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Feral Swine

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Figure 1. Feral swine *(Sus scrofa).*

Quick Links

Human-Wildlife Conflicts

Feral swine (*Sus scrofa*; Figure 1), also known as feral hogs, feral pigs, wild pigs, wild boar, or other similar derivations, are a non-native species considered to be one of the most destructive invasive terrestrial vertebrates in North America. While feral swine populations remained relatively small and confined in the continental United States following initial introductions by European explorers during the 15th century, substantial range expansion has occurred across every geographical region of the United States (Figure 2). This expansion has primarily been attributed to human-mediated movements, predominately for the purpose of establishing populations for recreational hunting, and facilitated by feral swine's highly adaptable biological and behavioral traits (e.g., habitat generalist, opportunistic omnivore, extremely high reproductive rate). Consequently, ecological, agricultural, and urban/suburban damages and human health and safety

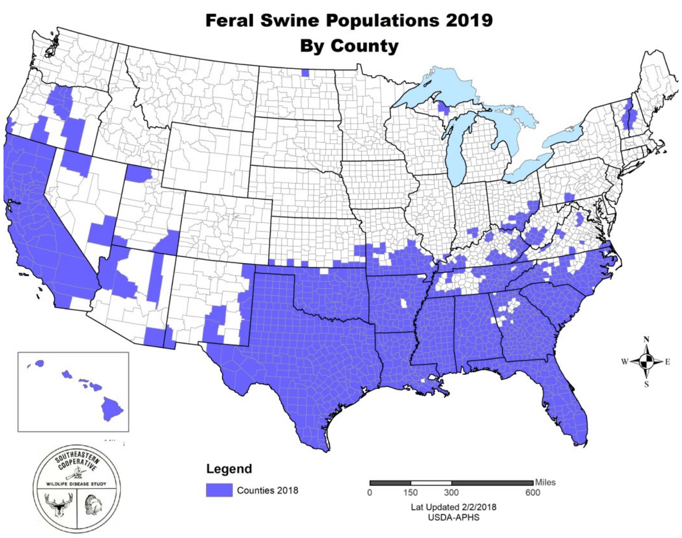

Figure 2. Feral swine populations by county in the United States, 2019.

risks have increased substantially across the United States, requiring extensive management efforts to mitigate their destructive impacts.

Agriculture and Livestock

Feral swine cause substantial damage to agricultural resources, primarily through the consumption and trampling of crops (Figure 3). Corn, peanuts, grapes, wheat, soybeans, rice, sorghum, and a considerable list of additional crops are all damaged by feral swine. Type of crop, proximity of crop fields to forest edges, and crop growth stage all influence the severity of feral swine damage. Substantial economic losses occur each year, sometimes forcing agricultural producers to plant less-profitable crops that are less desirable to feral swine in order to avoid additional losses due to damage.

Pastures and hay fields are damaged due to rooting by feral swine. This not only results in the loss of forage and costs to repair fields, but also may degrade the nutritional quality of pastures over time as less nutritious invasive plant species colonize disturbed pastures and replace native grass species.

Feral swine also damage fences, irrigation ditches, livestock feeders, and irrigation lines. Additionally, rubbing, tusking, and depredation of tree seedlings by feral swine negatively impacts the timber industry.

Disease transmission is the primary threat feral swine pose to livestock. Historically, the domestic livestock industry has implemented extensive efforts to eradicate many diseases that threaten livestock. However, feral swine are reservoirs for these diseases, including pseudorabies, swine brucellosis, and at least 30 other diseases that may be transmitted to livestock indirectly (e.g., feral swine accessing stored feed that is then fed to livestock) or through direct contact (Figure 4). Disease outbreaks spread by feral swine can be difficult and costly to manage and constitutes a significant economic risk. While foreign animal diseases, such as foot-and-mouth disease and African swine fever, are currently absent in the United States, there is a growing concern that feral swine could spread these diseases, resulting in potentially devastating impacts to the livestock industry.

Archaeological and Historical Sites

Damage occurs to archaeological, cultural, and historical sites due to feral swine rooting. Rooting can disturb, expose, and degrade the presence of artifacts and reduces the aesthetic value of these sites.

Figure 3. Feral swine damage to corn.

Figure 4. Feral swine are reservoirs for disease that may be transmitted to livestock.

Ecological

The magnitude of ecological damage attributed to feral swine is extensive. One of the most pervasive forms of ecological damage occurs as a result of feral swine rooting and wallowing (Figure 5). Although rooting and wallowing damage may vary annually and spatially, these behaviors affect a wide range of plant and animal species, including numerous threatened and endangered species (e.g., lesser prairie chicken (*Tympanuchus pallidicinctus*), Houston toad (*Bufo houstonensis*), Hawaiian moorhen (*Gallinula chloropus sanvicensis*)), by negatively altering the composition of ecosystems. For example, after rooting, habitats once composed of a diversity of beneficial native plant species are often colonized by invasive plant species that out-compete native species and provide little to no benefit to wildlife. Seed dispersal of invasive plants by feral swine further facilitates the spread of invasive species. Natural regeneration of coniferous and deciduous tree species in woodland ecosystems is often inhibited as well due to feral swine rooting and consumption of hard mast (e.g., acorns). Negative soil impacts, such as soil compaction and disruptions in nutrient cycling and soil chemistry may also occur.

Rooting and wallowing near watersheds and sensitive aquatic systems can negatively impact water quality due to erosion and sedimentation, algal blooms, oxygen depletion, and pathogen dispersal. Additionally, damage to marsh and wetland habitat negatively alters flood control, water filtration, and surge protection.

Feral swine compete for a variety of food resources with native wildlife species (e.g., wild turkey (*Melagris* spp.), raccoons (*Procyon lotor*), black bear (*Ursus americanus*)). In particular, hard mast is an important food source for feral swine, but numerous wildlife species, including white-tailed deer (*Odocoileus virginianus*) and squirrels (*Sciurus* spp.), depend on this resource as well.

