

African Swine Fever: Secure Zoo Strategy Plan

Zoo & Aquarium All Hazards Partnership

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Intended Audience of this Document

The scope of this document will include guidance for exhibition facilities that own or care for exotic or domestic species of pigs. This includes but is not limited to AZA accredited zoos, ZAA accredited zoos, non accredited zoos, and privately owned exotic collections. All facilities that fall within the purview of this document hereafter will be referred to as a 'zoo'. We recognize that while most swine species in zoo collections are exotic species, zoos do own or rent domestic pig breeds as well. This may add an additional challenge for a zoo when discussing foreign animal disease (FAD) outbreak management. This document will focus on zoo management of an FAD outbreak but details about the food production industry may be included as it is deemed important for zoos which have direct contact with that industry.

This document is meant to act as guidelines for the staff who develop disease prevention plans, and who work at these facilities in the face of an ASF outbreak in their facility or elsewhere in the US. Most documentation in regards to management plans of an ASF outbreak produced by the federal government focus on swine production facilities. This document is to help translate those plans into ones that are more relevant to those working in zoologic facilities or other exhibition settings. This document is intended to provide guidance, and does not supersede any state or federal regulations for the management of high consequence diseases in animals. However, this document may reference government documents which are considered regulation and backed by federal laws.

This document is written with the intent that all staff at a zoo facility will be able to understand the guidelines presented throughout this document, and determine which considerations apply to their specific facility.

Swine Production facilities vs Zoological facilities

Similarities

- Care for and produce swine species
- Regulated under the Animal Health Protection Act¹
- May play a role in the spread and reservoir of animal diseases
- Movement of animals across both national and international borders is a part of the industry
- Direct and/or Indirect relationships between humans and their animals
- High percentage of animals raised in captivity

Differences

- Working with exotic species, +/- domestic species
- Exotic swine do not enter the food supply
- Zoos have lower swine numbers
- Production facilities produce new animals at a much faster rate than zoo facilities
- Zoos have high foot traffic of public visitors while swine production typically does not
- Zoo animals typically raised outdoors with some indoor access

¹ The Animal Health Protection Act gives the Secretary of Agriculture authority to restrict animal entry into or movement within the U.S. as well authority to remove or destroy animals, related conveyances, or facilities for reasons of disease or pest control. The text of the document can be found at: <https://www.congress.gov>

The similarities and differences between the swine production industry and the zoological industry will shape what is discussed in this document in the context of an outbreak of African Swine Fever (ASF). Due to the focus of foreign animal disease (FAD) response plans on food production industries the zoological industry is frequently forgotten about or left without clear guidance on how to handle an FAD outbreak.

ASF is a disease of particular concern as it has consistently spread around the world. In 2021 swine tested positive for ASF in the Dominican Republic. This was the first point at which ASF was geographically close to the United States. This means that now is the time to ensure proper knowledge of prevention methods and response plans for an ASF outbreak.

Why Does African Swine Fever Matter?

African Swine Fever (ASF) is a viral disease that can have devastating effects on the swine industry of a country. In the U.S. the swine production is a billion dollar industry with the U.S. exporting \$7.7 billion worth of pork products in 2020 according to the USDA. A study conducted in 2020 by Iowa State University estimated that the overall cost of a large ASF outbreak in the U.S. could total \$50 billion (Carriquiry, 2020). The high mortality rate of this disease in combination with the international trade impact is what makes this disease have such a high cost. The disease survives for a long time in the environment and has a high mortality rate in pigs which makes the best management practice to cull entire herds. Many countries will not import any pork products from countries that have positive cases of ASF due to the disease's virility.

Zoos will also be impacted by an outbreak of ASF as both domestic and exotic pig species are susceptible to the disease. The mortality rate can reach 100% in a population of swine which could mean loss of ecologically important animals housed in zoo collections. Zoos in particular need to be aware of any ASF cases near their premises because African species like warthogs, bush pigs, and red river hogs typically do not show clinical signs becoming a carrier for the disease. Warthogs are the major reservoir in Africa for ASF (Brown, 2018). African swine have the potential, albeit low, to be a hidden reservoir for ASF in the U.S. if an outbreak were to occur. **This should be recognised by zoo staff and the animals tested when clinical signs of disease or sudden death of animals to ensure any infected animals are identified. Additionally there is no approved treatment protocol nor is there a vaccine available, so culling positive animals is the primary method to ensure spread of the virus is controlled.**

Managing an outbreak of ASF is extremely difficult and will take the cooperation of both industries. When a positive case of ASF is found, the USDA will implement a Control Area around the location. All movement into and out of the area will be monitored and potentially halted depending on what is being transferred across the border. All movement of living swine or swine carcasses across the control area border will be halted..Movement of feed, bedding and other products into and out of a Control Area will have to be issued a permit by regulatory

authorities. Being informed about prevention and management practices to deal with an ASF outbreak will be critically important for both the production industry and zoological industry to ensure they will be able to operate to the best of their ability within new constraints.

What is African Swine Fever?

ASF is a double stranded DNA virus of the Asfarviridae family. It infects all species within the *Suidae* family. Domestic pigs, feral hogs, and European wild boars are all highly susceptible to the disease with a mortality rate that can reach 100% within a population (Kramer, 2019). African species, warthogs, bushpigs, and red river hogs are susceptible to the virus but can be carriers for the virus rather than showing clinical signs. Warthogs are the major reservoir for the virus in Africa due to being carriers. Peccaries, family *Tayassuidae*, are not susceptible to ASF and pose no risk of spreading the disease (OIE, 2019).

Clinical Signs of ASF include:

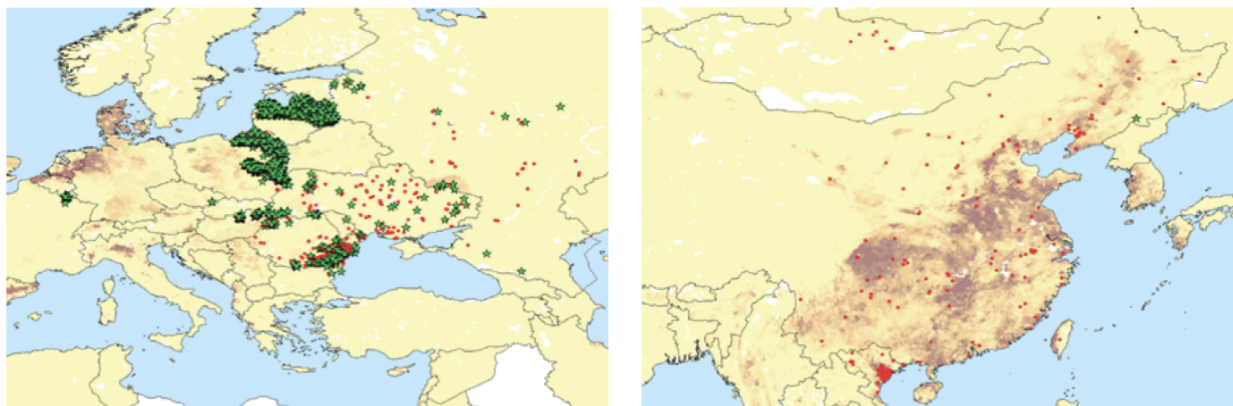
- High fever, up to 104-106 °F
 - May see grouping/piling of pigs due to difficulty of thermoregulation
- Decreased appetite and weakness
- Red, blotchy skin or skin lesions
- Discharge from nose and corner of eyes
 - Discharge may be bloody
- Diarrhea
- Vomiting
- Coughing and difficulty breathing
- Incoordination, paddling
- Blue tipped or necrotic ears
- Abortion
- Death-which may be quite sudden

Where is ASF Found?

ASF is endemic to sub-Saharan Africa but is found in many parts of the world including Asia and Europe (Dixon, 2020). Fortunately, to date (September 2021) there has never been a confirmed case of ASF in the United States. However, in 2021 ASF was found in the Dominican Republic. As ASF continues to spread around the world it has come closer to the U.S. Many U.S. officials feel that it is only a matter of time before we have our first case of ASF in the U.S. We need to be prepared when that day comes.

Below are two maps which show the spatial distribution of reported ASF outbreaks in domestic pigs and wild boar in 2018 and 2019 in Europe and East Asia, over a raster map of pig density. Darker brown means higher pig density; red dots are domestic pigs positive for ASF, and green stars are wild boar positive for ASF. We see that in those regions ASF has

become widespread. Due to the feral hog population in the U.S. officials are concerned that if ASF were to make it into the U.S. it would spread across the country quickly making it difficult to eradicate. Preparations prior to introduction of ASF into the U.S. will be key in making our efforts to eradicate the disease successful in the event of an outbreak.



