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# Overview of Feral Swine Management and Elimination Efforts in New York (2008-2016)

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**ABSTRACT:** State officials first discovered free-roaming feral swine breeding in New York from 2000-2005. Escapes from high-fence shooting facilities and Eurasian wild boar breeding operations, as well as intentional releases to create new hunting opportunities, allowed these animals to become established in four distinct populations. Utilizing a strategy of “whole sounder” management, in which entire family groups of swine are captured all at once, USDA APHIS, Wildlife Services and the New York State Department of Environmental Conservation removed 209 feral swine from 2008-2014. It appears that feral swine populations were eliminated from New York, as there have been no confirmed sightings since October 2014. Wildlife Services is leading a multi-faceted monitoring effort that includes the use of trail cameras, aerial surveys, detection dog surveys, and the development of an early detection network to reduce the risk of a reinvasion caused by failure to detect the last remaining individuals. Additionally, New York addressed the problem at its roots by passing legislation that prohibits hunting, propagation, trade, and possession of Eurasian wild boars and Eurasian wild boar hybrids. Much of the state’s feral swine elimination program success is attributed to lessons learned from successes and failures of past and ongoing wild pig elimination campaigns around the world. New York encountered unique challenges requiring innovative solutions that are informative to future invasive species eradication efforts. We provide an overview of the New York efforts to eliminate feral swine with an emphasis on education/outreach, regulatory action, lethal control, and monitoring.

**KEY WORDS:** coalition, detection dogs, elimination, extermination, Eurasian wild boar, feral swine, invasive, management, monitoring, New York, *Sus scrofa*, wild pig

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## INTRODUCTION

Feral Swine (*Sus scrofa*) became established in the continental United States as early as the 16<sup>th</sup> century (Mayer and Brisbin 1991). Since that time, they have become a highly invasive and destructive species, and the threats that they pose are numerous and well documented (Seward et al. 2004, Campbell and Long 2009). In states where feral swine populations are large and widespread, economic losses attributed to feral swine damage are substantial (Pimentel et al. 2000, Shi et al. 2010, Mengak 2012).

For centuries, feral swine were primarily associated with southern United States. Beginning in the 1980s, the population and geographic range of feral swine began to expand rapidly. The United States expanded from 17 states with documented populations of feral swine in 1988 to 38 states in 2007 (Waithman et al. 1999, Bevins et al. 2014). While many factors played a role in this population and range expansion, it is clear that the major drivers are anthropogenic, due in large part to the growing popularity of feral swine hunting fueled by television shows, documentaries, and other media exposure that glorify the sport.

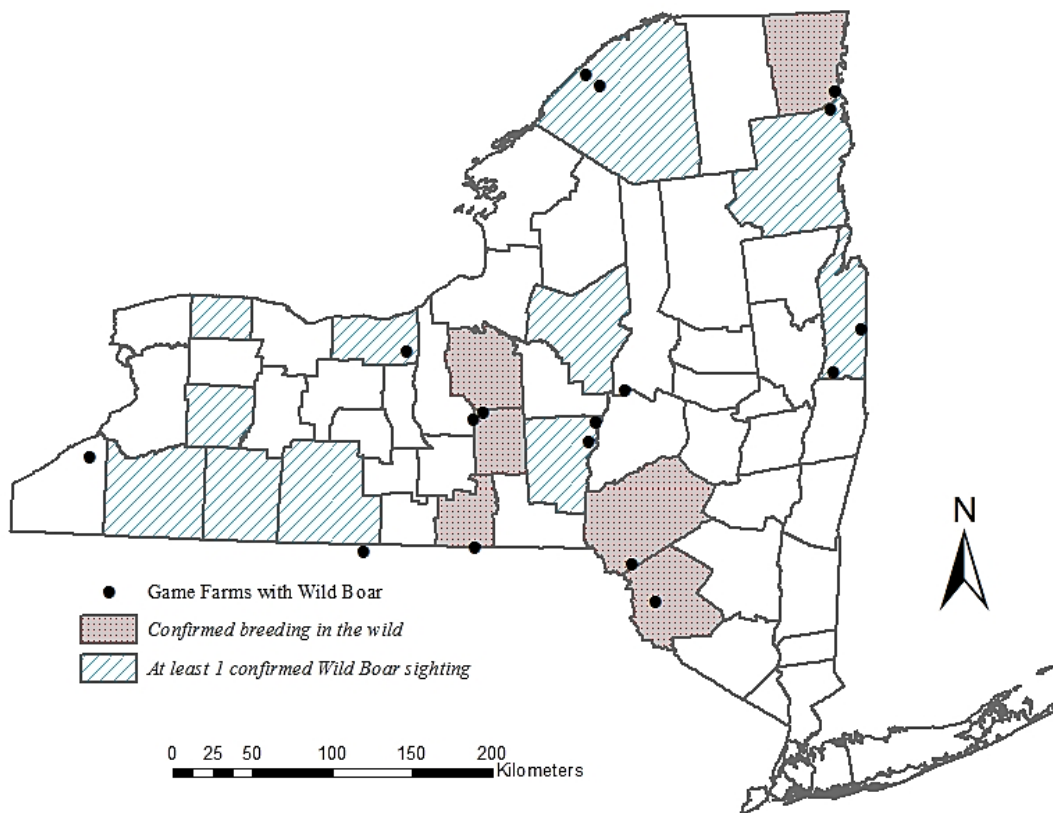
Intentional translocation and release of feral swine by “wild hog enthusiasts” (Gipson and Lee 1999) to establish new populations to hunt contributed greatly to range expansion in the United States (Zivin et al. 2000, Tennessee Natural Resources Agency 2012). As a result of the growing popularity and increased media exposure of feral swine hunting, many enterprising captive-hunt operators have attempted to capitalize by stocking Eurasian wild boar and Eurasian wild boar hybrids in high-fence shoot-