Although feral swine primarily consume plant matter, they also present a risk to numerous wildlife species through direct or opportunistic predation. Wildlife at risk includes ground-nesting birds and their eggs, invertebrate species, small ground-dwelling mammals, reptiles, and amphibians. Threatened and endangered species are also at risk to feral swine predation, including green sea turtle (*Chelonia mydas*) eggs.

Human Health and Safety

Feral swine carry many diseases and parasites that can be spread to people. Hunters or anyone who may come in contact with carcasses or eat feral swine meat are particularly susceptible. In several states, hunters have contracted brucellosis or trichinosis after butchering feral swine without gloves or eating undercooked meat, respectively. Therefore, it is highly advised that anyone butchering or handling feral swine meat use appropriate personal protective equipment (e.g., latex gloves) and cook meat to a safe internal temperature of 170° Fahrenheit. Trichinosis symptoms include abdominal pain, diarrhea, muscle pain, fever, and fluid accumulation and the severity will depend on the number of larvae ingested. Flu-like symptoms, headaches, fever, weakness, and muscle soreness are commonly associated with brucellosis and may be chronic.

Human food and water contamination is also a risk and concern. Feral swine were a potential cause to a nationwide *E. coli* outbreak in 2006 due to contaminated spinach from California that resulted in 205 illnesses and 3 deaths. Positive samples for *E. coli* were obtained


Figure 5. Feral swine cause ecological damage from their rooting *(left)* and wallowing *(right).*

from feral swine in the immediate area surrounding the contaminated spinach fields.

Feral swine-vehicle collisions are becoming an issue, especially in highly populated areas, resulting in physical injuries, potential fatalities, and significant damage to vehicles (Figure 6).

Increasing populations of feral swine in developed areas also increases the risk of attacks on people and domestic pets. Although rare, attacks do occur and can cause serious puncture wounds and lacerations. Most attacks occur when feral swine are threatened or cornered, but may also occur when unprovoked. In some cases, feral swine attacks have killed people.

Urban/Suburban

Damage to urban and suburban areas has been increasing as feral swine continue to expand their range and are attracted to anthropogenic resources available in these areas. Rooting damage in residential yards, cemeteries, golf courses, parks, sports fields, and levees is common (Figure 7). Destruction of ornamental landscaping, fences, and irrigation systems also occurs. Feral swine can compromise the integrity of power poles through extensive rubbing.

Damage Identification

Feral swine are often nocturnal, especially in areas where they are heavily pressured, so relying on direct observations may not be a good indicator of their presence. However, the appearance of feral swine tracks and sign (e.g., wallows, tree rubs, beds, scat; see Tracks and Sign section) will indicate they are in the area, translating to probable damage.

Figure 6. Feral swine-vehicle collisions are increasing.

Figure 7. Rooting damage to lawns, golf courses, and cemeteries is common.

Rooting is one of the most common and easily distinguishable signs of feral swine damage and is characterized by excavated or upturned soil. Depth and extent of rooting varies from shallow to extensive disturbances up to 3 feet (ft) (0.9 meter (m)) in depth. Rooting occurs in a variety of habitats, including grasslands, forests, marshes, wetlands, pastures, and agricultural fields. However, intensity varies seasonally and among different habitat types, often based on food availability.

The timing of crop damage varies based on individual crops and different growth stages, reflective of varying nutritional values during different stages. Recently planted crop fields are commonly damaged as feral swine will root straight lines and consume seeds along each crop row (Figure 8). Rooting, trampling, and direct consumption are all indicators of feral swine damage during the vegetative and fruiting stages, but sometimes may be confused with deer damage. Damage is typically concentrated along field edges, but may be more widespread in smaller fields where the proximity of escape cover is closer. Feral swine may use crop fields for cover, which can also cause extensive damage. Damage to tree seedlings in forest plantations is indicated by masticated root clumps that feral swine have chewed on, consumed sap and starches, and then spit out.

Although feral swine depredation on livestock may be confused with other types of predator depredation, signs include consumption of the rumen or stomach contents, a skinned carcass, and crushed skull or neck.

Management Methods

Management of feral swine is often confounded by numerous ecological, social, and economic factors which must be taken into consideration when determining optimal management plans. Further, given the adaptability of feral swine and the ability to reproduce rapidly, the use of a single control method is rarely advised. Multiple control techniques used in an adaptive, integrative management framework that incorporates region specific biological and ecological factors (e.g., seasonal availability of food resources, predominant habitat types, timing of feral swine birth pulses) and various stakeholder perspectives is highly recommended. Management objectives should also be considered before determining specific management actions and if those objectives are feasible. For example, eradication may be the goal, but is often very difficult and cost-prohibitive in areas where feral swine populations are high. Thus, population reduction to mitigate damage to a tolerable level may be more achievable.

Figure 8. Recently planted crop fields are commonly damaged as feral swine will root straight lines and consume seeds along each crop row.

Numerous lethal and nonlethal control techniques are utilized to control feral swine and mitigate their damage. While lethal control techniques are often most effective, nonlethal control may also be used effectively, especially when used in conjunction with lethal techniques. The use of lethal techniques may also be restricted in certain areas, such as urban and suburban environments, requiring nonlethal techniques to reduce damage.

Repeated and intensive removals of feral swine may be needed to keep populations low because populations rebound quickly following drastic declines. Therefore, annual removal of a substantial percentage of feral swine may be required to keep a population from increasing, especially in highly productive areas.

The following feral swine management methods are listed in alphabetical order.