The figure was obtained from Dixon et al. "African Swine Fever Epidemiology and Control" Annual Reviews.

Case Definitions

There are three case classifications for swine who may be infected with ASF. It is important that zoo personnel be familiar with them so they will understand what stage the case investigation is at and what the next steps will be. For a more detailed explanation of these case definitions please refer to the ASF Redbook produced by the USDA linked in the footer of this page.²

- **Suspect case** - an animal having clinical signs consistent with ASF or any exposure to ASF through an infected animal, or contaminated material (equipment, feed, manure, etc)
- **Presumptive positive case** - a suspect case with a non-negative screening laboratory test results for ASF. This does not necessarily mean a positive test result; even an inconclusive test result pushes a pig into being a presumptive positive case until proven negative.
 - Typically this is if a pig has been tested positive with an antibody test as this shows exposure to the virus but not technically infection
- **Confirmed positive case** - An animal from which ASF virus has been isolated through laboratory testing for antigen. This test shows the virus is truly inside the pig and not just that they have been exposed.

How African Swine Fever is Transmitted?

ASF has many routes of transmission which may make it a difficult virus to keep out of a herd. Direct contact with infected animals, consumption of contaminated foodstuffs,

² APHIS. (2020). African Swine Fever Response Plan The Redbook. USDA.

https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/emergency-management/CT_FAD_PReP_Disease_Response_Documents

transmission through vectors, and possibly airborne transmission are all potential routes. Direct contact and consumption of contaminated foodstuffs are the primary routes of transmission that is considered when discussing biosecurity efforts. An infected pig will shed the virus in their blood, nasal discharge, saliva, urine, feces, and milk so any contact with an infected pig could lead to transmission. Some studies found that infectious doses of ASF were in the air for 30 days after a pig was infected, suggesting that just being in close proximity to an infected pig could lead to exposure (Carvalho, 2013). Fortunately in practice it does not appear that ASF will travel far distances in the air so airborne transmission between herds is not a concern currently but it is a concern within a herd.

Consumption of the virus is a major concern for species in zoos where contact with infected animals is unlikely. Feed or water that is contaminated with infectious body fluids like blood, urine, or feces could be infectious for 30-60 days. Water maintains infectivity longer than feed. ASF is very stable in the environment and may be resistant to many disinfecting processes used on feed material such as high temperatures, desiccation, chemical disinfectants, curing, and freezing/thawing (Mazur-Panasiuk, 2019). Feed and water sources must be trusted to use proper biosecurity measures to ensure that feed and water given to swine at the zoo is not contaminated with the virus. Contaminated pork products can have a high probability of spreading ASF because the virus survives in improperly cured or uncooked meat for a very long time. Because of this, feeding pork products to swine should always be prohibited. Both uncooked and improperly cured pork products can carry the virus for a year or even longer according to some studies. Shockingly, in a study testing cured pork products it was found that pork belly, loins, and corned meat may not have a long enough curing process to kill the virus even though proper curing standards were followed in their production (Petrini, 2019). The products were still infectious once they made it to the consumer market. This could easily be a way for ASF to sneak past a zoo's biosecurity measures and infect swine on their facility if these materials inadvertently made it into an exhibit.

Soft bodied ticks of the genus *Ornithodoros* are also a potential transmission route for ASF. The tick is a part of the infection cycle of ASF in Africa with the tick acting as a secondary reservoir for the virus. After experimental infection of ticks it is shown the tick be infectious virus 77 - 502 days (Brown, 2018). The large range is thought to be due to differences between the many species of *Ornithodoros* ticks as well as differences in strains of ASF. In the United States there are five species of *Ornithodoros* ticks. Most of them are located in the western and midwestern U.S. with only two species located in the southeastern U.S. Three of these species, *O. coriaceus*, *O. parkeri*, *O. turicata*, have shown capability to be infected with ASF with *O. coriaceus* showing capability to transmit ASF to naive swine. However the tick species of most concern is *O. turicata* due to its distribution throughout Arizona, California, Colorado, Florida, Kansas, New Mexico, Oklahoma, Texas, and Utah (Brown, 2018). These states either already have large populations of feral swine or have suitable habitats for feral swine to establish themselves. Interaction between *O. turicata* and feral swine population could establish a sylvatic cycle here in the U.S. making the disease endemic and extremely difficult to eradicate.

These ticks are also a potential route for infection of zoo swine. Consider the habitats of swine in your zoo, are their habitats close to open fields or woods that would make it easy for ticks to crawl into their enclosure.

Survivability of ASF³

It is well established that ASF can survive a long time in the environment due to its resistance to temperature extremes. It is important to understand what general ranges of environmental conditions are suitable to keep ASF alive and which ones are not. Looking at infected blood samples the lower the temperature the longer ASF will survive. At -94°F ASF has been found to survive for more than 3 years. At 140°F ASF only survived for 30 minutes. What ASF is hiding in also affects how long it can survive. ASF can survive in water for 60 days but only 30 days inside solid feed. ASF survived in backyard soil for 1 week (Mazur-Panasiuk, 2019). ASF has also been found to survive in feces, urine, raw pork, cured pork, and garbage (Petrini, 2019).

³ For more detailed information about the survivability of ASF in various samples at various environmental conditions you can a review study published by Natalia Mazur-Panasiuk, Jacek Żmudzki, and Grzegorz Woźniakowski in the *Journal of Veterinary Research* accessed: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6749736/>

Prevention

Prevention is the mainstay of dealing with any foreign animal disease. This applies both when considering the U.S. as well as individual facilities. It is much easier, cheaper, and more effective to prevent a disease from entering the borders of a country or the borders of a zoo than it is to completely eradicate it. This is particularly true for a disease like ASF which has great capability to survive in the environment but also many routes to establish a reservoir.

Regulatory Authority

Regulatory authority of foreign animal disease management and prevention is held by the state until the outbreak has crossed state lines. Each state has a State Animal Health Official (SAHO), most commonly this is the state veterinarian, who has jurisdiction over development and implementation of their state's FAD response plan. In cases of a disease outbreak that may quickly spread across state lines the USDA may take authority of outbreak response operations. This is likely to occur in an outbreak of ASF which can spread rapidly. USDA will work closely with the SAHO to coordinate state and federal activity as well as actions like depopulation and movement restrictions.

Having a good relationship with your SAHO is important as they will be making many decisions that will have a direct impact on your zoo's ability to conduct business and the lives of your animals. Making sure they are aware of your zoo's FAD response plans including prevention, management, and recovery will help your SAHO have confidence in your zoo's ability to partner with them to handle a FAD like ASF. Things change rapidly during an FAD outbreak; size, scope, and scale can all grow quickly during these events. This also means that response plans and decisions made by the SAHO will change rapidly as well. The more knowledge the SAHO has of your zoo's planning efforts the more likely they will consider your zoo's animals when making these impactful decisions. Holding regular meetings with your SAHO or their representative to discuss your zoo's prevention efforts to protect your swine will help ensure that no rash decisions are made. Something to discuss during your meetings include:

- The ecological and/or genetic value of the species your zoo is trying to protect
- Day to day operations involving the swine and the specific biosecurity and preventative health care utilized to prevent ASF exposure
- Share your disease contingency plan
 - How would you report a suspected ASF case in your zoo?
- Keep the SAHO up to date on any changes to your disease management efforts

Risk assessment

Before facility appropriate prevention planning efforts begin, a risk assessment must be conducted to identify the level of risk an individual zoo has for introduction of ASF into their facility. A risk assessment is a process to identify potential hazards and analyze what could happen if that hazard were to occur. Below is a formula that can be used in a risk assessment to understand the risk that a zoo may have for introduction of ASF into their facility.

$$\text{Risk} = \text{Hazard} + \text{Likelihood} + \text{Vulnerability} + \text{Consequence}$$

- **Risk** - the total risk of ASF being introduced into the zoo
- **Hazard** - identification of what the hazard is, in this case we are talking about ASF
- **Likelihood** - how likely is it for ASF to be introduced into the zoo
 - Location of zoo in comparison to other swine facilities
 - Presence of feral swine near zoo or potential access to swine collection
 - Presence of *Ornithodoros* spp. on or near the zoo facility
 - Do staff have their own pigs at home
 - Are pigs exposed to foods from visitors to their exhibit
 - Pork products - cooked or raw
 - Uncooked garbage
- **Vulnerability** - how vulnerable are the species housed on the premises to ASF
 - How many swine does the zoo have
 - How susceptible are the swine species to the disease
 - African species are less likely to show clinical signs of ASF than domestic species
 - What biosecurity methods are in place currently that work to keep ASF out of the swine enclosures
- **Consequence** - how damaging are the outcomes if ASF were introduced into the zoo
 - How important are the swine species to genetic diversity and breeding programs
 - What movement penalties would be implemented if the zoo was found to contain ASF
 - Monetary losses imposed from reduced business operations due to lock down
 - Monetary losses incurred from losing the swine due to culling or succumbing to ASF
 - Loss of confidence in the 'mission' of the facility. Patrons expect that a facility is doing all it can to keep their animals safe.

