Wildlife Services

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National Wildlife Research Center

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Defining Economic Impacts and Developing Control Strategies for Reducing Impacts of Feral Swine and Other Ungulates

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Groups Affected:

- Consumers
- Livestock producers and farmers
- Meat processors
- Sporting organizations
- U.S. citizens and landowners
- Wildlife and natural resource managers

Major Cooperators:

- Animal Control Technologies Australia
- Archbold Biological Station
- Invasive Animals Cooperative Research Centre
- MacArther Agro-ecology Research Center
- Mississippi State University, Center for Resolving Human-Wildlife Conflicts
- Mississippi State University, College of Veterinary Medicine
- Mississippi State University, Department of Wildlife, Fisheries and Aquaculture
- Sul Ross State University
- Texas A&M University-Kingsville
- Texas Department of Agriculture
- Texas Parks and Wildlife Department
- University of Florida
- USDA/APHIS/Veterinary Services
- USDA/APHIS/Wildlife Services

National Wildlife Research Center Scientists Provide Basic Ecological Information to Reduce Feral Swine Damage

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research organization devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective, and socially responsible methods, tools, and techniques.

The high reproductive rate and adaptability of feral swine has resulted in populations that have dramatically increased in size and distribution. This invasive animal now occurs across much of the United States, where it causes a range of agricultural and environmental damage by habitat destruction through their rooting, wallowing, trampling and feeding behaviors. Furthermore, feral swine compete with native wildlife and livestock for food and other resources. They can carry at least 30 diseases and nearly 40 parasites that may affect people, pets, livestock, and wildlife. It is estimated that feral swine in the United States cause more than $1.5 billion in damages and control costs each year. NWRC research supports activities of the Animal and Plant Health Inspection Service (APHIS) National Feral Swine Damage Management Program by developing new methods and strategies for monitoring and reducing feral swine damage. Current activities focus on toxicant development and registration, economic assessments, and new methods to optimize damage management programs.

Applying Science and Expertise to Wildlife Challenges

Toxicant Bait Formulation. — Since 2013, NWRC researchers have been evaluating sodium nitrite for use as a feral swine toxicant, including its effectiveness and potential impacts to non-target animals. After numerous trials, a final formulation has been identified and tested, resulting in a 95 percent mortality rate with captive feral swine. APHIS submitted a data registration package and request for an Experimental Use Permit to the U.S. Environmental Protection Agency (EPA) in August 2016. If granted the permit, NWRC and WS Operations will begin field testing the bait on free-ranging feral swine populations in several areas across the country. NWRC experts are evaluating different oil-based baits. The goal is to find a mixture that not only masks the salty taste of the sodium nitrite so feral swine eat it, but also minimizes the bait's appeal to non-target species. NWRC field-tested three different placebo bait mixtures on free-ranging feral swine in Texas. Researchers compared the uptake of the bait by feral swine and other wildlife to a reference food (whole-kernel corn) that feral swine readily eat. Feral swine visited the placebo bait as often as the whole-kernel corn control bait. They also ate enough of the placebo bait to have ingested lethal doses of micro-encapsulated sodium nitrite if it had been included in the mixture. All of the bait mixtures were visited and eaten equally by non-target species, with the most common species being white-tailed deer and raccoons. As such, researchers are evaluating swine-specific delivery systems designed to keep other wildlife species from accessing the bait.

Economic Damage Assessment. — To understand crop damage by feral swine on a national level, the National Agricultural Statistics Service administered a survey designed by NWRC researchers to more than 9,500 producers in 11 States: Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, and Texas. About 4,300 producers of corn, soybeans, wheat, rice, peanuts, and sorghum responded to the survey. Survey results indicate that feral swine damage to crops exceeds $190 million in the United States annually. Though large, this number represents only a small fraction of the total damage by feral swine because it includes damage to only six crops. Producers also spent a great deal on damage management and control costs. Many growers reported using a suite of control methods, including shooting and trapping. The costs of control measures, as well as losses in yield, were substantial for crop producers, many of whom typically operate on very small profit margins.

Spread of Feral Swine in the United States. — NWRC researchers modeled the distribution of feral swine in the continental United States from 1982 to 2012. During this period, the swine's rate of northward range expansion accelerated from 6.5 km to 12.6 km per year. If the trend persists, feral swine are predicted to reach most counties in 30–50 years. Results also showed that the spread of feral swine was largely associated with similarities between existing and new habitats—feral swine were more likely to expand their range into areas that were similar to the ones they currently occupied. The most notable exception was the tendency for feral swine to spread into areas with colder winters, something that is also reflective of their northward expansion. In recent years, the spread has been associated with milder winters. Researchers note that milder winters may have made it easier for animals released into unfamiliar areas to survive. By highlighting areas in the United States that the animals may invade, the model helps managers identify locations that need active feral swine management.

