

## Health Status of a Recently Discovered Population of Feral Swine in Kansas

Philip S. Gipson,<sup>1</sup> Johna K. Veatch,<sup>2,3</sup> Raymond S. Matlack,<sup>4</sup> and David P. Jones<sup>5,1</sup> Kansas Cooperative Fish and Wildlife Research Unit, United States Geological Survey, Division of Biology, Kansas State University, Manhattan, Kansas 66506, USA; <sup>2</sup> Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University, Manhattan, Kansas 66506, USA; <sup>3</sup> Current address: Central States Veterinary Pathology Service, P.O. Box 577, Manhattan, Kansas 66506, USA; <sup>4</sup> Division of Biology, Kansas State University, Manhattan, Kansas 66506, USA; and <sup>5</sup> Natural Resources Division, Fort Riley Army Base, Kansas 66442, USA.

**ABSTRACT:** Twenty feral hogs (*Sus scrofa*) from a newly discovered population on Fort Riley Army Base (Kansas, USA) were shot and examined from November 1993 through February 1994 to assess the health of the population. The hogs were generally healthy, although serologic evidence indicated that some individuals had been exposed to parvovirus, enterovirus, and swine influenza. We found no indications of brucellosis, pseudorabies, or porcine respiratory and reproductive syndrome. Lung worms (*Metastrongylus* spp.), round worms (*Ascaris suum*), and whipworms (*Trichuris suis*) were found in nine, four and two of the hogs, respectively. Seven hogs had infestations of lice (*Haematopinus suis*). Fence-line contacts were documented between four wild boars and domestic sows, and in three cases wild boars entered pens containing domestic sows. We recommend that hogs be examined periodically from this and other wild populations to monitor health status since new animals may enter populations through deliberate translocation, escape from shooting preserves or domestic swine producers, or dispersal from other feral populations.

**Key words:** Feral hogs, infectious diseases, survey, translocation.

Populations of feral hogs (*Sus scrofa*) occurred in 20 states in 1988 with the highest concentrations in southeastern United States, California, and Hawaii (Mayer and Brisbin, 1991). By 1997 the range of wild hogs expanded into the central tier of states from Colorado and Kansas to Indiana and Ohio (Gipson et al., 1998). New populations probably originated from releases of wild hogs for hunting, escape of wild hogs from shooting preserves, dispersal from established populations, and domestic hogs avoiding capture in free-range commercial operations (Gipson et al., 1997). Wild hog populations may include descendants of domestic hogs

that became wild, Eurasian wild boar, and hybrids of these forms; all are considered *S. scrofa* (Mayer and Brisbin, 1991). Feral hogs represent a potential source of diseases that can be transmitted to domestic swine.

During fall, 1993 a population of feral hogs was discovered on Fort Riley Army Base in northeastern Kansas (USA), the first feral hog population reported in the state (Gipson et al., 1994). This study was undertaken to determine whether brucellosis, pseudorabies, or other contagious diseases of swine were present. Concern about importing into Kansas feral hogs infected with swine diseases prompted the State Legislature to pass a law in 1995 prohibiting importation or possession of feral hogs (Livestock and Domestic Animals Act, 1995). Two additional populations of feral hogs and numerous free-ranging hogs were documented in Kansas during 1996 and 1997 (Gipson et al., 1998).

Hogs were killed from November 1993 through February 1994 on Fort Riley during controlled hunts or when captured in cage traps. Fort Riley includes 44,500 ha, mostly in tall grass prairie and narrow bands of riparian forest along streams, in the Flint Hills of northeastern Kansas (39°70'N, 96°57'W). Elevations range from 312 to 416 m.

A sample of blood was taken from each hog at the time of death and submitted along with the carcass to the Department of Diagnostic Medicine (College of Veterinary Medicine, Kansas State University, Manhattan, Kansas, USA). Carcasses of feral hogs were examined for external parasites and necropsied. Using the appropri-

ate conjugates, lung, tonsil, and kidney tissues were taken for fluorescent antibody testing for pseudorabies (PRV) (NVSL; National Veterinary Services Laboratories, Ames, Iowa, USA), swine influenza (SI) (NVSL), porcine respiratory and reproductive syndrome (PRRS) (D. Benfield, Animal Research and Diagnostic Laboratory, Brookings, South Dakota, USA), and leptospirosis (NVSL).