Education

Ensuring landowners and other stakeholders responsible for feral swine management on private lands are aware of the most current and effective control options and how to properly implement those techniques is very important to maximize management efforts. Numerous informational outlets from state and federal agencies, university extension cooperatives, and other organizations are available in the form of workshops, outreach events, educational materials, websites, YouTube channels, and field events.

Public education is vital for future management efforts (Figure 9). All too often, false or inaccurate information is obtained from non-scientific sources including the internet and word of mouth. Informing the public and policy makers with science-based information regarding the destructive impacts of feral swine is crucial to gaining public and political support for management efforts. Raising public awareness of the risks associated with human-mediated movements of feral swine is also extremely important. Management efforts are largely ineffective and wasted in areas where control is negated by continued human-mediated movement of feral swine into the area. Additionally, agencies tasked with controlling feral swine must stretch their resources to control new populations of feral swine established by people, in addition to already established populations.

Figure 9. The National Feral Swine Damage Management Program and its local, state, and federal partners provide a variety of information on feral swine ecology and damage management to the public.

Fencing

Temporary fencing can provide a short-term solution to mitigate feral swine damage to resources, including agricultural crops and sensitive ecological areas. For example, a 2-strand, polywire electric fence at 8 and 18 inches (in) (20 and 46 centimeters (cm)) from the ground has been shown to temporarily protect agricultural resources and provide a relatively inexpensive fencing option. Hog panel fencing 5 ft x 16 ft (1.5 m x 4.8 m) may also be used to protect specific areas from damage (Figure 10). Permanent fencing options may provide long-term solutions for keeping feral swine out of high-value crops, airports, or other areas where the expense is warranted. Cost, effort to install, and longevity of fencing varies by fence type, and its effectiveness often depends on the motivational level of feral swine to access the resources being protected.

Fertility Control

Although interest in the use of contraceptives as a humane, nonlethal control technique for feral swine has increased, none have been registered for use in the United

Figure 10. Hog panel fencing.

Figure 11. A feral swine is captured and fitted with a GPS collar to serve as a "Judas pig", leading managers to other groups of feral swine.

States. Ideally, contraceptives need to render a considerable proportion of a feral swine population permanently infertile following a single dose. Research has shown that gonadotropin-releasing hormone (GnRH) injections could provide an effective fertility control agent, but alternative forms of administration (e.g., orally) need to be developed for applicability in large-scale operations. Additional forms of contraceptives are also being developed, but additional research is required. Similar to toxicants, feral swine-specific delivery methods also need to be developed for contraceptives in order to reduce the risk of exposure to non-target species.

Frightening Devices

Frightening devices may provide short-term relief from feral swine damage, however, limited efficacy and applicability have been reported. Variations of blinking or bright lights and loud, piercing noises have been tested with limited success. Similar to repellents, feral swine eventually become habituated to these devices, rendering them an ineffective long-term solution.

"Judas Pigs"

The "Judas pig" strategy helps to inform feral swine removal efforts by identifying areas where pigs may be present. It involves equipping individual feral swine with a global positioning system (GPS) or very high frequency (VHF) device (Figure 11). Their locations are then monitored to determine where additional feral swine may be present based on the assumption that the Judas pigs will seek out and gather with other groups of pigs. Research is needed to determine the best sex or age class for Judas pig candidates.

Monitoring

Monitoring is an essential part of evaluating the efficacy and success of any management program. Metrics that demonstrate the success of a program, such as the proportion of a population removed or the amount of damage prevented, are more informative than solely reporting the total number of feral swine removed. If eradication or significant population reduction is the goal, management efforts will ultimately be ineffective if, for instance, 100 feral swine are removed, but those 100 feral swine only represented 25% of the total population. Trail cameras are commonly used to monitor feral swine populations and damage assessments are conducted before and after removal efforts. Researchers are working to develop quick and easy methods to quantify these metrics.

Once established, feral swine populations can be extremely difficult to control. Therefore, monitoring and early detection are often the focus in areas where feral swine are currently absent or have recently been eradicated. This is followed by a rapid management response when feral swine are detected to prevent future populations from becoming established.

Environmental DNA (also known as eDNA) refers to DNA that is shed by an organism into the environment (e.g., water, soil, air). The genetic material could come from shed skin or hair, mucous, urine, or feces. Geneticists have developed a method for detecting feral swine eDNA in water sources. This method has been deployed operationally in several states, including New Mexico, to help locate feral swine, and may be particularly useful in large, remote areas where surveillance is difficult.

Figure 12. Aerial shooting of feral swine is commonly done in open landscapes.

Recreational Hunting

While recreational hunting for feral swine is popular in many states, it is generally not considered an effective management option. Significant population reductions typically do not occur and feral swine behaviors or movements may be altered such that they impede other removal operations (e.g., trapping). Hunters usually target large males instead of females, which has little impact on overall population reduction. Additionally, recreational hunting creates incentives to maintain feral swine on the landscape and move feral swine to new areas for increased hunting opportunities, which has largely been attributed to the expansion of feral swine across the United States. Although controversial, several states have outlawed hunting in attempts to better manage feral swine populations. Research has shown that feral swine removal via hunting is often negated by the use of bait to attract feral swine. The supplemental food source increases fecundity and population growth despite hunter harvest.

<u>Hunting with Dogs</u>

Hunting with dogs can be effective in certain circumstances, particularly in areas where feral swine densities are low or when trying to remove the last few remaining individuals of a population. However, it is best used in conjunction with additional management tools for large-scale removal efforts. This practice is also dangerous and of questionable ethics, given the frequently sustained injuries to dogs and feral swine prior to death. Dog owners should also be aware that their dogs are at high risk of exposure to pseudorabies if used to hunt feral swine in the United States.

Repellents

Considering the powerful olfactory senses of feral swine, repellents could be an effective nonlethal damage management tool, but have yet to be developed for operational use. Most repellents are only effective for a short amount of time as animals become habituated to them.