Once the level of risk is understood this can be considered when developing biosecurity methods. For example a zoo which does not have swine species in its collection would have few consequences, or vulnerability if ASF were introduced into their facility. Their likelihood may be high if they are located near a swine production facility or if they have many international visitors. However the total risk of ASF impacting their facility is extremely low due

to not having any swine species on collection. This facility would not need very strict biosecurity measures specifically to prevent ASF. In contrast to the first zoo, other zoos may have a collection of critically endangered swine such as the Visayan Warty Pig. This zoo would have a high vulnerability and high consequence due to the genetic importance of the swine species they house. Even if their likelihood of ASF being introduced were low the total risk may be high warranting strict biosecurity measures.

Questions to Consider

- What species of swine are housed on the premises?
- Are these species threatened or endangered?
- Are these species highly susceptible to ASF?
 - Remember that african species may not show clinical signs becoming a carrier instead
- Do visitors bring food products from the outside into the zoo?
- Do visitors throw food products or garbage into the enclosures?
- How many visitors have traveled from a country in Europe, Asia, or Africa recently? (May be impossible to determine, but urban zoos with high international tourism may be more at risk)
- Does my zoo have any exhibits that allow visitors to interact directly with any swine species?
- Are there feral swine populations geographically close to your zoo?
 - Is it possible for the feral swine to access or get close to the swine enclosures at your zoo?
- Is your zoo located geographically near another swine facility?
 - Are there farms near your zoo?
 - Does the region have many backyard pigs?
- Do zoo staff own any pigs?
 - Do zoo staff have family who work in slaughter plants?
- What locations do zoo vendors travel from?
 - Are delivery routes or trucks/trailers 'shared' between farms and zoo?
- Does the zoo bring in any pork products to sell to visitors?
 - Are any of these products cured pork products?
- What is your zoo's vector control program?
 - Are scavengers (mice, rats, vultures, other birds) potentially acting as mechanical vectors bringing the virus into the facility?
 - Are control measures in place for arthropod vectors

Surveillance

Surveillance is an integral part of any prevention strategy. Its purpose is to define the distribution of the disease, detect new outbreaks, and establish disease free-zones. This document will provide a brief overview of surveillance activities that your zoo can use to protect your swine from ASF. It will also provide a brief overview of surveillance activities conducted by the swine production industry and the U.S. government as all surveillance plans should work together to form an effective prevention and detection plan.

Surveillance in a Zoological Facilities

Protection of your pigs from ASF begins with a strong surveillance program that has existed well before any outbreak has occurred. A surveillance program will help to protect your pigs from ASF by determining all possible access points that ASF may be introduced into your zoo as well as monitoring biosecurity protocols established at those access points for proper function.

Communication with your SAHO about your zoo's surveillance program and all prevention activities performed prior to an outbreak of ASF is a critical piece of any prevention plan that is frequently forgotten. Regular communication with your SAHO prior to an outbreak will create confidence in your facilities ability to manage and protect your pigs during an ASF outbreak.

In order to gain your SAHO's confidence your zoo must have a strong surveillance program which is built from two general types of surveillance: passive surveillance and active surveillance; both work together to build a complete surveillance plan.

Passive Surveillance in a Zoo

Passive surveillance is a process that is conducted at all times and relies on 'good samaritan' acts of individuals to notice and report any activity that they deem to be worthy of reporting. What this means in the context of this document is that there are not specific individuals designated to search for signs of ASF in the pigs nor look for breaches of biosecurity; rather any problems get reported by those who see them due to their own good will and training to report. Passive surveillance includes both zoo staff and the public; anyone who reports something they think might expose the pigs to ASF is under this umbrella. Due to its reliance on both trained animal caretakers, general zoo staff, and the public; education is critically important in a passive surveillance program.

Placing educational signs around swine enclosures is a great way to help get the public involved in your passive surveillance program at your zoo. The signs can inform visitors that no food, garbage, or any other items should be thrown into the enclosures mentioning the risk of spreading diseases such as ASF. Adding contact information and asking for visitors to report if they see any trash, food, etc. in the enclosure or if other visitors are throwing items into the

enclosure. This immediately expands your zoo's passive surveillance program from just your zoo personnel to the hundreds of visitors your zoo receives.

Zoo keepers and other staff will continue to participate in the passive surveillance program through their regular activities with the animals. Ensuring that staff is trained on abnormal health and behaviour signs of pigs is critical so that any signs of ill health can be investigated immediately. Given the continued spread of ASF around the world, providing specific training now on clinical signs, disease progression, and spread of ASF will help bolster your surveillance program in the future.

There is typically no record keeping involved in passive surveillance. Passive surveillance is not something that is required of the visitors or your zoo staff. It is a first line 'eyes on the ground' defense against the introduction of FADs. Passive surveillance may lead into activation or increasing your zoo's active surveillance. If there is a spike in the number of reports received from visitors or keepers then it is time that required observations are established. Once individual personnel are required to perform surveillance activities then the surveillance program transitions into active surveillance. This is how passive and active surveillance work together to make a complete surveillance program.

Active Surveillance in a Zoo⁴

Active surveillance is a deliberate process that utilizes the regular examination and diagnostic testing of animals, inspection of biosecurity methods, or monitoring of any other process whose function is to protect the animals. In the context of this document this means that zoo keepers or zoo veterinarians are performing regular examinations of the pigs for clinical signs of ASF with documentation of the examination as well as examination of enclosures for signs of possible exposure to any vector of ASF such as trash, food, or ticks. Active surveillance may also include testing your pigs for ASF through blood draws if it is deemed necessary. It should be noted that blood draws from exotic swine held in zoological collections will likely require the use of general anesthesia, unlike their domestic counterparts. This makes the serological testing of these swine difficult, and not without risk.

Active surveillance also includes Active Observational Surveillance (AOS).⁵ AOS relies on zoo veterinarians or trained keepers to note changes in animal behaviour having established baseline normals. Understanding these baselines and noting changes or clinical signs that deviate from a predefined tolerance threshold prompts further disease investigation. Daily observations are recorded including deviations from predefined thresholds. Follow up communication and actions that occurred are recorded as a result. AOS will be influenced by the accessibility of the swine for zoo personnel. Large numbers of swine or large/open

⁴ For more information about ASF Surveillance Programs you may read *Swine Hemorrhagic Fevers: African and Classical Swine Fever Integrated Surveillance Plan*. This focuses on swine production facilities but offers another viewpoint of an ASF surveillance program.

https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/swine/hemorrhagic-fevers-integrated-surveillance-plan.pdf

⁵ For more information about AOS you can watch this informational video produced by ZAHP by following this weblink: <https://www.youtube.com/watch?v=jSGEfc2B9e0&list=PLRdOJi7fBTOKbTdNZ3Uso3HXKTijbhbJG>

enclosures will make observation of each animal more difficult. All surveillance plans should be designed with both feasibility and a risk assessment in mind. The higher the risk your facility has the more resources should be dedicated towards a surveillance program.

A key feature of active surveillance is record keeping. By keeping detailed records of all active surveillance activity zoo personnel can maintain their confidence that their facility is ASF free or can show that if they do have a case of ASF it was handled appropriately. How to handle a positive case of ASF will be discussed later in this document in the management section.

Questions to Consider

- What surveillance activities are currently being used by the zoo that might detect early cases of ASF?
- Is your zoo's passive surveillance program strong enough to detect a new case of ASF in the swine?
 - Are the veterinarians and keepers trained to detect clinical signs of ASF?
 - Do visitors and zoo staff know who to contact if they want to report anything suspicious?
- Is your zoo located in a high risk area for ASF introduction?
- Has your facility discussed what Active Observational Surveillance metrics would be used as part of an AOS plan?⁶
- Is there accurate record keeping of your zoo's active surveillance program?
- Does your facility have the necessary equipment to perform a necropsy and collect tissue samples?
 - If not, does your zoo have someone to contact that does have the ability to do so?

