

# Serologic evidence of *Brucella* and pseudorabies in Mississippi feral swine

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**Abstract:** Feral swine (*Sus scrofa*) are an ever-increasing problem across the United States. Besides physical environmental damage that they cause, they may harbor and transmit a number of pathogens to humans, livestock, and other domestic animals. We sampled feral swine across the state of Mississippi for titers to several diseases. Antibodies against *Brucella* were found in 16 of 499 (3.2%) feral swine, and antibodies against pseudorabies (porcine herpes virus, type 1; *Herpesveridae* sp.) virus were identified in 37 of 499 (7.4%) feral swine from across the state of Mississippi. Evidence of classical swine fever, African swine fever, swine influenza, and foot-and-mouth disease were not identified in any of the feral swine examined.

**Key words:** brucellosis, disease, feral swine, human–wildlife conflicts, pseudorabies

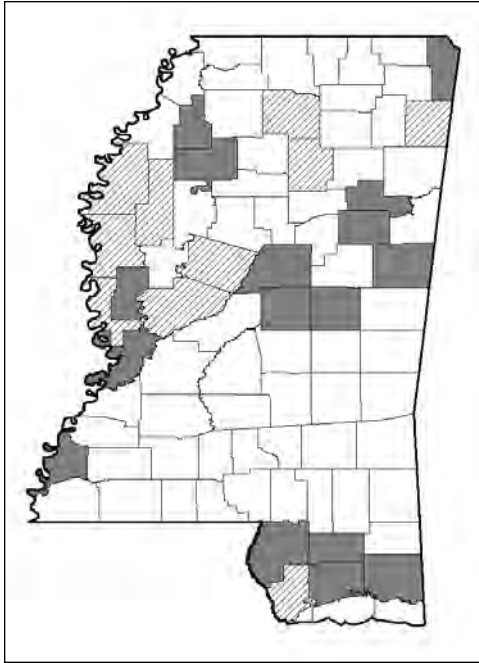
**FERAL SWINE (*SUS SCROFA*)** are considered an invasive species in North America, and they continue to expand their range across the United States (Corn et al. 2004, Hamrick et al. 2011). They are susceptible to and harbor several pathogenic agents that are zoonotic and can affect the health of domestic animals (Meng et al. 2009). The U.S. Department of Agriculture, Animal Plant Health Inspection Service, Wildlife Services (WS) recognizes the threat of swine diseases to domestic livestock and the public, and it has control and eradication programs in place for brucellosis and pseudorabies in domestic swine (USDA 1998). As feral swine populations and their range increase, they are becoming a greater threat to public health and to the health of domestic livestock and pets.

Little is known about the disease status of Mississippi's feral swine population; therefore, we collected samples from a wide range of the total feral swine population in the state to establish some baseline data. To gain a greater understanding of the health status of feral swine and the potential threat they pose, WS and the National Wildlife Disease Program (NWDP) initiated a feral swine classical swine fever (CSF) surveillance project in 2009. Along with CSF surveillance, we evaluated serum for titers against pseudorabies virus (PRV), swine brucellosis (SB), swine influenza virus (SIV), foot-and-mouth disease (FMD), and African

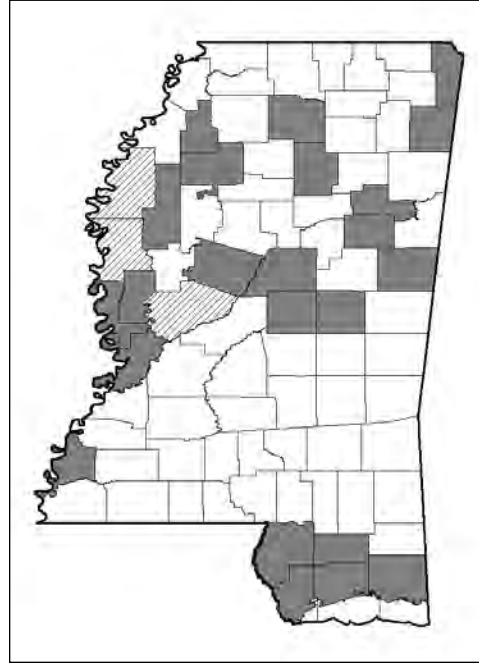
swine fever (ASF). In this paper, we report results from the first 2 years of data collected.