Shooting

Aerial shooting is a common management tool that is most effective in open landscapes where feral swine densities are high (Figure 12). Helicopters are the most frequent type of aircraft used. As feral swine population densities decrease, the costs and efforts associated with aerial shooting increase. Therefore, additional removal methods as part of an integrated management program are advised when eradication or a significant population reduction is the goal.

Advancements in technology have increased the effectiveness and affordability of thermal and night vision scopes for shooting feral swine at night from the ground or elevated platforms and may be particularly useful in areas where feral swine are primarily active at night. However, little research has been done to evaluate its efficacy for large-scale removal efforts. Night shooting is legal in many states, but check local and state regulations to ensure compliance. In addition to removing some feral swine, night shooting has the added benefit of hazing nearby swine to keep them from damaging crops at night.

Snares

Snares can be an effective lethal option under certain circumstances (Figure 13). Portability is a major advantage to using snares, particularly in inaccessible areas where corral or box traps are not feasible. Snares can also be advantageous when targeting particular individuals (e.g., feral swine accessing crop fields through a fence) or trap-shy individuals, but are less effective for large-scale removal operations. Neck snares are most common and can be set under fences, on mud rub posts or trees, or along trails. Snaring regulations vary by state and must be followed accordingly.

Toxicants

An anticoagulant-based toxicant containing warfarin, known as Kaput® Feral Hog Bait, is registered by the U.S. Environmental Protection Agency (EPA), but is not yet approved for operational use on feral swine by any state.

HOGGONE®, a sodium nitrite-based toxicant, is currently under research and development in the United States and will likely be submitted to the EPA for registration. Sodium nitrite causes a quick and humane death from methemoglobinemia (inability of blood to transport oxygen to organs and tissues).

Researchers are also working to develop feral swine-specific bait boxes to restrict access to bait by non-target species and ensure the safe deployment of toxicants (Figure 14).

Trapping

Trapping followed by lethal removal is one of the most commonly implemented control techniques. Relocation of trapped feral swine is not recommended as it moves the problem elsewhere, may facilitate the spread of disease, and is illegal in most states. Trapping success varies seasonally and is most effective when natural food resources are limited. The type of trap, trigger, and door, as well as trap placement in high-use areas, and ample pre-baiting also influence trapping success. Corral and box

Figure 13. A snare set for feral swine. Snaring regulations vary by state and must be followed accordingly.

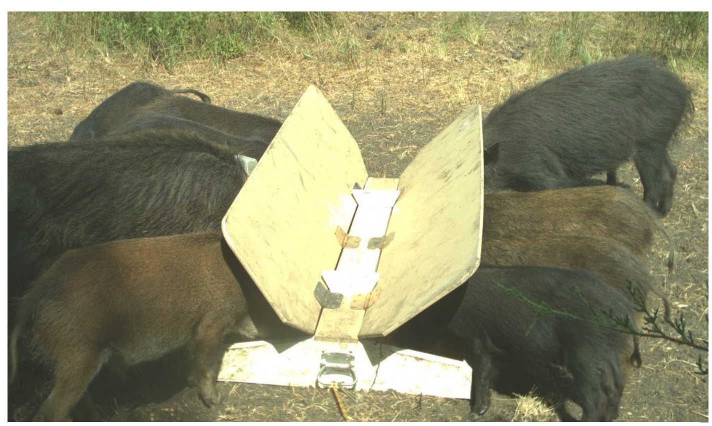

Figure 14. USDA researchers have designed feral swine-specific bait stations. The bait station's lids take advantage of swine rooting behavior. Feral swine can lift the heavy, magnetized lids, but many non-target species cannot.

Figure 15. Common corral trap *(left)* and box trap *(right).*

traps are the most commonly used trap types (Figure 15). Corral traps are larger than box traps, allowing a greater number of feral swine to be captured at once, and are generally more effective. Box traps are more portable which may be beneficial in more inaccessible areas.

Corral Traps

Corral traps are typically constructed with 5 to 6.5 ft (1.5 to 2 m) high galvanized wire livestock panels or custom built trap panels that fit together securely (Figure 15). Trap panel wire spacing varies and each type has pros and cons. Panels with 4 in x 4 in (10 cm x 10 cm) wire spacing are lighter and less expensive, but allow piglets to escape. Comparatively, panels with 2 in x 4 in (5 cm X 10 cm) wire spacing prevent piglets from escaping, but are substantially heavier and more expensive. A lighter option that still retains piglets includes panels with graduated spacing, where spacing is smaller towards the bottom and increases in size towards the top. A 4- or 5-panel corral trap is generally recommended, as trap-wary feral swine might be hesitant to enter a trap any smaller. Corral traps are most commonly constructed in a circular design with panels secured to T-posts around the perimeter of the trap.

Box Traps

Box trap designs vary but are often 4 ft x 4 ft x 8 ft (1.2 m x 1.2 m x 2.4 m) and consist of a welded angle iron frame with a door on one side and wire panels covering the top, bottom, and sides (Figure 15). Commercially manufactured box traps are available. If the floor of a box trap has wire paneling, cover it with dirt to reduce trap shyness by feral swine.

Drop Traps

Drop traps consist of a corral trap suspended approximately 3 to 4 ft (0.9 to 1.2 m) off of the ground. It drops when triggered, eliminating the need for a gate (Figure 16). This trap style may increase capture success when feral swine are reluctant to enter a trap through a gate.

Trap Gates

There are a variety of designs to choose from, but trap gates are generally grouped into 3 categories: guillotine, rooter, and saloon (Figure 17). Guillotine gates drop straight down from above when activated. Rooter gates are a “continuous-catch” gate commonly constructed from steel tubing that is hinged at the top and set to close from above. They are similar to guillotine gates, but are angled towards the inside of the trap. This allows additional feral swine to root under the gate and enter the trap once the gate has been closed. Saloon gates are typically spring-loaded and hinged on the sides in order to swing closed when triggered. Wider gate doors (i.e., 5 to 8 ft (1.5 to

Figure 16. Drop trap.