ASF Surveillance in Other Industries

When discussing surveillance it is important to keep in mind surveillance activities that are occurring at the national or even global level. The swine production industry and the U.S. government is always on high alert for any potential routes that may introduce ASF to our swine livestock. Surveillance is the key to protecting the herds as antemortem testing for ASF is currently not an efficient way to catch it quickly. Frequently the disease kills the pigs before any serology testing can be conducted. That is why swine production facilities have developed highly effective surveillance programs for their swine. They monitor them daily for any clinical signs and they monitor foot traffic of individuals who have access to the pigs. Food and water sources are carefully controlled. Cleaning and disinfection protocols are established. Slaughter processing plants are integral to surveillance, as suspected illness is promptly reported.

⁶ For more information about ASF Surveillance Programs you may read *Swine Hemorrhagic Fevers: African and Classical Swine Fever Integrated Surveillance Plan*. This focuses on swine production facilities but offers another viewpoint of an ASF surveillance program.

https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/swine/hemorrhagic-fevers-integrated-surveillance-plan.pdf

The U.S. government also has effective surveillance programs to protect swine against ASF. Government officials inspect imported shipments of pork products or animals, inspect swine facilities to ensure proper surveillance programs are being followed, and rapidly respond to any reported suspect case of ASF. Illegally imported pork products are one of the biggest risks for introduction of ASF into the U.S. With the recent ASF positive status of the Dominican Republic (D.R.) and Haiti in 2021 the U.S. increased its surveillance activity around borders near D.R. like Puerto Rico and the U.S. Virgin Islands. On 8/26/2021 the U.S. declared Puerto Rico and the U.S. Virgin Islands protection zones in response to the new positive status of D.R.

Protection Zone

A protection zone is a designated area that is recognized by the World Organization of Animal Health (OIE)⁷ as being free of a particular disease. In order for OIE to recognize a protection zone the area must be free of the disease of concern and be at risk of the disease being spread into that area. Increased protection measures must be put into place to prevent the disease from being spread into the area as well. These measures should include intensified movement control and surveillance and specific animal identification and animal traceability to ensure that animals in the protection zone are clearly distinguishable from other populations. As of 9/23/2021 USDA APHIS put restrictions on interstate commerce of swine and pork products preventing movement of them from Puerto Rico and the U.S. Virgin Islands into the mainland U.S. (USDA, 2021).

As ASF continues to spread around the world, zoos must consider whether they are located in a high risk region and whether they may be placed inside a protection zone in the future. If this were to occur increased biosecurity measures and heightened surveillance protocols would be appropriate and may be required depending on the actions of USDA. High risk areas for ASF introduction are those which have high international traffic, high populations of feral swine, and high populations of domestic swine.

Biosecurity

Biosecurity is defined as a system of barriers (physically and functionally) that reduce the probability of the introduction of a novel disease. Disinfection of equipment and environment, controlled movement of staff through animal facilities, quarantine of new animals are all procedures that fall under the umbrella of biosecurity. Biosecurity functions to either contain the virus within an infected premises or to prevent the introduction of the virus into a Free Premises. This section will focus on biosecurity efforts that will help prevent ASF from being introduced into a zoo.

Identification of likely routes that ASF could take to enter a zoo is a critical first step. Due to its ability to be transmitted through contaminated pork, pig carcasses, introduction of new animals, mechanically on equipment, or through biological vectors means that there are several avenues that must be considered.

⁷ The World Organization of Animal Health (OIE) is an intergovernmental organization that promotes, coordinates, and supports animal disease control. It is the animal version of the World Health Organization (WHO).

Biosecurity Basics

Basic tenets of biosecurity that are effective at controlling movement of all pathogenic organisms include wearing personal protective equipment (PPE), establishment of clean and dirty lines, limiting transfer points within a facility, and setting sanitation expectations.

Zoos should consider adopting the principle of Lines of Separation or LOS. This 'line' may be physical such as walls, or functional, such as an imaginary line that should not be crossed by potentially infectious people, equipment or animals. Maintaining the LOS means that when materials or caretakers cross the line, they should do so at Controlled Access Points (CAPs) where specific measures are taken to avoid the possibility of moving that pathogen into the susceptible animals in the enclosure. These measures may include footbaths, disinfection of any tools used in the enclosure, or personal protective equipment (PPE). The necessary biosecurity steps that should occur at these CAPs are dictated by many factors, and should be determined with input from facility veterinarians.

Controlled access points (CAPS) in a facility are areas of entry or exit to the facility or exhibit itself. Visitor entrance, zoo personnel entrance, vendor entrance, supply access points, garbage pick up, etc. are all transfer points. Each CAPS is a potential route that ASF may introduce or leave into your zoo. Limiting the number of CAPS your zoo has allows for biosecurity efforts to be more focused and more effective.

Establishing disinfection expectations with your zoo personnel is critical when it comes to an outbreak of ASF. ASF can survive in the environment for a long time if equipment, walls, floors, etc are not sanitized properly. Regular review of cleaning and disinfection training with all zoo personnel responsible for cleaning and disinfection is an important piece of a zoo's biosecurity program. All it takes is one person to not perform disinfection procedures properly one time for a pig to be exposed to ASF and become infected. Additionally, educating all zoo personnel about the serious nature of an ASF outbreak prior to the outbreak will help your zoo keep its pigs ASF free in the event that ASF is introduced into the U.S.

Don't rely on one system when it comes to biosecurity. Utilizing multiple steps and multiple systems to prevent spread of disease is the difference between good biosecurity and great biosecurity. This is particularly true for disinfection protocols. Human compliance with disinfection protocols is surprisingly low. Having multiple disinfection steps that are effective at eliminating ASF will increase the odds that at least one step will be successful at eliminating ASF before it can infect your zoo's pigs.

PPE is a tool to be considered when protecting collections from disease. PPE is especially important for any disease considered zoonotic, fortunately ASF is not a zoonotic disease. PPE includes gloves, coveralls, hair bonnets, shoe covers, etc. Essentially PPE is any body covering that has the intended purpose of preventing the exchange of material that could potentially carry pathogenic organisms between the person wearing the PPE and the environment around them, animals, or other people. The appropriate and proper use of PPE to protect the swine in your collections should be discussed with your facility veterinarian and proper training must be implemented to have confidence in its use.

Contaminated pork

Contaminated pork poses the largest risk for introduction of ASF into a zoo due to the difficulty of controlling what foods visitors are bringing into the zoo as well as preventing visitors from throwing food into enclosures. Discussed earlier in this document is the incredible survivability of ASF within pork both raw and cured. Products like sausages can carry ASF for long periods of time depending on if they are improperly cured or raw. Chinese sausage has been shown to test positive for ASF, pork products from China would be a particular concern for their potential infected status. Consider if your swine exhibits are located near common eating grounds for visitors. Is there a high probability that human food could make its way into an animal exhibit? Visitors like to throw food to animals if they think they are hungry. Trash that carries ASF, such as sausage packaging can be blown or carried by rodents into swine enclosures.

Additional barriers between swine exhibits and visitors may be necessary if the risk of ASF introduction is high for your zoo. Zoo staff should be trained on the dangers of pork products for swine and ensure that any human trash is quickly removed from an enclosure. Signs that ask visitors to not feed the animals may be helpful. Framing the message to educate how human food can make an animal feel ill or have a stomach ache would be a good way to encourage visitors to not throw food into the enclosures.

New Animals

Exposure of disease free pigs to an infected pig through normal zoo operations should be at the forefront of all zoo staff's minds. Direct contact with an infected animal is the most efficient way for ASF to be spread. Ideally all pigs that are coming to the zoo for any reason should be isolated for a minimum of 30 days. Zoo staff should handle the new pigs last and never visit other pigs on the premises after handling the new animals. Staff should also wear protective gear such as gloves and boot covers when handling or entering the new animal's enclosure. It is the expectation that staff will shower when they get home but it does not hurt to remind staff that showering when they get home is not only about cleanliness but also a part of the biosecurity systems of the zoo.

Mechanical vectors

Mechanical vectors are anything that could potentially carry ASF from one location to another that does not become infected itself. Examples include, the hands of zoo staff, the clothes they wear, equipment that comes in contact with infected animal or tissue (ropes, harness, mops, brooms, brushes), or even other animals. Staff must be trained about their potential role in spreading disease. Washing their hands between handling animals is critical in preventing spread of disease. Equipment should be cleaned and disinfected regularly, and not shared between animals of unknown infected status. During an ASF outbreak vehicles that come onto grounds should be disinfected before entering and after leaving the zoo.