## Methods

Wildlife Services personnel collected all samples from free-ranging feral swine in Mississippi (Figure 1). Feral swine populations near domestic swine production facilities, landfills, high-risk backyard swine producers, and river ports were selected for sampling, based on the potential entry pathways of foreign animal diseases. For collection of serum samples, feral swine were either caught by using walk-in traps and shot, or they were hunter-harvested. Age (as determined by dentition and wear), sex, date, and location data were collected for every animal that was sampled. Serum was collected for determining exposure to endemic diseases and CSF. Additionally, swabs and whole blood samples were collected for FMD, ASF and SIV. All samples for serum were collected as soon as possible after the animals' death (usually within minutes, occasionally within hours, for hunter-harvested animals). Whole blood was collected from the heart or from the orbital sinus behind the eye using a sterile 7.62-cm, 18-gauge needle and 30-ml syringe. Blood was immediately transferred to 3, 10-ml red or gray top tubes labeled with a unique subject identification and maintained on ice while in the field. Within 12 hours, these samples were



**Figure 1.** Map of Mississippi counties indicating pseudorabies serologic results of feral swine sampled between August 2008 and April 2011 by county (hatched = seropositive; shaded = no seropositive results).



**Figure 2.** Map of Mississippi counties indicating brucellosis serologic results of feral swine sampled between August 2008 and April 2011 by county (hatched = seropositive; shaded = no seropositive results).

centrifuged for 15 minutes. Serum was then pipetted into 7, 1.8-ml cryotubes for shipment to appropriate diagnostic laboratories. Four additional tubes were sent to the NWDP feral swine archive in Fort Collins, Colorado, and stored for future disease investigations. Whole blood for ASF was placed into 10-ml, purple-top (EDTA) tubes.

For FMD sampling, sterile 15.24-cm polyester-topped swabs were used to swab the soft palate and under the tongue of each pig. Swabs were placed into an 8-ml, individually labeled, cryotube filled with buffer solution and placed on ice. For SIV, similar swabs of the nasal cavity were taken and placed into 8-ml cryotubes containing brain-heart infusion broth and held on ice until returning from the field. All swabs were held in an ultralow freezer (temp =  $-80^{\circ}\text{C}$ ) until shipped to the appropriate laboratory on dry ice.

All CSF serum samples were submitted to the Foreign Animal Disease Diagnostic Laboratory, Plum Island, New York, for testing. Pseudorabies virus samples were sent to either the Washington state or Wisconsin National Animal Health Laboratory Network (NAHLN)

labs to be tested using gB ELISA. Swine brucellosis samples were tested by NWDP staff by using the card test and then forwarded to the Kansas State and Federal Brucellosis Laboratory for confirmatory testing via FPA assay, if necessary; ASF and FMD samples were sent to the Kansas NAHLN for testing by rRT-PCR. Swine influenza virus samples were sent to the Mississippi NAHLN lab for testing by rRT-PCR (Matrix). All samples were submitted to respective labs within 1 week of collection.

## Results

From August 2008 to April 2011, 499 swine were sampled from 24 counties in Mississippi (Table 1). Antibodies against CSF, ASF, or FMD were not identified in any of these animals. Pseudorabies virus antibodies were identified in 37 individuals from 10 counties (Table 1; Figure 1). Swine brucellosis titers were identified in 16 individuals in 3 counties (Bolivar, Washington, Yazoo; Figure 2). Swine influenza virus was not found in any of the 60 individuals sampled.

## Discussion

Feral swine create problems throughout

**Table 1.** Serologic results of Mississippi feral swine tested for swine brucellosis (SB) and pseudorabies virus (PRV) by county.

County	# Tested	+SB	+PRV
Adams	9	0	0
Attala	12	0	0
Bolivar	41	12	4
Calhoun	27	0	5
Clay	14	0	0
Hancock	54	0	3
Harrison	1	0	0
Holmes	94	0	11
Issaquena	75	0	2
Itawamba	4	0	2
Lafayette	8	0	1
Leake	1	0	0
Neshoba	30	0	0
Noxubee	8	0	0
Pearl River	2	0	0
Oktibbeha	11	0	0
Quitman	3	0	0
Sharkey	10	0	0
Stone	9	0	0
Sunflower	4	0	1
Tallahatchie	1	0	0
Tishomingo	3	0	0
Washington	10	1	1
Yazoo	68	3	7
Total	499	16	37

their ever-expanding range. Much interest has focused on crop damage and disruption of the physical environment (Sewar et al. 2004, Hamrick et al. 2011). However, there are many reports of zoonotic and domestic animal diseases that swine may harbor and transmit (Gresham et al. 2002, Corn et al. 2004, Sewar et al. 2004, Hartin et al. 2007, Meng et al. 2009, Jack 2011). In this paper, we have provided evidence of exposure to swine brucellosis and pseudorabies virus in Mississippi. Both of these are federal reportable diseases (USDA-APHIS

1998). Evidence of CSF, SIV, FMD, and ASF was not demonstrated.