2.4 m)) may increase capture success compared to smaller gate openings.

Trap Triggers

An array of different trigger types and designs exist, but triggers can generally be grouped into either manual (i.e., triggered by feral swine) or human-activated triggers. Manual triggers are usually less expensive, but human-activated triggers prevent the capture of non-target species and allow for the desired number of feral swine to enter a trap before closing the gate.

A trip wire and root stick are the two most common manual trigger types. The trip wire is set horizontally across the back of a trap approximately 16 to 20 in (41 to 51 cm) above the ground and strung to a gate retention mechanism attached to the trap door (e.g., prop stick, pin). Bait is set behind the trip wire so feral swine must apply pressure to the trip wire in order to release the retention mechanism. Alternatively, a root stick is anchored horizontally by 1 or 2 set stakes secured into the ground to hold up the trap gate and surrounded by bait (Figure 18). The trap is then triggered when feral swine feed at the bait pile and inadvertently dislodge the root stick, which closes the trap.

Human-activated triggers may be as simple as a pull string attached to a gate with a person waiting in a nearby blind. More advanced systems allow for remote monitoring and activation from a cell phone or computer. There are several remote controlled systems on the market that provide excellent options to increase trapping efficiency and success (Figure 19). However, cost may be prohibitive, as these systems range from $2,000-5,000/system and require a monthly cellular service plan. Additionally, functionality of these systems may be limited in areas with poor cellular service.

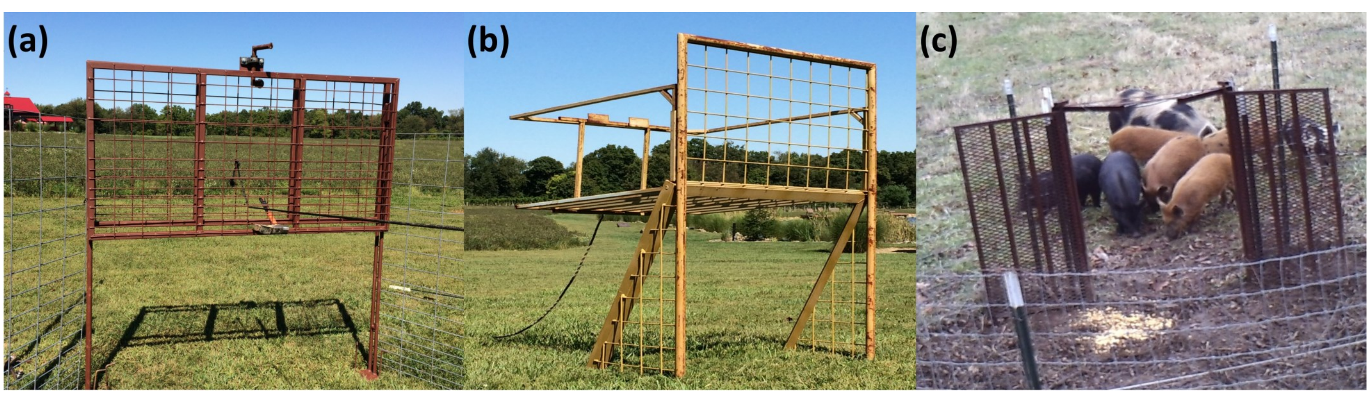

Figure 17. Trap gates designs include a) guillotine, b) rooter, and c) saloon.

Figure 18. Root stick trigger design.

Figure 19. Remote controlled trap trigger.

<u>Bait</u>

An expansive list of bait has been used to trap feral swine, including various grains, peanuts, fish, and commercial livestock feed. However, dry or fermented whole-kernel corn is used most commonly. Olfactory attractants, such as strawberry jello or commercial scent products, may also be used. Bait attractiveness may vary by season and/or region. Feral swine-specific baits that reduce non-target consumption have not been identified. Always be sure to follow state baiting regulations, as restrictions in some states may occur.

Economics

Given their destructive nature, economic impacts of feral swine damage in the United States are extensive, but quantifying these impacts on a national scale can be difficult. A commonly reported and likely conservative annual estimate of damage and cost of feral swine control is $1.5 billion, based on an estimated 5 million feral swine in the United States that cause $300 of damage per individual.

Agricultural damage alone is substantial. Damage estimates of approximately $390 per individual have been reported in areas with extensive agriculture. Feral swine damage to crops is estimated at $30 million annually in Alabama. Corn, wheat, rice, soybeans, sorghum, and peanut damage in 11 states including Florida, Mississippi, and Texas was estimated at $190 million per year. Damage to pastureland from feral swine rooting is also prevalent, with estimates at $9.9 million in hay loss and $2.5 million in repairs to pastureland in Louisiana. Additionally, timber loss due to feral swine damage in Tennessee and Louisiana is estimated to be $1.5 million per year.

Disease transmission from feral swine to domestic livestock represents a potential threat that could lead to significant economic impacts, particularly from the spread of foreign animal diseases (e.g., African swine fever, classical swine fever, foot-and-mouth disease). Estimates suggest a foot-and-mouth disease outbreak in the United States would cost from $13.6 to $20.8 billion in the first year alone. Losses over a 5-year period may reach $2.6 to $4.1 billion if a classical swine fever outbreak were to occur. Additional livestock-related economic impacts, such as predation, have not been estimated.