Serum was tested for antibodies to brucella, using the rose bengal card test (Animal and Plant Health Inspection Service, 1991a, b); leptospira, using the microplate agglutination test (Cole et al., 1980); and to enterovirus serotype 8, swine influenza virus type H1N1, and transmissible gastroenteritis (TGE), using serum neutralization (Snyder et al., 1991). Antibodies to porcine parvovirus (PPV) were determined by hemagglutination inhibition (Mengeling, 1992), and PRRS antibodies were detected by indirect fluorescent antibody testing (Frey et al., 1992). Lung, tonsil, liver, spleen, and kidney tissues were taken on necropsy, fixed in 10% neutral buffered formalin and routinely processed for histological evaluation.

Skulls of hogs examined were placed in the Museum of Natural History (University of Kansas, Lawrence, Kansas, USA) where they are identified as the Fort Riley Feral Hog Collection. This collection includes skulls from 32 feral hogs collected on Fort Riley.

Twenty feral hogs were collected from November 1993 through February 1994. Ages of the hogs ranged from approximately 6 mo to >3 yr based on tooth replacement and wear (Mayer and Brisbin, 1991). All but one of the hogs were in good body condition with significant subcutaneous fat deposits. The one hog in poor body condition was thin with a lacerated ear, and recently broken ribs (numbers 10 and 11) on the right side. Mammary tissue was developed suggesting she was probably nursing or had just weaned young, and the uterus was involuted.

Grossly, the caudal dorsal portions of

the lungs from nine of the hogs were mottled and lung worms (*Metastrongylus* spp.) were found within the bronchi. Round worms (*Ascaris suum*) were found in four of the hogs, and two had whipworms (*Trichuris suis*). Seven hogs were collected in November and December 1993, and all had a marked infestation of lice (*Haematopinus suis*). Nine were collected during January and February 1994, and none had noticeable lice. Representative specimens were placed in the National Parasite Collection (United States Department of Agriculture, Agricultural Research Service, Beltsville, Maryland, USA; accession numbers 088529, 088530, and 088572).

Antibodies were present in sera from hogs to swine influenza virus type H1N1 (15 individuals), swine enterovirus serotype 8 (13 individuals), and PPV (14 individuals). Antibody titers ranged from 1:10 to 1:80 for swine influenza ( $n = 15$ ,  $\bar{x} = 1:31$ ) and 1:8 to 1:256 for swine enterovirus ( $n = 13$ ,  $\bar{x} = 1:106$ ). One hog had an antibody titer to porcine parvovirus of 1:32,768; the remaining hogs had antibody titers that ranged from 1:16 to 1:512 ( $n = 11$ ,  $\bar{x} = 1:78$ ). All hogs were negative for PRV, SI and PRRS on fluorescent antibody testing. Fluorescence suspicious of leptospira was found in kidney tissue from four hogs with one of those having serum antibodies to *Leptospira interrogans* serovar *pomona* (1:400) and *L. interrogans* serovar *bratislava* (1:200). In addition, the adult female in poor condition had a 1:100 titer to *L. interrogans* serovar *pomona*. The other 13 hogs tested were negative for serum antibodies to leptospira. All 20 hogs tested negative for serum antibodies to *Brucella* sp. and pseudorabies virus.

The nine hogs with gross evidence of lung worms had localized necrotizing bronchiolitis with loss of respiratory epithelium and migration of eosinophils, neutrophils, and fewer mononuclear cells into the bronchiolar submucosa. Nematode sections were present in some of the airways. Histological sections from the livers of two hogs had increased periportal fibro-

sis with an eosinophilic infiltrate suggestive of parasite migration. However, grossly the livers did not show the typical lesions of multiple white fibrotic foci caused by larval parasite migration. The two hogs with antibody titers to leptospira had mild to moderate nonsuppurative interstitial nephritis, but spirochetes were not found on silver stained sections of the kidneys. Other tissues examined appeared normal.