Living mechanical vectors are a source for disease transmission that is often overlooked and may be difficult to control in a zoo facility if the swine enclosures are outdoors. Due to the survivability of ASF in blood, tissue, and in the environment it can be carried by many smaller animals such as flies, rodents, and birds. *Stomoxys calcitrans* (stable fly) is able to mechanically transmit the virus for 24 hours after coming in contact with infected blood (Mazur-Panasiuk, 2019). Fortunately this fly must be ingested by the pig to transmit the virus and it does not travel very far during its life so it is unlikely to be a major source of transmission between different facilities. However if an infected feral swine were to die near the zoo premises this fly may be a source of transmission from the carcass of the feral pig to the swine on exhibit. Both rodents and scavenging birds like vultures could potentially bring carcass tissue into a swine enclosure by chance which if ingested by the pigs could infect them. Wherever possible, prevention of wildlife, even small ones, gaining entry into an enclosure of zoo swine will be important in preventing ASF transmission into your animals.

Biological vectors

A biological vector is a living organism that can be infected by a disease and then transmit the disease to other living organisms. Biological vectors of ASF are ticks from the *Ornithodoros* genus. Their distribution ranges from the west, midwest, and southeastern U.S. overlapping with many of the hot spots of feral swine. *Ornithodoros* spp. ticks could transmit ASF from feral swine to zoo swine if feral swine come close to the swine enclosures.

Ornithodoros ticks are capable of transmitting ASF rapidly to a pig they bite. Any efforts to prevent transmission of ASF through tick bite should focus on bite prevention. If tick preventative medications are used it is important to choose ones that have repellent activity or kill the tick rapidly on contact. Products that kill ticks after they bite the animal would not be helpful in control of ASF. Using tick preventative products that contain permethrins will be the most helpful in this scenario. Examples of such products include: Permethrin SFR, Swine Guard, and Permethrin II.

Questions to Consider

- What biosecurity protocols does my zoo utilize currently?
- Has zoo staff training on proper biosecurity measures been reviewed recently?
- Do zoo staff own any pigs of their own?
- If you are not already regularly cleaning and disinfecting equipment and vehicles how might you implement those procedures in the future?
- Is there heavy traffic of animals into and out of the zoo?
 - If so, where are these animals traveling from and to?
- Where are the visitors to my zoo coming from?
- Do visitors of my zoo frequently bring food from home?
- Is human food or garbage frequently found in animal enclosures?
- Do you have any exhibits where visitors have access to swine species?

- What pork products are sold within the zoo grounds?
 - Are these fully cooked before being purchased by visitors?
- Is wildlife of any kind frequently found within animal enclosures?
 - Are any of these carnivorous/omnivorous scavenging species?
- Are feral swine populations located near your zoo?
 - Do the feral swine have access to or can get near to your swine enclosures?
- Are there any other swine facilities near your zoo? Production facility, state fair, etc.
 - Do visitors of your zoo also visit the other facility as well?

Management

This section of this document will discuss who has regulatory authority over management of FAD outbreaks as well as outbreak response efforts at the state and national level. Furthermore this section will discuss best management practices for your zoo in the event you have a suspected case of ASF.

Below is a reminder of the case definitions of ASF recognised by the SAHO and USDA. Refer back to the 'What is African Swine Fever' section of this document for descriptions of each case definition.

- Suspect Case
- Presumptive Positive Case
- Confirmed Positive Case

First Steps of Outbreak Management at the National Level

Upon confirmation of a presumptive positive case of ASF in the U.S. in any swine species by NVSL, either the APHIS Administrator or VS Deputy Administrator will initiate first steps of disease outbreak management. Upon receiving word from USDA the Secretary of Agriculture will declare an Extraordinary Emergency. This will give the Secretary of Agriculture additional authority to hold, seize, treat, destroy, or otherwise dispose of any animal, articles, facility, or means of conveyance. Once the Emergency has been declared the Secretary will authorize a National Movement Standstill, depopulation of infected premises, and payment for virus elimination of an infected premises.⁸

In the event of a movement standstill the USDA will provide clear guidance on the implementation of the movement standstill. Depending on the epidemiological circumstances of the outbreak a movement standstill may have varying factors. All movement at the time of the movement standstill was enacted will be allowed to reach their intended destination but no new movement will be allowed. Listed below are the minimum specifications that will be defined⁶:

- A specific geographical area or boundary
 - This may be nationwide or only regional
- A specific requirement that all live swine in transit at issuance must reach a destination
- A specific time indicating the duration of a standstill
 - At minimum this will be 72 hours but it may be longer
- A specific list of what items are restricted from movement
- A specific list of what items are exempt from movement restriction

It will be important for zoo management to understand the specifications of the movement standstill so they can adjust zoo business appropriately. If your zoo does not have a

⁸ Information about regulatory authority and national movement standstill specifications come from the African Swine Fever Response Plan The Redbook accessed at:
https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/emergency-management/CT_FAD_PReP_Disease_Response_Documents

suspect or confirmed case of ASF and are not geographically near the location of the confirmed case of ASF then your business operations may not be heavily impacted. Your SAHO may place their own restrictions on operations of various animal industries to try to mitigate any risks to animal health in their state. The state maintains authority to make decisions regarding regulatory action during FAD outbreaks.

After the initial National Movement Standstill order has reached its time limit some movement restrictions will still be in effect. Movement into and out of Control Areas will typically require a permit and will be monitored. Areas that are considered free of ASF will have more freedom of movement to ensure Continuity of Business (COB). Movement restrictions will continue to evolve as the ASF outbreak continues. Keeping up to date on current restrictions for your zoo's region will be important during an outbreak.

Outbreak Zoning

Once the SAHO has confirmed a positive case of ASF in the U.S. the USDA will immediately begin establishing zoning around the location. These zones are the same used for any FAD outbreak but the sizing may be different depending on the ecology of the disease of concern and the geographic location of the outbreak.

Below is a list of the different zone classifications with a brief description. It is important to know that all facilities that have a connection to an infected zone are subject to control area restrictions and diagnostic testing. Specific sizing of zones and movement controls are covered in greater detail in the *ASF Response Plan: The Redbook*.⁹

- Infected zone (IZ)
 - Zone that immediately surrounds an Infected Premises or Infected Pig(s).
 - This zone will be subject to movement restrictions of live pigs, carcasses, and pork products as all 3 have the ability to carry ASF. Pigs, carcasses, and pork products will not be allowed to leave the IZ unless given specific permission. Pigs may enter the IZ if they are going to slaughter and the closest facility is inside the IZ.
 - Federal/state surveillance activity within the IZ will focus on identification of all ASF cases as well as the original source of ASF introduction.
 - Zoo activity will focus on increased prevention efforts and surveillance to protect your pigs which are not positive for ASF. Risk of ASF is very high for pigs inside the IZ. If your pigs are positive then coordinate with your SAHO about proper disposal of carcasses.
- Buffer zone (BZ)
 - Zone that immediately surrounds an Infected Zone or a Contact Premises.
 - This zone will have movement restrictions similar to the IZ.

⁹ APHIS VS. (2020). African Swine Fever Response Plan *The Red Book*. United States Department of Agriculture. https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/emergency-management/CT_FAD_PReP_Disease_Response_Documents

- Federal/state surveillance activity within the BZ will focus on investigation of all possible ASF reports as well as inspecting pigs for 20 days (longest incubation period of ASF).
- Zoo activity will be the same as in the IZ but your pig's ASF risk may not be quite as high.
- Control area (CA)¹⁰
 - Consists of an Infected Zone and a Buffer Zone.
 - Refer to IZ and BZ for movement restrictions and activities.
- Surveillance zone (SZ)
 - Zone outside and along the border of a Control Area.
 - The Surveillance Zone is part of the Free Area.
 - Federal/state surveillance activity within the SZ focuses on investigation of reports that match with ASF. As well as conducting a public awareness campaign to increase reporting of suspected ASF cases.
 - Zoo activity will include increased prevention efforts and surveillance of your facility so any suspect case of ASF is reported quickly as well source of introduction can be determined.
- Free Areas
 - Area not included in any Control Area
 - Includes the Surveillance Zone
 - Free areas are those parts of the country which are not considered to have an ASF outbreak occurring.
 - Federal/state surveillance activity within the Free Areas will focus on increasing public awareness to increase reporting of suspect cases as well as promoting increased facility surveillance activity to provide as much confidence as possible that Free Areas are truly free of ASF.
 - Zoo activity should include thorough evaluation of risk even though the facility currently resides in Free Areas. Any additional biosecurity protocols should be discussed

Infected Zone (IZ) and Buffer Zone (BZ) will typically be established within 12 hours of the index case. As the outbreak progresses the Control Area (CA) may change to best fit the needs of outbreak management. If feral swine become infected with ASF it will be immediately assumed that all swine in the population are infected. This will likely create an IZ that is very large and subsequently increase the size of the CA. Zoo management should do their best to follow developments in outbreak response.