Although financial losses due to feral swine damage are substantial, feral swine also provide some economic benefits. Feral swine hunting generates approximately $1.2 million annually for California, where feral swine are considered a game animal. Additionally, feral swine are sold to meat markets in Louisiana, Florida, and Texas to be used in restaurants or pet food for upwards of $0.40 per pound (lb) ($0.88/kilogram (kg)). Landowners generate income by charging hunting fees for feral swine on their land and there is a well-established commercial trapping industry for feral swine. However, these examples often complicate management by providing incentives to maintain feral swine on the landscape and rarely outweigh the negative impacts.

Species Overview

Identification

A single species, *Sus scrofa*, constitutes all feral swine currently found in North America. Domestic pigs and Eurasian wild boar are considered the same species because the Eurasian wild boar is the ancestor to all domestic breeds. The species is classified by three main types: 1) domestic pigs that became feral, 2) Eurasian wild boar, and 3) hybridization between feral domestic pigs and wild boar. However, most feral swine populations in the United States are characterized by varying degrees of hybridization between feral domestic pigs and wild boar. As a result, characteristics often vary regionally or locally, depending on the ancestral origins of the feral swine.

Physical Description

Feral swine have a stout, barrel-shaped body, short legs, short and stocky neck, and long, pointed head. They have small eyes and large ears that are pointed at the tip. Their tail is short, generally covered in hair, and may be straight or curled. Keratinized hooves cover 4 toes on each foot, with 2 lateral toes, or dew claws, located higher on each leg. The density of coat hair varies, but is typically coarse and bristled. Coat coloration is highly variable, from different shades of black, white, or red-brown in a solid, spotted, mottled, or grizzled pattern (Figure 20). Grizzled patterns are characterized by light brown to black hair with white or tan tips and are mainly expressed in feral swine with predominantly wild boar ancestry. Piglets are often characterized by a striped pattern for the first 4 to 6 months after birth (Figure 21). While body mass may be highly variable among feral swine populations, averages typically range between 150 to 220 lbs (70 to 100 kg), and rarely exceed 550 lbs (250 kg).

Several characteristics can be used to distinguish males from females. Males tend to be 1.2 to 1.4 times larger than females. They also have a thick tissue layer under the skin surrounding the lateral portion of their shoulders for protection while fighting for breeding opportunities. This is commonly known as a “shield” and increases in size with maturity. Permanent canines in males are also significantly larger and the upper canines grow upward. The upper canines of females grow downward.

Range

Feral swine were originally introduced and relatively confined to coastal regions of the southeastern United States and California beginning in the early 1500s, but the range of feral swine has increased substantially over the last several decades across all major geographical regions of the United States (Figure 2). Recently reported in up to 48 states, feral swine have since been eradicated or thought to be removed from 11 states (Colorado, Idaho, Illinois, Iowa, New Jersey, New York, Maine, Maryland, Minnesota, Washington

Figure 20. Feral swine coat coloration varies.

Figure 21. Striped piglets.

and Wisconsin). However, continued control and management is crucial to prevent further spread of feral swine. Recent research has predicted that without intensive control feral swine have the potential to become established across much of the United States in the next 3 to 5 decades (Figure 22). Currently, feral swine are sporadically dispersed in relatively low numbers across much of the western, northeastern, and north-central United States, but are found in high concentrations across the majority of the southeastern region, California, Texas, and Oklahoma.

Voice and Sounds

Feral swine use a variety of vocalizations, including contact, nursing, and feeding grunts, squeals, growls, and teeth clacking. Females and piglets tend to be more vocal than males. Numerous scent glands (e.g., metacarpal, preputial, tusk, preorbital) are also used for communication, generally during reproductive activities.

Tracks and Sign

Numerous signs can be used to determine the presence of feral swine in an area, including rooting, wallows, rubs, tusking, beds, and farrowing nests.

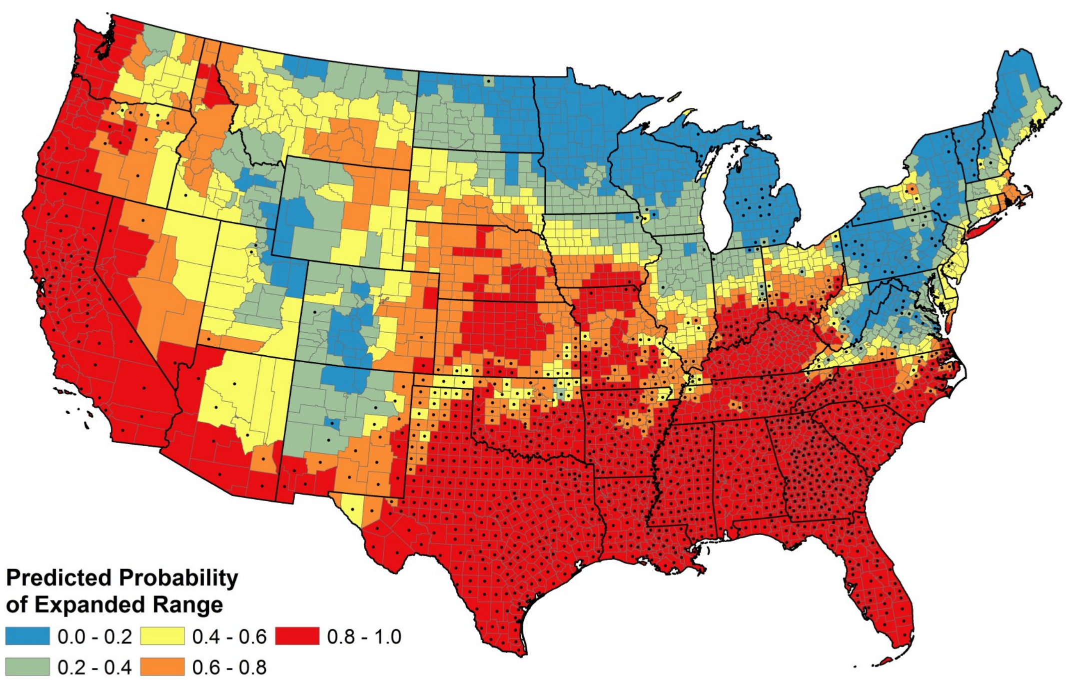

Figure 22. Models predict that the range of feral swine in the United States would expand dramatically over the next 30 to 50 years without intensive management and control. Counties in red represent areas that have been or are highly susceptible to feral swine invasion. Counties in blue represent areas that are least susceptible to invasion. Black points indicate the 2012 range of feral swine.