Kansas has brucellosis free status for swine (United States Department of Agriculture, 1997). Pseudorabies is occasionally found in the state, and when cases are confirmed, quarantine and control measures are instituted in the infected herd. Feral hogs are known to be reservoirs of brucellosis and pseudorabies in southeastern states and Texas (Davis, 1993; Hahn, 1993; Hulligan, 1993; Van der Leek et al., 1993). The possibility exists of feral hogs being introduced to Kansas and other midwestern states from infected southern populations.

Our data indicated that hogs on Fort Riley were probably free of brucellosis and pseudorabies. Keeping additional untested feral hogs from being released in Kansas and other states is important to the swine industry because of the possibility of feral hogs carrying diseases that might be transmitted to domestic hogs. The 1995 Kansas State Legislature responded to concerns of the swine industry and passed a law prohibiting the introduction or possession of feral hogs in the state (Livestock and Domestic Animals Act, 1995). Other midwestern states are considering similar laws (Gipson et al., 1998).

Nineteen of the 20 hogs we examined were in good body condition, although lung worms were found in nine hogs along with localized necrotizing bronchiolitis, round worms were found in four, and two had whipworms. Livers of two hogs contained histological lesions of increased periportal fibrosis with an infiltration of eosinophils suggesting larval parasite migration, but no lesions typical of parasite migration were found.

Numbers of lice found on feral hogs declined markedly from hogs collected during fall compared to those collected in the winter. The decline in lice probably represents a seasonal variation due to weather extremes and lack of shelter for the hogs.

The presence of antibodies to parvovirus, enterovirus, swine influenza, and leptospira in several hogs from the Fort Riley herd indicates that the population has been exposed to these diseases. We were not able to obtain multiple serum samples from hogs at Fort Riley and a single antibody titer from an animal can not indicate the presence of an active pathogen. Antibody titers found in the feral hogs were similar to those found in commercial herds in the state (J. Veatch, unpubl. data).

Parvovirus (Mengeling, 1992), enterovirus (Derbyshire, 1992), and *Leptospira* sp. (Ellis, 1992) are known to be involved in early fetal death, stillbirths, and weak births. Swine influenza causes morbidity due to pneumonia (Easterday and Hinshaw, 1992). The presence of antibodies to these pathogens in hogs from Fort Riley suggests that they are endemic in the population. The presence of the pathogens could affect the feral population and pose a threat to naive domestic herds, especially gilts. Swine production in Kansas varies from large total confinement operations to fenced lots for finishing hogs. The potential for transmission of diseases from feral populations to domestic herds is greatest through fence line contact. There also is a possibility that feral hogs could be captured and introduced to domestic herds for finishing, or persons who had contact with feral hogs could serve as a source of transmission to domestic herds.

Three wild boars entered pens containing domestic sows and a fourth boar attempted to enter pens with sows near Fort Riley during 1996 and 1997, demonstrating that fence-line contact occurs between wild and domestic hogs. A wildlife biologist employed to control feral hogs (C. D. Richardson, pers. comm.) reported one wild boar was killed inside a pen with

sows, another was killed after entering and leaving a pen with sows, and a third boar was killed near a pen of sows after being chased away earlier. The first author visited a swine production facility 61 km north of Fort Riley where a wild boar entered a pen holding domestic sows on three consecutive nights during November, 1997.