¹⁰ For more detail about movement restrictions of the CA please refer to *FAD Response Ready Reference Guide - Movement Control in an FAD Outbreak*:
https://www.aphis.usda.gov/animal_health/surveillance_toolbox/docs/mvmt_control_reference_guide_aug_2013.pdf

Premises Designation

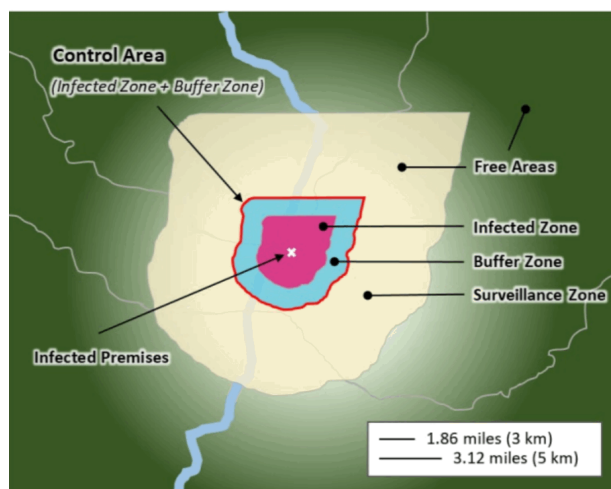
It will be important for your zoo staff to understand the language used to describe the classification of premises as it relates to an outbreak of ASF. These premises designations relate to the ASF status of pigs in the premises as well their location within the zones classifications. The management activities at your zoo is dependent on your Premise Designation, which will change over time as the outbreak extends, or is managed. Below is a list of the different premises designations used in an ASF outbreak response and what each designation means.

- Infected Premises (IP)
 - Premises where a presumptive positive case or confirmed positive case exists based on laboratory results, compatible clinical signs, ASF case definition, and international standards.
 - In Infected Zone only
- Contact Premises (CP)
 - Premises with swine that have been epidemiologically linked to an IP through exposure to animals, animal products, fomites, or people. CPs would be subject to Network Based Controls.
 - In Infected Zone, Buffer Zone, or Free area
- Suspect Premises (SP)
 - Premises under investigation due to the presence of swine reported to have clinical signs compatible with ASF. This is intended to be a short-term premises designation.
 - In Infected Zone, Buffer Zone, or Surveillance Zone
- At-Risk Premises (ARP)
 - Premises with swine, but none of those swine have clinical signs compatible with ASF. ARPs are not IPs, CPs, or SPs. ARPs may seek to move susceptible animals or products within the Control Area by permit. Only ARPs are eligible to become MPs.
 - In Infected Zone or Buffer Zone
- Monitored Premises (MP)
 - Premises objectively demonstrates that it is not an IP, CP, or SP. Only ARPs are eligible to become MPs. MPs meet a set of defined criteria in seeking to move susceptible animals or products out of the Control Area by permit.
 - In Infected Zone or Buffer Zone
- Free Premises (FP)
 - Premises outside of a Control Area and not a CP or SP.
 - In Surveillance Zone and/or Free Area

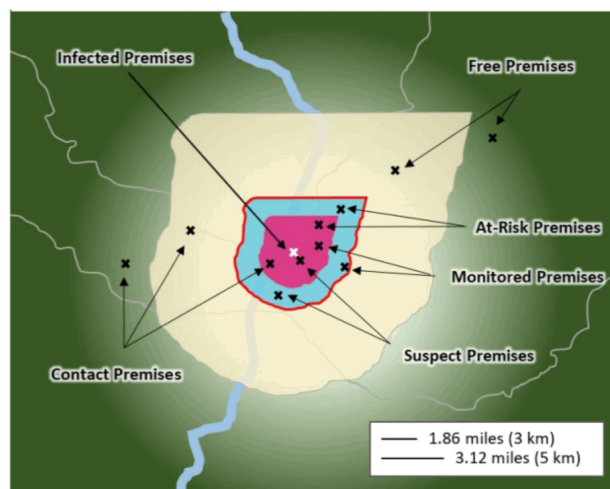
Below are visual representations of zones and premises designations within each zone. These images were taken from the African Swine Fever Response Plan *The Red Book* created by the USDA (APHIS, 2020).

Domestic Swine

Zones and Areas



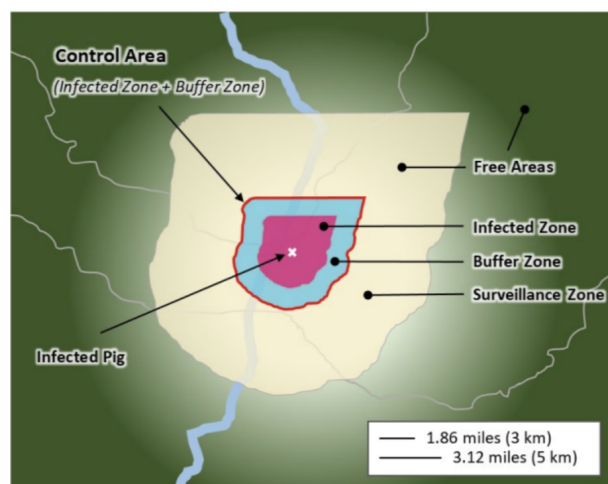
Premises



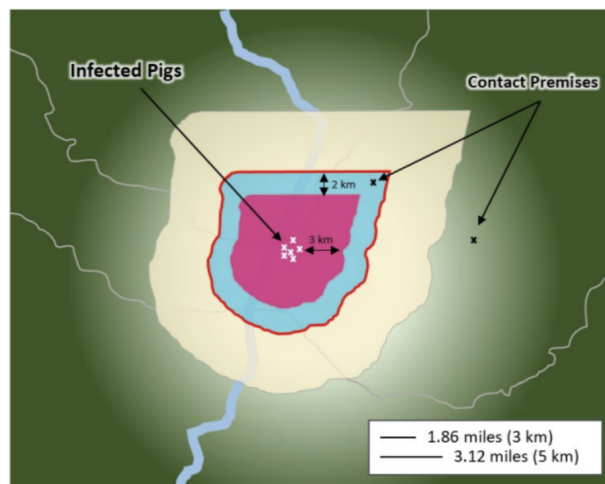
The image above shows zones and premise designations for a domestic swine facility. We can see the slight variations in the perimeters of the IZ due to geographical landmarks but it is roughly 3km from the infected premises. If a zoo were to become infected zoning and premises designation would operate the same as this domestic swine example.

Feral Swine

Zones and Areas



Pigs*



The image above shows zone designations for feral swine but due to the free roaming nature of feral swine it is difficult to classify an initial infected premises. We can see that the zones and alternate premises are classified based on the roaming nature of the feral swine population. This is why the IZ is much larger compared to the domestic swine example.

Questions to Consider

- What geographical landmarks around your facility might be used to create the zones?
- Are there other facilities around your zoo which also house pigs, even temporarily?
- Is your zoo involved with the movement of animals between facilities or across state lines frequently?
 - When do these movements occur?
 - When you ship animals do you have a contingency plan that would address communication and coordination with the receiving facility and any states through which the shipment is traveling?
 - Does your zoo have a plan if you could no longer move those animals in or out of your zoo?
- Would restrictions on pork products being moved into your zoo cause a large disruption in business?

How to Report a Suspect Case of ASF

Suspect cases should be reported immediately to your facility's attending veterinarian. They are responsible for contacting the State Animal Health Official (SAHO) or Area Veterinarian in Charge (AVIC) who will decide if the report is credible and assign a Foreign Animal Disease Diagnostician (FADD) to further investigate the possibility of ASF infection. It is important that your zoo veterinarian knows who your SAHOs are and how to contact them, each state will have a different official. Current SAHOs can be found on the United States Animal Health Association (USAHA) website: <https://www.usaha.org/saho>.