Feral swine tracks are commonly confused with other ungulate species, primarily white-tailed deer. However, feral swine tracks tend to have more rounded or blunt tips with an overall squared or rounded shape, and tracks are often found in conjunction with other sign (Figure 23a).

Feral swine scat is primarily in the form of segmented clumps that are irregularly shaped (Figure 23b). Appearance and size will depend on the diet and size of the animal, respectively.

Rooting is a foraging method used by feral swine to excavate subterranean food. While rooting is most common in winter and spring, it occurs on a year-round basis in a variety of habitats, often based on food availability.

Wallows may be natural mud depressions or are created via rooting. They are often filled with water and are typically found in wet areas that feral swine use for thermoregulation, especially in the summer (Figure 5). Feral swine wallow to reduce their body temperature because they lack sweat glands. It also helps to protect them against ectoparasites, such as ticks and fleas. Muddy vegetation and rubs are common in areas surrounding wallows. Feral swine rub excess mud, hair, and ectoparasites on trees, fence posts, logs, utility poles, or creosote-soaked poles (Figure 23c).

Tusking occurs when feral swine cut a tree with their tusks to release the tree's sap. Feral swine rub themselves in the sap in order to protect themselves from ectoparasites.

Beds and farrowing (birthing) nests are typically found in dense vegetation or cover and often appear similar, but farrowing nests are generally larger and lined with leaves, vegetation, or grass (Figure 24). During the winter in northern regions of the United States, feral swine build nests with vegetation, such as cattails (*Typha* spp.), in wetlands often referred to as "pigloos."

Figure 23. In addition to rooting and wallowing sites, common feral swine sign include a) tracks, b) scat, and c) rubbings on trees or fence posts.

Reproduction

Feral swine are extremely prolific breeders with a high reproductive potential, capable of breeding as early as 6 to 12 months of age. They can breed and farrow year round because they are polyestrous. However, seasonal peaks have been reported in the spring and fall, when forage resources are typically more abundant. Availability of hard mast and other quality forage significantly influences feral swine reproductive success.

Figure 24. Feral swine nest made of grass.

The average litter size is approximately 5 piglets, and ranges from 1 to 12 piglets. Average gestation length is 112 to 120 days. Multiple litters per year are possible, with reports of sows breeding within 1 month of farrowing, but this is often limited based on resource availability. Sows build a farrowing nest shortly before giving birth and piglets stay in or near the nest for approximately 3 weeks after birth.

Mortality

Few studies have been conducted in the United States to quantify the specific causes of feral swine mortality. Anthropogenic mortality, including recreational hunting and population management efforts, is likely the most significant source of mortality, Although increased mortality for feral swine less than 1 year of age has been observed in other parts of their invasive range, this has not been consistently observed in the United States. Natural mortality may be caused by diseases, parasites, accidents (e.g., piglets crushed in a farrowing nest or trampled by adults), starvation, or predation. Predation is a small percentage of overall feral swine mortality. Common predators include coyotes, bobcat (*Lynx rufus*), black bear (*Ursus americanus*), and mountain lions (*Puma concolor*), but predation on adult feral swine is predominately restricted to black bears and mountain lions. Feral swine often live up to 8 years, but rarely past 10 years.

Habitat

Feral swine are an adaptable species, capable of surviving nearly anywhere across the United States. Habitat selection is based upon locally available habitat types and varies seasonally, but is primarily driven by the need for ample food, water, and cover. Feral swine have a particular inclination towards water, especially in arid regions, and habitat types that readily accommodate this resource (e.g., wetlands, swamps, riparian areas, marshes) are used extensively.

Feral swine in the southeastern United States commonly inhabit bottomland hardwoods, drainage corridors, marshes, sloughs, forested swamps, and mesic hardwood forests. In the south-central United States, feral swine prefer riparian and upland areas with an abundance of water, mast, agriculture, or other resources. Comparatively, mixed forest-agriculture, scrub-shrub wetlands, cattail marshes, and spruce (*Picea* spp.) and fir (*Abies* spp.) forests are preferred habitats of feral swine in the northeastern United States. In western states, oak woodlands and grasslands, chaparral scrublands, and northern coastal sage are preferred.

Behavior

Feral swine are social animals, usually found in matrilineal (based on kinship with the mother) groups known as sounders. A typical sounder consists of one or several sows and their young, with group sizes ranging from 2 to 30, sometimes more, often fluctuating in size and composition. Juvenile males will travel in bachelor groups, whereas adult males are primarily solitary except when with sounders for breeding purposes. Limited research suggests territoriality among sounders may exist, which may be particularly evident in areas with a high density of feral swine and low abundance of resources.

Both diurnal and nocturnal activity is common, but feral swine subject to repeated control efforts or recreational hunting are usually more nocturnal. Seasonal variations in temperature also cause shifts in daily activity (i.e., increased nocturnal activity during the summer and diurnal activity in the winter), likely as a way to regulate body temperature. Feral swine may also increase activity during the day in areas with thick vegetation.