Feral Swine Genetic Archive. — NWRC researchers, with the help of WS field specialists in 39 States and Guam, are collecting hair samples from feral swine to create a national feral swine genetic archive. The samples provide NWRC geneticists with enough DNA to genotype or "genetically fingerprint" individual feral swine. The hairs will help scientists identify and distinguish among current feral swine populations as well as determine their origins. To date, more than 4,000 samples have been collected. Geneticists are also beginning to compare the genetics of emerging feral swine populations with potential source populations (including domestic breeds and wild boar) to help identify the origins of new populations. The genetic insights gathered will help determine the effectiveness of current management efforts, as well as how feral swine may be spreading across the country.

Monitoring Feral Swine Populations. — NWRC modelers developed a method for estimating feral swine abundance before and after management actions based on the number of animals removed and the amount of effort expended to find feral swine ("search effort"). In addition to inferring the proportion of feral swine removed in an area, the population estimation tool allows managers to assess how effective their management actions are by estimating capture rates.

Modeling Disease Emergence in Feral Swine. — How quickly a disease spreads through an animal population depends on several factors, including movement behavior, social structure, the number of susceptible individuals in the population, and the life history of the pathogen. NWRC researchers modeled how differences in contact structure and rates between individuals in a population affect the likelihood of a disease outbreak, its size, and its progression. Hypothetical populations of feral swine were exposed to either foot-and-mouth disease virus (FMDV) or classical swine fever virus (CSFV). Findings showed the persistence probability of FMDV under a wide range of feral swine population scenarios was near zero, while it was more probable that CSFV could persist. As a result, an FMDV detection in feral swine likely would not warrant very early response and management. However, simulations showed that responding to a CSFV detection was generally effective at limiting the outbreak's size and scope. Also, when pre-emergence culling of feral swine caused population declines, it was effective at decreasing the size of outbreaks for both diseases by more than 80 percent.

Feral Swine Impacts to Rangelands. — Grazing lands in central Florida are a mosaic of sown pastures, native grasslands, wetlands, and woodlands. Feral swine damage to these areas negatively impacts economic productivity and biodiversity. NWRC and University of Florida researchers looked at the specific impacts of feral swine damage in pastures and grasslands. They found that feral swine rooting in native grassland pastures reduced the number of plant species, while rooting in sown pastures increased the number of plant species. In both habitats, swine rooting altered plant communities and reduced agricultural productivity. Forage grasses were mainly associated with unrooted areas, whereas low-quality forage or nuisance species dominated rooted areas. Researchers estimated that more than 300,000 hectares (about 741,000 acres) of pasture and forage are lost to feral swine rooting in central Florida each year, amounting to a $2 million loss in cattle production.

Selected Publications:

Anderson, A., C. Slootmaker, E. Harper, J. Holderieath, and S.A. Shwiff. 2016. Economic estimates of feral swine damage and control in 11 US states. Crop Protection 89:89-94. doi: 10.1016/j.cropro.2016.06.023

Pepin, K.M. and K.C. VerCauteren. 2016. Disease-emergence dynamics and control in a socially-structured wildlife species. Scientific Reports 6:25150. doi: 10.1038/srep25150

Bankovich, B., E. Boughton, R.Boughton, M.L. Avery, and S.M. Wisely. 2016. Plant community shifts caused by feral swine rooting devalue Florida rangeland. Agriculture, Ecosystems and Environment 220:45-54. doi: 10.1016/jagee.2015.12.027

Snow, N.P., J.M. Halseth, M.J. Lavelle, T.E. Hanson, C.R. Blass, J.A. Foster, S.T. Humphrys, L.D. Staples, D.G. Hewitt, and K.C. VerCauteren. 2016. Bait preference of a free-ranging feral swine for delivery of a novel toxicant. PLoS One 11(1):e0146712. doi: 10.1371/journal.pone.0146712

Snow, N.P., M.A. Jarzyna, and K.C. VerCauteren. 2017. Interpreting and predicting the spread of invasive wild pigs. Journal of Applied Ecology. doi: 10.1111/1365-2664.12866

Major Research Accomplishments:

- APHIS submitted a data registration package and request for an Experimental Use Permit to the U.S. Environmental Protection Agency in August 2016 for a sodium nitrite-based feral swine toxicant. The final formulation resulted in a 95 percent mortality rate in trials with captive feral swine.

- A National Agricultural Statistics Service survey (designed by NWRC) indicates that feral swine damage to crops exceeds $190 million in the U.S. annually. Though large, this number likely represents only a small fraction of the total damage by feral swine.

- WS models show that the rate of feral swine range expansion in the U.S. accelerated from 6.5 km to 12.6 km per year between 1982 and 2012. If the trend persists, feral swine are predicted to reach most counties in 30–50 years.

- WS geneticists created a national feral swine genetic archive.

- WS researchers developed a method for estimating feral swine abundance before and after management actions based on the number of animals removed and the amount of effort expended to find feral swine ("search effort").

- WS researchers modeled how differences in contact rates between individual feral swine may affect the likelihood of a disease outbreak, its size, and its progression.

- WS researchers estimated that more than 300,000 hectares (about 741,000 acres) of pasture and forage are lost to feral swine rooting in central Florida each year.