Outbreak Tracing

Within the first 72 hours of the initial outbreak, during the movement standstill, FAD investigators will immediately begin to trace-back and trace-forward movements of animals connected with the infected premises. This is the most crucial period of an outbreak investigation as the ability to control the spread of ASF is at its most easiest to accomplish. If a positive ASF pig were missed then the spread of ASF would quickly grow making eradication of the disease incredibly difficult.

Quick action will continue to be crucial for any subsequent positive cases that are discovered. Therefore even if your zoo was not the location of the initial outbreak it is imperative that zoo veterinarians and any other pertinent zoo personnel work with FAD investigators to provide them with any information they need in the event of a zoo pig testing positive for ASF.

Tracing will be conducted using an epidemiological questionnaire. It will assist investigators in determining the scale and scope of the outbreak. The investigation and

associated questionnaire will incorporate wildlife contact, particularly for feral swine, as well as an assessment to determine whether *Ornithodoros* spp. ticks are implicated in, or present a risk for, ongoing transmission. The investigation will also cover all movement onto and off of an infected premises by both animals, materials and people for the last 30 days. During any tracing that involves your zoo, work with the investigator by providing any pertinent information that may be needed that the questionnaire did not cover.

It is important to know that all premises with direct or indirect contact with an infected premises in the last 15 days of an outbreak will be subject to tracing and surveillance programs. Think about what connections your zoo has to other animal facilities so you are aware of how likely your zoo will be subject to tracing during an ASF outbreak.

Outbreak Tracing at a Zoo

As discussed in the beginning of this document, swine production facilities have many differences from zoo facilities. A key difference that relates to outbreak tracing is the number of visitors that a zoo has. It may be difficult for a zoo to provide accurate records as may be requested by the investigators due to the amount of visitors that come through. It is imperative that your zoo provide as accurate of records as possible.

Most zoos do not keep a detailed list of all visitors that come through the doors but alternative options that may be useful to investigators include online ticket sales or any security camera footage of the swine enclosure. Record of vendors, contractors, and zoo personnel who have come to the zoo each day is within expectations of a zoo and should be provided in the event of an outbreak investigation.

What if Your Zoo is Confirmed Positive for ASF?

In the unfortunate event that one of your swine species at your zoo is suspected to be positive for ASF then your facility will be immediately placed under quarantine restrictions by State authority. It is important to note that confirmation of ASF is **not** required for State authority to implement quarantine restrictions for an individual premises. Zoning will be established around your zoo along with premises designations for all facilities within the established zones. Your zoo would be designated an infected premises.

Questions to Consider

- Who is my state's SAHO?
 - Is their contact information known by your zoo's veterinarian?
- Does my zoo have a plan in the event of a 72 hour National Movement Standstill?
 - Are you able to house animals for longer than you intended?
- Who will be responsible for coordinating with the SAHO and USDA officials conducting outbreak tracing at your zoo?

- What records does your zoo have that would be useful in an epidemiologic investigation?
 - Visitor records
 - Zoo staff which had contact with the pigs
 - Vendors operating at the zoo
 - List of pork products are sold at the zoo
- Who will be responsible for communicating with the public in those first hours and days of an outbreak either near or within your zoo?
- Does your zoo have a plan if your zoo was temporarily closed due to having a positive case of ASF?

Eradication of ASF

Eradication of ASF after an outbreak in the U.S. is the ultimate goal of any outbreak response. Due to this all outbreak response activities will focus on the ‘3D activities’: depopulation, disposal, and decontamination.

Depopulation

Depopulation, or stamping-out, is the current method used to eliminate ASF from swine populations. Currently there is no approved treatment or vaccine for ASF leaving depopulation as the only method available. In swine production facilities if any pig tested positive for ASF then the entire population of pigs at the facility will be culled through mass depopulation methods in accordance with the American Veterinary Medical Association (AVMA) guidance.¹¹ This strategy may increase into “fire break” depopulation as a means to stop the spread of the “fire” that is ASF. This means that even if a facility does not have a suspect case of ASF they may still be subject to depopulation if the risk of ASF exposure for their animals is very high. This strategy may include zoological facilities.

Through discussion with USDA and state officials there may be a lack of clear language regarding zoological facilities in government response plans. It is imperative that facilities understand current state planning language, and where possible, work with their SAHO to understand how their animals may be handled in various outbreak situations. Depending on the confidence in biosecurity protocols agreed upon between the facility and the SAHO this might mean that the facility may not be subject to a “fire break” depopulation strategy.

These discussions are particularly important in states that do not have large numbers of swine production facilities. This may seem backwards as the risk of ASF is lower but states which have high numbers of swine production facilities will have very detailed and well thought out response plans for ASF while other states may not. In all cases the earlier you can discuss the response plan with your SAHO, the more likely you are to have favorable outcomes

Disposal

¹¹ AVMA guidance for mass depopulation of animals can be accessed at:
<https://www.avma.org/sites/default/files/resources/AVMA-Guidelines-for-the-Depopulation-of-Animals.pdf>

Proper disposal of any swine carcasses and all infected material during an outbreak of ASF at your facility, either suspect or confirmed case, is critical. Materials that should be considered for proper disposal are carcasses, animal products, contaminated manure, litter, bedding, contaminated feed, contaminated personal protective equipment, and any other contaminated materials or equipment that cannot be cleaned and disinfected. Any facility exhibiting animals should already be following all local and state ordinances for proper disposal of these materials. Extra precautions will be taken during an FAD outbreak to ensure the disease is not spread through these materials.

Due to the survivability of ASF in the environment, in infected tissues, and on contaminated materials disposal practices must meet quality standards to ensure the virus is destroyed. USDA and your SAHO will work together to determine the best disposal method in the event of an outbreak. Disposal methods that may be used if available include composting, rendering, permitted landfill/burial, incineration, and open-air/uncontrolled burning. Each method has its own advantages and challenges which may or may not make it suitable for disposal of contaminated material. For example, permitted landfill/burial would likely not be deemed appropriate for disposal of material contaminated with ASF because of its ability to persist in the environment for long periods.

Work with the USDA and your SAHO to develop a plan that will work best for your zoo. It is important that the disposal plan is both effective at preventing spread of ASF through the contaminated material but also feasible for your facility. If your facility's current waste disposal contractor meets USDA standards for diseased animal management then your SAHO may advise you to continue utilizing their services for disposal of contaminated materials. It is the recommendation of this document that zoo management review the NAHEMS Guidelines: Disposal document on the USDA APHIS website.¹² This contains detailed information regarding each disposal method available and how regulatory officials choose which method is best

Cleaning & Disinfection

Cleaning and disinfection of any zoo enclosure surfaces which housed swine infected with ASF, either suspected or confirmed, should be disinfected whenever possible to ensure destruction of any ASF persisting in the environment. Unfortunately guidelines for cleaning and decontamination of the environment focus primarily on swine production facilities which have many differences from zoological facilities in terms of animal housing.

Cleaning vs disinfection is important to remember because they mean two different things. Cleaning is the physical removal of organic and non organic matter from a surface such as washing off dirt, manure, hair etc from equipment or cage flooring. Disinfection is the act of killing all pathogenic organisms typically through the use of chemicals or heat. A clean surface may not be disinfected properly as pathogens can cling to the surface of equipment and animal housing. There are various disinfection methods but the most practical for disinfection of an animal enclosure are chemical disinfectants.

¹² Guidelines for disposal of contaminated materials can be found within *NAHEMS Guidelines: Disposal*. These guidelines will help shape the decision made by your SAHO. This document can be found at:

<https://www.aphis.usda.gov>

Areas that utilize concrete, wood, tile, etc for the flooring and walls can be disinfected using similar methods as those developed for swine production facilities. USDA provides a document with a list of various disinfectants and their proper use that are effective against ASF. This document can be found at the link in the footer of this page.¹³ It is important that you follow all instructions listed on the product labels as they do not all work the same. Some important points to look for on the product labels are:

- **Contact-time** - this is the length of time it takes for the disinfectant to kill the pathogenic organisms on the surface. It is imperative that this rule is followed as if the disinfectant is removed before the contact-time has elapsed then there will still be pathogenic organisms left on the surface such as ASF.
- **Surface Preparation** - many disinfectants require that the surface be cleaned of gross debris and organic matter prior to application of the disinfectant. This is because some disinfectants are deactivated by organic matter and will not properly disinfect the surface if it is not cleaned first. Follow the instructions for surface preparation to ensure the disinfectant will work properly.
- **Dilution instructions** - most disinfectants come in a concentrated form that should be diluted. This is to make the product lighter and help with shipping. Some disinfectants will have different uses for different concentration levels but others will have one concentration level that is desired. Be sure to dilute the product appropriately following the instructions.