ing facilities in areas where feral swine do not occur in the wild, especially in northern states. In many instances, these animals escaped such facilities and established breeding populations in the wild.

From 2000-2013, feral swine became established in four areas of New York as a result of captive Eurasian wild boars escaping high-fence shooting preserves, breeding facilities, and sanctuaries (Figure 1). Fortunately, wildlife officials recognized the problem before populations were allowed to become large and widespread. In 2008, the New York State Department of Environmental Conservation (NYSDEC) and USDA APHIS Wildlife Services (WS) began working together to manage feral swine. Early management efforts focused on population control, damage management, source identification, and disease surveillance. In 2012, NYSDEC entered into a 5-year agreement that charged WS with the task of developing and implementing a comprehensive feral swine management plan, evaluating the feasibility of eradication, documenting the impacts of wild pigs in New York, conducting public outreach, and removing free-roaming feral swine from the wild.

## EDUCATION, OUTREACH, AND COALITION BUILDING

Wildlife Services’ outreach strategy was predicated on the goal of building a broad and diverse coalition of supporters to advocate for programs and policies that would reinforce efforts to eliminate feral swine from New York and prevent future populations from taking hold. Wildlife Services provided information about feral swine to landowner associations, agricultural interests, state and



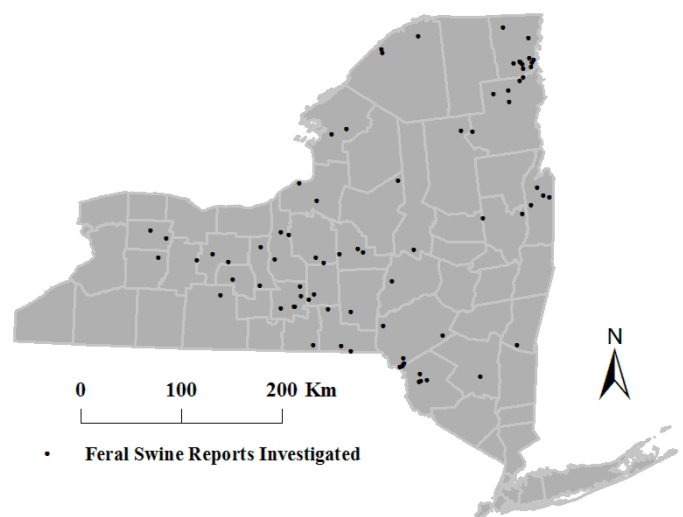
**Figure 1. County feral swine status in relation to game farms known to have Eurasian wild boars or Eurasian wild boar hybrids in New York, USA, May 2013.**

federal natural resource agencies, conservation groups, sportsmen, and other groups through educational presentations, workshops, and informational booths. Additionally, biologists interviewed for articles highlighting feral swine management in New York that were published in various newspapers, periodicals, and magazines.

The primary objectives of the outreach campaign were to: 1) articulate the myriad threats that feral swine pose to agriculture; natural resources; and human health, safety, and property; 2) dispel the misconception that feral swine could not survive in New York because of the climate; 3) stress the importance of implementing a swift, aggressive, and professional eradication effort before populations become large and widespread; 4) stress the need to stop future escapes and releases of Eurasian wild boars and their hybrids into the wild; 5) communicate the shortfalls of sport hunting as a tool to eliminate feral swine in New York; and 6) encourage the public to report possible feral swine sightings.