#### LITERATURE CITED

- ANIMAL AND PLANT HEALTH INSPECTION SERVICE. 1991a. Diagnostic Reagents Manual 65E: Supplemental test procedures for the diagnosis of brucellosis. National Veterinary Services Laboratories, Ames, Iowa, 25 pp.
- . 1991b. Diagnostic Reagents Manual 65F: Laboratory procedures for isolating, identifying and typing *Brucella*. National Veterinary Services Laboratories, Ames, Iowa, 32 pp.
- COLE, J. R., H. C. ELLINGHAUSEN, AND H. L. RUBIN. 1980. Laboratory diagnosis of leptospirosis of domestic animals. Proceedings of the U.S. Animal Health Association 83: 189–199.
- DAVIS, D. S. 1993. Feral hogs and disease: Implications for humans and livestock. In *Feral swine: A compendium for resource managers*, C. W. Hanselka and J. F. Cadenhead (eds.). Texas Agricultural Extension Service, San Angelo, Texas, pp. 84–87.
- DERBYSHIRE, J. B. 1992. Enterovirus. In *Diseases of Swine*, 7th Edition, A. D. Leman, B. E. Straw, W. L. Mengeling, S. D'Allaire, and D. J. Taylor (eds). Iowa State University Press, Ames, Iowa, pp. 299–311.
- EASTERDAY, B. C., AND V. S. HINSHAW. 1992. Swine influenza. In *Diseases of swine*, 7th Edition, A. D. Leman, B. E. Straw, W. L. Mengeling, S. D'Allaire, and D. J. Taylor (eds). Iowa State University Press, Ames, Iowa, pp. 349–357.
- ELLIS, W. A. 1992. Leptospirosis. In *Diseases of swine*, 7th Edition, A. D. Leman, B. E. Straw, W. L. Mengeling, S. D'Allaire, and D. J. Taylor (eds). Iowa State University Press, Ames, Iowa, pp. 529–536.
- FREY, M. L., K. A. EERNISSE, J. G. LANDGRAF, J. E. PEARSON, AND D. W. CHLADEK. 1992. Diagnostic testing for SIRS virus at the National Veterinary Services Laboratories (NVSL). American Association of Swine Practitioners Newsletter 4: 31.
- GIPSON, P. S., R. MATLACK, D. P. JONES, H. J. ABEL, AND A. E. HYNEK. 1994. Feral pigs, *Sus scrofa*, in Kansas. Proceedings of the North American Prairie Conference 14: 93–95.
- , W. HLAVACHICK, T. BERGER, AND C. D. LEE. 1997. Explanations for recent range expansions by wild hogs into midwestern states. Proceedings of the Great Plains Wildlife Damage Control Workshop 13: 148–150.
- , ———, AND ———. 1998. Range expansion by feral hogs across the central United States. Wildlife Society Bulletin 26: 279–286.
- HAHN, E. C. 1993. Report to the USAHA PRV Committee on the meeting of the feral swine advisory committee. Proceedings of the Annual Meeting of the United States Animal Health Association 97: 395–397.
- HULLIGAN, B. A. 1993. Feral swine report. Proceedings of the Annual Meeting of the United States Animal Health Association 97: 398–401.
- LIVESTOCK AND DOMESTIC ANIMALS ACT. 1995. Kansas Statutes Annotated, 1995 Supplement. In Section 47-1809, Division of Printing—Department of Administration, Topeka, Kansas, pp. 356–357.
- MAYER, J. J., AND I. L. BRISBIN, JR. 1991. Wild pigs in the United States: Their history, morphology, and current status. University of Georgia Press, Athens, Georgia, 313 pp.
- MENGELING, W. L. 1992. Porcine Parvovirus. In *Diseases of swine*, 7th Edition, A. D. Leman, B. E. Straw, W. L. Mengeling, S. D'Allaire, and D. J. Taylor (eds). Iowa State University Press, Ames, Iowa, pp. 299–311.
- SYNDER, M. L., W. C. STEWART, AND J. I. KRESSE. 1991. Protocol for microtitration neutralization tests for pseudorabies and transmissible gastroenteritis virus test. National Veterinary Services Laboratories, Ames, Iowa, 3 pp.
- VAN DER LEEK, M. L., H. N. BECKER, E. C. PIRTLE, P. HEMPHREY, C. L. ADAMS, B. P. ALL, G. A. ERICKSON, R. C. BELDEN, W. B. FRANKENBERGER, AND E. P. J. GIBBS. 1993. Prevalence of pseudorabies (Aujeszky's disease) virus antibodies in feral swine in Florida. Journal of Wildlife Diseases 29: 403–409.
- UNITED STATES DEPARTMENT OF AGRICULTURE. 1997. Swine brucellosis quarterly report, January 1, 1997–March 31, 1997. Animal and Plant Health Inspection Service, Veterinary Services, National Animal Health Programs, Riverdale, Maryland, 46 pp.

Received for publication 26 July 1998.