Disinfection of outdoor enclosures which have vegetation and soil is possible but impractical. The amount of organic material and naturally occurring bacteria make disinfection very difficult outside of using heat methods such as turning and burning the soil for several rounds. Best method of decontamination for an outdoor enclosure is time. ASF will eventually die off in the environment if given enough time and not allowed to infect other pigs. In a study that tested ASF survivability in different soil types it was found to survive in sand the longest, at least 3 weeks, and yard soil for only 1 week. ASF was unable to survive in acidic forest soil so it was concluded that low pH soil decreases the survivability of ASF (Carlson, 2020).

Due to the species specificity of ASF towards swine, utilizing the enclosure to house a different species is likely warranted. The return of swine species to a zoological facility previously infected with ASF will be under the discretion and oversight of the SAHO. Above are simply guidelines that can be considered when deciding how to return swine back to your zoo or utilizing the swine enclosure for different purposes.

Vaccination Against ASF

Currently there is no approved vaccine for ASF in the U.S. However, promising research is being done to develop a vaccine. Vaccine research is in early development but a recent clinical trial published its results showing that the vaccine being developed was completely protective against death for pigs challenged with an Eurasia strain of ASF after vaccination

¹³ APHIS. (2020). Disinfectants Approved for Use Against African Swine Fever Virus in Farm Settings. USDA. https://www.aphis.usda.gov/animal_health/emergency_management/downloads/asf-virus-disinfectants.pdf

(Borca, 2019). Live attenuated vaccines (LAVs) appear to be at the forefront of ASF vaccine research (Bosch-Camós, 2019). Because this is new technology it will take time for a new vaccine product to be properly tested and approved for use. Hopefully in a few years a vaccine against ASF will be available for swine in the U.S if needed.

It is important to note that there are reports of underground ASF vaccines existing in China. There is no evidence that these vaccines are effective and there are reports that the vaccine killed pigs injected with it in China (Patton, 2021). It is the definitive recommendation of this document to never use a vaccine product in the U.S. that has not been approved by the USDA.

Recovery

Recovery after an FAD outbreak begins while the outbreak is still occurring. While this section comes after the management section it is best if your zoo's staff think about management and recovery efforts at the same time. The reason for this is because communication with the public, the SAHO, and with other facilities is a big part of a zoo's ability to recover. In this section the document will discuss recovery at the national level, communication strategies, and other considerations.

Crisis Communication¹⁴

Communication will be a crucial piece of your zoo's ability to recover after having an outbreak of ASF in your pigs. A common theme in FAD outbreaks is to have regular, open, and honest communication with your SAHO and the USDA so they are aware of any changes in your zoo's ASF status and to keep their confidence in your zoo's ability to play their part in an FAD outbreak. Communication with the public is a separate but equally important issue.

During FAD outbreaks there is most likely going to be a spread of miscommunication about the disease, how it got into the U.S., and whether it can hurt humans or not. If your zoo has a positive case of ASF then the public may lose confidence in your zoo's ability to protect them. The COVID-19 pandemic of 2020-2021 has shown that misinformation can rapidly derail any confidence the public has in government or private institutions which are trying to protect them. An ASF outbreak could cause a decline in visitors to your zoo out of fear or it may bring activist activity against your zoo claiming that your zoo is not protecting your animals properly. Fortunately, SAHOs have Communication professionals that will be used to craft messages about disease management in the state. A zoo's messages should mirror what is being said by the SAHO, while still having the appropriate level of detail for the intended audience. It is important that public statements are put out rapidly to show that your zoo is not hiding anything and is ready and willing to manage the ASF outbreak and protect the public to the best of its ability.

Recovery at the National Level

In order to recover from an outbreak of ASF the U.S. government will aim to declare 'proof of freedom' meaning the U.S. is free from ASF. All trading partners with the U.S., especially those which wish to import U.S. pork, will evaluate the U.S. claims and determine whether to lift trade restrictions based on information provided by the U.S.

The OIE does provide provisions on declaration of ASF-freedom in the OIE Terrestrial Animal Health Code.¹⁵ This document can be used as guidelines for what should be expected of a country if they declare freedom from a FAD. The U.S. will follow these guidelines as other countries will use it as their criteria if they will begin trade relationships with the U.S. again.

¹⁴ For more information about crisis communication strategies during a FAD outbreak please review the Secure Zoo Strategy on the ZAHP website accessed at: <https://zahp.org/secure-zoo/>

¹⁵ OIE Terrestrial Animal Health Code can be accessed at: <https://www.oie.int/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/>

Recovery from ASF in Your Zoo

This document has given you a glimpse of the strategies and tactics that would be considered to address an ASF outbreak in the US, and potentially your zoo. It is hoped that facilities recognize that it is in their best interest ***to keep disease out of their collections in the first place.*** If your zoo were to have a positive case of ASF, the following should be understood by the facility owner-operators and regulatory officials who will be responsible for outbreak management.

- It is highly likely that swine on your facility, if exposed, would succumb quickly to ASF. Those species suspected to be carriers (site the carrier species) would likely be humanely euthanized.
- Breeding programs could be severely impacted
- Designation as an Infected Premise may require closure of some or all of the facility. This may be short or long term, depending on scale and scope of the outbreak
- Environmental sampling will be required prior to lifting of any quarantine or movement restrictions.¹⁶
- The loss of these animals may cause significant stress for the personnel who care for and train these animals. The mental health of facility owners/operators may be compromised.
- This traumatic event may alter the facility's desire to house any swine species for the foreseeable future
- The visiting public may lose confidence in the facility's ability to adequately protect their animals from disease, thereby affecting attendance which may diminish cash flow and the ability to care for unaffected species.
- If a facility wishes to continue to exhibit swine and is given permission to repopulate a previously infected enclosure at an appropriate time, a pathogen-specific surveillance program would likely be required that provides confidence that detection of ASF will occur quickly should it reemerge..
 - Refer to the surveillance section of Prevention in this document for more detail about building a pathogen-specific surveillance program. This will likely include diagnostic testing, observation, and diligent record-keeping. These requirements may be deemed too difficult for the facility to manage.
 - Determine that appropriate biosecurity and other protocols are in place to prevent future outbreaks of ASF in their animals.

National Recovery Depends on Local Recovery

It is important to understand the relationship that each individual facility (swine production or zoological) has with the ASF disease status of the U.S. In order for the U.S. to recover ASF-free status the government must show that the last infected establishment

(production swine or zoological species) has been disinfected and free of ASF for 3 months. A single facility that has a tested positive for ASF in their swine could prevent the U.S. from being considered ASF-free. Even though exotic susceptible swine are not involved directly with the pork industry of the U.S. they can have a direct impact on the exportation of pork products. Zoo personnel should keep this in mind when considering recovery planning. The value of your zoo's swine collection must be considered in the context of the value of the pork industry to the U.S. economy.

The U.S. could declare a zone free of ASF rather than the entire country. Swine production is focal within the U.S. with the majority of swine production facilities in Iowa, Minnesota, North Carolina, and Illinois. The U.S. may declare those states or regions that include those states ASF-free prior to complete U.S. disease freedom. Recall that each country has complete control of whether they would consider this adequate enough to import U.S. pork again. Your zoo's geographical location in relation to swine production facilities may impact what your SAHO and U.S. government expects of your zoo. It is always best to have regular communication with your SAHO and to pay attention to the development of any ASF outbreaks.

Indemnity

Indemnity is a process through which swine production facilities can be reimbursed for the mandatory destruction of their pigs by the government in the event of an FAD outbreak. This is so that the farms are not bankrupt by the loss of their current livestock unable to financially recover. Because swine in zoos are not a part of the food supply in the U.S. there is no indication that Indemnity will be provided for mandatory destruction of zoological swine.

Restocking

Review the Cleaning & Disinfection section of this document for more information about how your facility will be disinfected. This will be required prior to restocking to ensure that no new pigs become infected by latent ASF virus hiding in the environment. During an ASF outbreak in the U.S. your SAHO and/or the USDA will provide additional guidance for restocking previously infected premises, including any sentinel activities that may be required. These decisions will be based on the perceived adequacy of disinfection, the risk of reintroduction of ASF, and current outbreak status of the U.S.

Questions to Consider

- Who will be responsible for your zoo's crisis communication?
- Does your zoo have a communication strategy in the event of an FAD outbreak in your facility?

- Does this strategy include how to handle bad publicity?
- If your zoo must depopulate all swine, would your zoo intend to repopulate?

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