The support garnered through these outreach activities was critical for successful implementation of several aspects of the state feral swine management plan, particularly the need for regulatory action addressing captive Eurasian wild boar/hybrids in game farms and shooting preserves. Furthermore, outreach efforts resulted in a marked increase in general public awareness of feral swine issues. The increase in awareness was

important to note because public reports of feral swine activity were the foundation of New York's early detection network (Figure 2).



**Figure 2. Public reports of potential feral swine activity in New York, 1 January 2014 to 31 March 2016. Reports included 1) pig sightings, 2) damage, 3) scat, 4) carcasses, 5) and trail camera photos.**

## REGULATORY ACTION

Clear evidence suggested the four breeding populations identified in New York resulted from captive Eurasian wild boar and their hybrids escaping high-fence shooting preserves, game farms, and wild pig sanctuaries (Figure 1). Such escapes contributed to shorter-lived outbreaks and isolated sightings. Additionally, several instances documented feral swine in new areas with no link to these facilities, or to established wild populations. Though difficult to prove, these cases likely resulted from intentional introductions. Given the establishment of feral swine in New York was facilitated by humans, the need for common-sense regulatory measures to address the problem at its source was apparent.

As part of a 2012 Environmental Assessment for Feral Swine Damage Management in New York, WS and cooperating agencies analyzed existing regulations pertaining to feral swine and captive Eurasian wild boar/hybrids in New York as well as regulatory actions taken by other states that have experienced emergent feral swine issues. The analysis concluded that states that were most effective in reducing wild pig numbers and preventing the establishment of new populations achieved these goals by passing laws that made it illegal to release pigs into the wild; prohibited or restricted sport hunting of wild pigs (Kansas, Tennessee); and prohibited the possession of Eurasian wild boar and their hybrids in captivity (Wisconsin). Wildlife Services, NYSDEC, and other members of the New York Feral Swine Task Force worked together to generate recommendations based on the outcomes of these and other actions taken by states related to wild pig management, as well as on circumstances unique to New York.

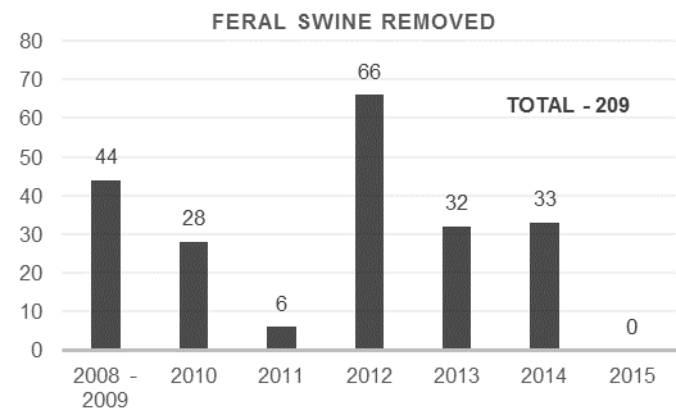
In response to these recommendations, the NYS Legislature passed a bill in 2013 that would, over a 3-year period, make it illegal to breed, release, trade, transport, or possess Eurasian wild boar or Eurasian wild boar hybrids in New York, and the governor enacted it (NY AB 2013). Additionally, the NYSDEC addressed feral swine hunting through regulatory action in 2014. The adopted regulation prohibited hunting and trapping of free-roaming Eurasian boars and Eurasian boar hybrids in New York, with limited exceptions for landowners incurring damage to their property. The reason for this measure was two-fold: First, when hunting, it is difficult to remove more than a fraction of the animals in the group, causing the remaining individuals to scatter and become increasingly difficult to capture. Second, the opportunity to hunt wild pigs encourages intentional translocations and releases by individuals attempting to establish new populations for hunting (Waithman et al. 1999, Bevins et al. 2014).

## POPULATION REDUCTION

Feral swine population reduction was accomplished primarily through trapping efforts by WS and NYSDEC. Though feral swine did occur on public land, the majority of management activities took place on private property. Agency personnel secured permission and access to 28,960 ha of private property from 151 landowners in five areas of New York where feral swine were known to occur.

Using corral traps, lethal removal was accomplished through live-trapping and euthanizing, as well as by shooting over bait from ground blinds and elevated tree stands. Given that feral swine learn to avoid humans after failed capture attempts, great care was taken to avoid educating the target population (Morrison et al. 2007). For this reason, measures were taken that maximized the percentage of pigs in a sounder captured on the first attempt, a technique known as “whole sounder management.” These measures involved the consideration of factors such as time of conditioning to traps before the trap is set, trap size, tripwire trigger configuration, animal behavior (based on monitoring cameras), and local hunting pressure. On two occasions, technicians manually triggered the trapdoor from a nearby ground blind using a string in order to ensure that all individuals were captured. The fact that the target animals in these situations were relatively naïve and easily patterned afforded WS the option to use this low-tech, cost-effective approach rather than more sophisticated electronic trapdoor triggering devices. Furthermore, technicians avoided using firearms to remove free-roaming feral swine in a group unless they felt that all individuals could be successfully removed at once.