Pseudorabies is not zoonotic, but it can pose a threat to domestic swine and several other livestock (e.g., cattle) and domestic animals and wildlife. However, swine brucellosis is zoonotic and has been reported present in hunters in Florida (Harder and Basta 2007, Giurgiutiu et al. 2009). In some areas, the impact of feral swine disease transmission has been downplayed because most domestic swine are currently raised under relatively high biosecurity (i.e., fencing and buildings to restrict interaction between feral and domestic swine, as well as shower-in and shower-out requirements for humans, and sanitizing vehicles when entering the premises). However, recent expansion of free-ranging swine production operations poses an increased threat to animals at those facilities. Moreover, pseudorabies and brucellosis are transmissible (and debilitating or fatal) to other domestic livestock and pets. Because feral swine are much more likely to encounter these domestic animals, this represents an important potential for human-wildlife impact.

Antibodies against swine brucellosis were found in only 3 counties (i.e., Bolivar, Washington, and Yazoo). Each of these counties is in the mid- to south-delta region of Mississippi. Antibodies against PRV were identified in feral swine from 10 different counties that are fairly evenly distributed around the state. The distribution of SB may suggest a limited source, but at this point, sample numbers are too low to draw any firm conclusions from the distribution of positive titers to either SB or PRV. There is marked overlap in the presence of antibodies against PRV and SB in several counties. This warrants further investigation (i.e., increased sample numbers) to pinpoint affected premises and expanded regional surveillance to provide more in depth information and better understanding of the extent and nature of these diseases within Mississippi.

Percentages of animals with antibodies (PRV = 7.4%; SB = 3.27%) were relatively low. However, both of these diseases are considered chronic or persistent and may result in later shedding of the pathogen if the host animals are appropriately stressed or debilitated for other reasons. Hence, any titers at all indicate the potential for ongoing problems.

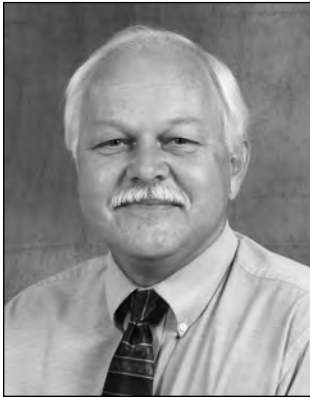
Another problem with feral swine is their illegal transportation across jurisdictional boundaries for release (Hamrick et al. 2011). The potential for disease spread indicates that continued surveillance and management practices to reduce feral swine numbers and range is imperative.

Continued surveillance is needed to gain further knowledge and understanding of the extent and prevalence of feral swine disease throughout the United States. Because feral swine share many environments with humans and their domesticated animals, this is essential to provide insight into control and preventive measures necessary to improve management of these diseases that have been largely eradicated from domestic livestock.

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KRISTINA C. GODWIN has been state director for the Mississippi USDA-APHIS-Wildlife Services program since 1999. She oversees the Mississippi beaver control assistance program, as well as working with numerous airports, state and federal agencies, and nongovernment organizations on wildlife damage management issues. She is an adjunct assistant professor at Mississippi State University where she teaches a split-level course on human-wildlife conflict resolution techniques. She is the current past president of the Mississippi Wildlife Federation and 2-term past president of the Mississippi chapter of The Wildlife Society. She holds an AAS degree in biological technology from State University of New York (SUNY)-Cobleskill, a B.S. degree in wildlife ecology from SUNY College of Environmental Science and Forestry, Syracuse, New York, and an M.S. degree in wildlife management from Mississippi State University. She is married to Dave Godwin, who is the wild turkey and small game program coordinator for the Mississippi Department of Wildlife, Fisheries and Parks. She and Dave have 2 children, daughter Brannon and son Eric.

