The hot-spot analysis revealed that 200 of these counties were part of substantial clusters of outdoor access. The largest hot spot covered the northern portion of Illinois, eastern Iowa, southern Wisconsin, and a small portion of Indiana. One cluster appeared in northwest Washington. Visibly smaller clusters occurred in Michigan, Pennsylvania, and New York, and hot spots were identified in Oklahoma, Arkansas, Texas, Louisiana, Florida, and North Carolina (figure 1).

Figure 1. Hot spots (in red) where domestic swine had outdoor access



Identified hot spots were overlaid with the NFSP's feral-swine distribution map (figure 2). Orange indicates hot-spot counties that did *not* overlap with NFSP distribution data. When the known feral-swine population data from NFSP was overlaid with hot spots of outdoor access, 36 percent of the hot-spot counties intersected with the NFSP feral swine population. Most of the overlap occurred in southern States. However, a number of smaller counties with hot spots of outdoor access overlapped with feral swine populations in several northern States (red areas), including Iowa, Illinois, Wisconsin, Pennsylvania, and New York.

Figure 2. Spatial overlay of outdoor access hot spots and the NFSP feral swine populations



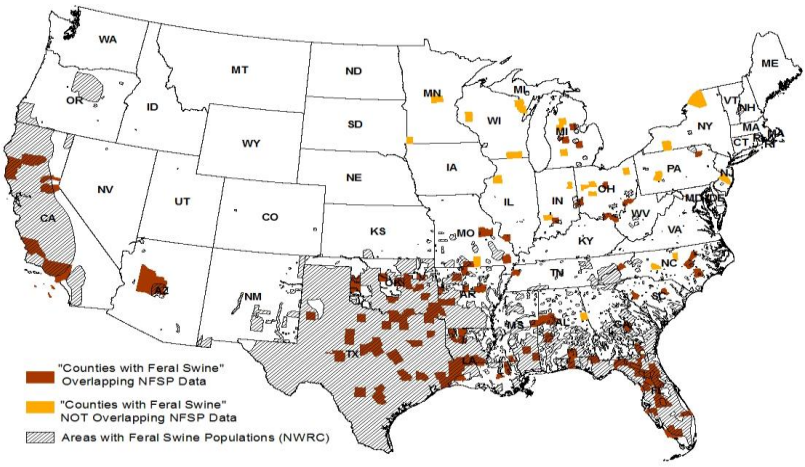
While most of the feral swine populations are concentrated in the southern States, the NFSP data indicate that smaller pockets of feral swine were present in the northern United States. This spatial-overlay analysis reveals that for small swine operations with outdoor access in the northern States, the risk of feral swine contact may be higher than previously thought and may warrant increased biosecurity measures. Hot-spot areas may need a higher level of surveillance for diseases of concern, such as pseudorabies and brucellosis.

Additional overlay analyses were performed to evaluate and identify potential gaps in the NFSP mapped feral-swine population data. The following NAHMS study variables were first summarized by county:

- Number of operations with feral swine sightings
- Number of operations that reported having feral swine in the county.

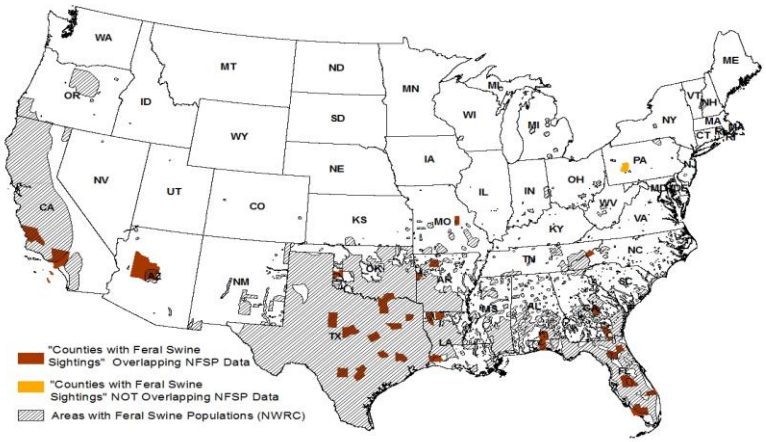
Spatial overlay methods were used to compare these county summaries with the NFSP feral-swine population data. Results from the NAHMS study indicated that 18 percent of the counties surveyed contained operations that reported having feral swine in the county. In comparison, only 8 percent of the counties contained operations with feral swine sightings on the operation. When the feral swine in the counties' survey data were overlaid with the NFSP feral-swine population data, 70 percent of the counties (54 of 78) intersected, indicating some agreement between the datasets (figure 3).

Figure 3. Spatial overlay of counties with feral swine and NFSP feral-swine population data



Agreement was higher between surveyed counties with feral swine sightings and the NFSP feral-swine population data (figure 4). When these two spatial layers were overlaid, 97 percent of the counties aligned with the NFSP-mapped feral swine population, which indicates agreement between the NAHMS data on swine sightings and the NFSP feral-swine population dataset.

Figure 4. Spatial overlay of counties with feral swine sightings and NFSP feral-swine population data



The spatial overlay of counties with feral swine and counties with feral swine sightings provides valuable information that could improve the current knowledge regarding locations of feral swine populations.

In particular, the lack of agreement between the counties with feral swine study data (30 percent did *not* overlap) and the NFSP dataset indicate a potential information gap in the mapped NFSP feral swine population. Many of the counties that did not intersect the NFSP population range were in northern States (yellow areas in figure 3), including Minnesota, where there are currently no NFSP-reported swine populations. It is, however, important to recognize the limitation of this NAHMS data variable. Producers that reported there were feral swine in their counties may have based their response on anecdotal information, not on an actual sighting. Therefore, the variable may be inaccurate and may represent an over-reported presence of feral swine in a given county. It is also possible that producers reporting feral swine in their counties had also seen feral swine near their farms. Despite these uncertainties, the feral-swine-in-county variable may still provide insights into areas where feral swine populations may be expanding. According to the NFSP feral-swine population map, small pockets of feral swine do exist in some northern States. However, the spatial overlay analysis performed using the feral-swine-in-county data indicate that feral swine may have a broader range in these northern States than currently documented.

Limitations

The scale used in this study was at the county level, and county sizes vary in acreage across the United States. Results reflect general spatial patterns across a county, rather than at the farm level.

Hot-spot analysis indicated the locations of clusters based on neighboring counties, providing a guide for assessing feral swine sightings and presence in the counties. Actual values within each county vary. Field validation at the local level regarding specifics related to feral swine sightings and presence is recommended.

The NAHMS 2012 Swine study data on swine operations with fewer than 100 pigs represent selected areas in the United States, while feral-swine population data (NFSP) is on a regional scale.

References

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National Feral Swine Program (NFSP): Feral Swine Population Data from the National Feral Swine Damage Management Program. Contact: Mark Lutman, Wildlife Biologist (Mark.W.Lutman@aphis.usda.gov)
NAHMS 2012 Swine study
http://www.aphis.usda.gov/animal_health/nahms/swine/downloads/swine2012/Swine2012_is_Participate.pdf

Regions: http://www.sare.org/

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APHIS Program Aid #2086; Feral Swine: Damage and Disease Threats.

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