Feral swine primarily restrict daily movements to relatively short distances. The average hourly distance moved is approximately 0.2 to 0.3 miles (0.35 to 0.42 kilometers (km)) with a maximum of 0.5 to 1.3 miles (0.8 to 2.1 km). However, large-scale movements do occur (e.g., when adult males are searching for breeding opportunities or in areas where food or water resources are limited). Relatively unpressured feral swine (i.e., those exposed to minimal control efforts or recreational hunting) can usually be tracked as they consistently use the same trails and bedding areas. Feral swine movement in response to management pressure varies. For example, feral swine have been reported to increase their space-use and movements following repeated management operations. They may also disperse outside of their home range during aerial gunning operations, but often return to normal movement patterns shortly thereafter.

There is considerable variation in feral swine home range size which is influenced by numerous factors, such as resource abundance, feral swine density, habitat type, season, climate, sex, and age. The average home range size is approximately 4.8 $miles^2$ (12.4 km^2), but has been reported to exceed 19.3 $miles^2$ (50 km^2). Male home range size may be up to 2 $miles^2$ (5 km^2) larger than female home range size.

Food Habits

Feral swine are opportunistic omnivores but primarily feed on plant matter. Leaves, stems, fruits, and seeds are selectively eaten relative to plant phenology and nutritional quality. Specific diets vary regionally and seasonally, based upon available resources. Rooting is a common foraging method used by feral swine to access subterranean food resources (e.g., roots, bulbs). Hard mast (primarily acorns) are an important seasonal food source. Feral swine readily consume an extensive list of agricultural crops, including corn, wheat, soybeans, peanuts, rice, potatoes, pumpkins, grapes, pecans, and berries, that varies by region (Figure 25).

Feral swine eat animal matter as well, but usually to a much lesser extent. Consumption of animal matter is typically opportunistic, but intentional predation may also occur. Common animal matter includes earthworms, insects, crustaceans, small mammals, amphibians, reptiles, and birds. Predation of white-tailed deer fawns and young domestic livestock has been reported, but most large mammal consumption is in the form of carrion.

Figure 25. Aerial view of feral swine damage to a corn field in Texas.

Legal Status

There is a complex legal and political network surrounding the issue of feral swine in the United States. As such, laws and policies vary from state to state. Feral swine are generally classified as an invasive species, nuisance animal, or similar variation in most states. Feral swine are listed as a game animal in California, Alabama, West Virginia, Ohio, and Hawaii, which has created a socio-economic challenge for management and provides an incentive to sustain populations of feral swine within those states. Numerous states have outlawed feral swine transportation, but transportation following varying guidelines is still permitted in many other states (e.g., Alaska, Florida, Georgia, Mississippi, North Carolina, Oklahoma, Texas), despite the fact that the human-mediated movement of feral swine has been a primary factor in their expansion.

Although high-fenced shooting operations for feral swine are becoming more restrictive, they are still permitted in several states, including Texas, Pennsylvania, and Iowa. Furthermore, feral swine meat markets are legal in Florida, Texas, and Louisiana. A full spectrum of hunting regulations also exist depending on the state. For example, there are no seasons, and night shooting with night vision or thermal equipment is permitted in Texas. Conversely, public hunting has been banned in several states (e.g., Kansas, New York, North Dakota, South Dakota) or restricted to incidental take during seasons for other game species as a management strategy to de-incentivize the establishment of feral swine populations for hunting. Increased efforts to inform state and federal policy makers about the risks associated with feral swine ensures science-based laws and regulations are enacted to aid in the reduction of feral swine populations and associated damage.

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Figure 1, 3-25. Photos and map by USDA-APHIS-Wildlife Services
Figure 2. Map by the Southeastern Cooperative Wildlife Disease Study Program

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Glossary

Aerial Shooting: A lethal removal method where a professional marksman shoots feral swine from a helicopter or fixed-wing airplane.

Boar: A male feral swine.

Corral Trap: A type of trap used to catch feral swine that is typically circular in shape and large enough to capture numerous individuals at once.

Farrowing: The act of giving birth to feral swine piglets.

Omnivore: An animal that eats both animals and plants.

Piglet: A feral swine less than 6 months old.

Polyestrous: An animal that has multiple estrous cycles per year.

Sounder: A group of feral swine typically consisting of one or several related sows and their offspring.

Sow: A female feral swine.

Keywords

Agricultural damage, Damage management, Disease, Eurasian wild boar, Feral swine, Rooting, Monitoring, Sounder, Aerial shooting, *Sus scrofa*, Toxicants, Trapping, Wallow, Wild Pig, Wildlife Damage Management

Disclaimer

Wildlife can threaten the health and safety of you and others in the area. Use of damage prevention and control methods also may pose risks to humans, pets, livestock, other non-target animals, and the environment. Be aware of the risks and take steps to reduce or eliminate those risks.

Some methods mentioned in this document may not be legal, permitted, or appropriate in your area. Read and follow all pesticide label recommendations and local requirements. Check with personnel from your state wildlife agency and local officials to determine if methods are acceptable and allowed.

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Appendix

Damage Management Methods for Feral Swine

Type of Control	Available Management Options
Fencing	• 2-strand, polywire electric fence • Galvanized wire mesh fence • Hog panel fence
Fertility Control	None currently available
Frightening Devices	Loud noises and flashing lights have been used with limited success
“Judas Pigs”	Capturing and radio-collaring an individual feral swine, then tracking it as it returns to its sounder or another group of feral swine. The entire group can then be removed using a variety of methods.
Monitoring	• Trail cameras • Environmental DNA
Repellents	None currently available
Shooting	Regulations vary by state • Aerial shooting • Thermal and night vision equipment • Hunting with dogs
Snares	Neck snares placed under fences, on mud rub posts, or trees or along trails.
Toxicants	• Kaput® Feral Hog Bait; Registered for use by EPA, but not approved by states • HOGGONE® sodium nitrite bait; Under development
Trapping	Regulations vary by state • Corral trap • Box trap • Drop trap