Altogether, WS and NYSDEC removed a total of 209 feral swine over a 7-year period (2008-2014; Figure 3). Of these, 165 were removed using corral traps and 44 were removed through shooting. Hunters and landowners also removed feral swine prior to the new regulation, which took effect April 2014, but the number is unknown.



**Figure 3. Number of feral swine removed by USDA APHIS Wildlife Services and New York State Department of Environmental Conservation in New York, 2008-2015.**

From 2008-2012, control efforts focused on isolated populations of feral swine that were established on the landscape for several years. Subjected to hunting pressure for years, the animals were highly nocturnal and wary of humans. Beginning in 2013, following the apparent elimination of the original isolated populations, all pigs removed by WS were the result of new escape events from high-fence shooting preserves and Eurasian wild boar breeding facilities. Having habituated to humans while in captivity, these animals were exclusively

diurnal, and less wary of human activity (Figure 4). Technicians attempted to take advantage of this naivety by implementing control efforts as soon as possible following escape events: before the pigs were shot at and dispersed by opportunistic hunters. To do so involved preemptively securing access to private property near high risk captive-hunt operations and having trapping equipment in place in anticipation of escape events. Not knowing exactly when an escape event would occur, reports of feral swine sightings by residents and landowners were particularly important for locating and removing wild pigs in a timely manner.



**Figure 4. Photo taken by a motorist showing recently escaped Eurasian wild boar/hybrids on the roadside near a high-fence shooting preserve in Delaware County, NY. Having spent their lives in captivity, these animals were not conditioned to fear humans. This resulted in unexpected and threateningly close encounters with area residents.**

## **DOCUMENTING ELIMINATION**

With the exception of eradication campaigns on islands (Ramsey et al. 2008, Parkes et al. 2009) and fenced control areas (McCann and Garcelon 2008), there is no widely accepted standard or monitoring protocol in place to define the point at which elimination of feral swine from an area is achieved. This, in part, may be due

to the fact that feral swine occur in such a broad range of habitat types and at varying degrees of infestation. The possibility of new escapes from game farms and illegal releases are also confounding factors. It is, however, necessary to take steps to reduce the risk of re-infestation caused by a failure to remove the last remaining free-roaming individuals (Schuyler et al. 2002). As it becomes exceedingly difficult to detect animals at very low population levels, especially when the last individuals remain by virtue of their ability to escape detection, absolute certainty of absence is nearly impossible to attain (Perkins 1989). The proper course of action is to maximize our degree of certainty of absence, which, in the simplest of terms, is a function of the passage of time with no detections and the probability of detecting any remaining feral swine (Morrison et al. 2007). With time as a limiting factor, we chose to maximize the probability of detecting remaining feral swine by implementing a wide range of monitoring techniques throughout, focusing the most intensive monitoring on areas where breeding populations previously occurred. We have termed this strategy of systematic monitoring the “Five-Pronged Approach” to document the elimination of feral swine in New York; it consists of 1) on-the-ground management and surveillance, 2) an early detection network, 3) collaborating with law enforcement, 4) aerial surveillance, and 5) canine surveillance. Spatial data were collected and managed using a Geographic Information System (GIS) for all monitoring techniques in order to document, analyze, and make adjustments to monitoring efforts.

### **On-the-Ground Management and Surveillance**

From the time the elimination campaign began, as many as three feral swine technicians conducted continuous ground surveys by foot and ATV in areas where feral swine occurred, even after the last individual was presumed dead. Wildlife Services gained access to 34,000 ha of land – including both public and private property – on which to search for field sign that indicated feral swine were present including rooting, wallows, rubs, tracks, and scat. This is a labor-intensive but effective method of surveillance because feral swine sign is conspicuous, can persist for months, and is easily identified by trained specialists (Engeman et al. 2013).

Additionally, camera traps were used extensively to monitor for feral swine activity, both during the active population reduction phase and in the monitoring phase. Camera traps were instrumental to trapping success because they provided valuable information on abundance, demographics, behavior, and movement patterns of the target animals. Remote cameras allow for continuous monitoring with fewer field visits and reduced staff time, making them an extremely efficient method of monitoring for the presence of feral swine in areas where they are presumed to be eliminated (Engeman et al. 2013). In 2015, WS technicians reviewed 63,844 photos from 53 trail camera locations (8,153 camera nights; Figure 5). Technicians continued to maintain 75 camera trap locations in 2016. No feral swine were detected as of May 2016.

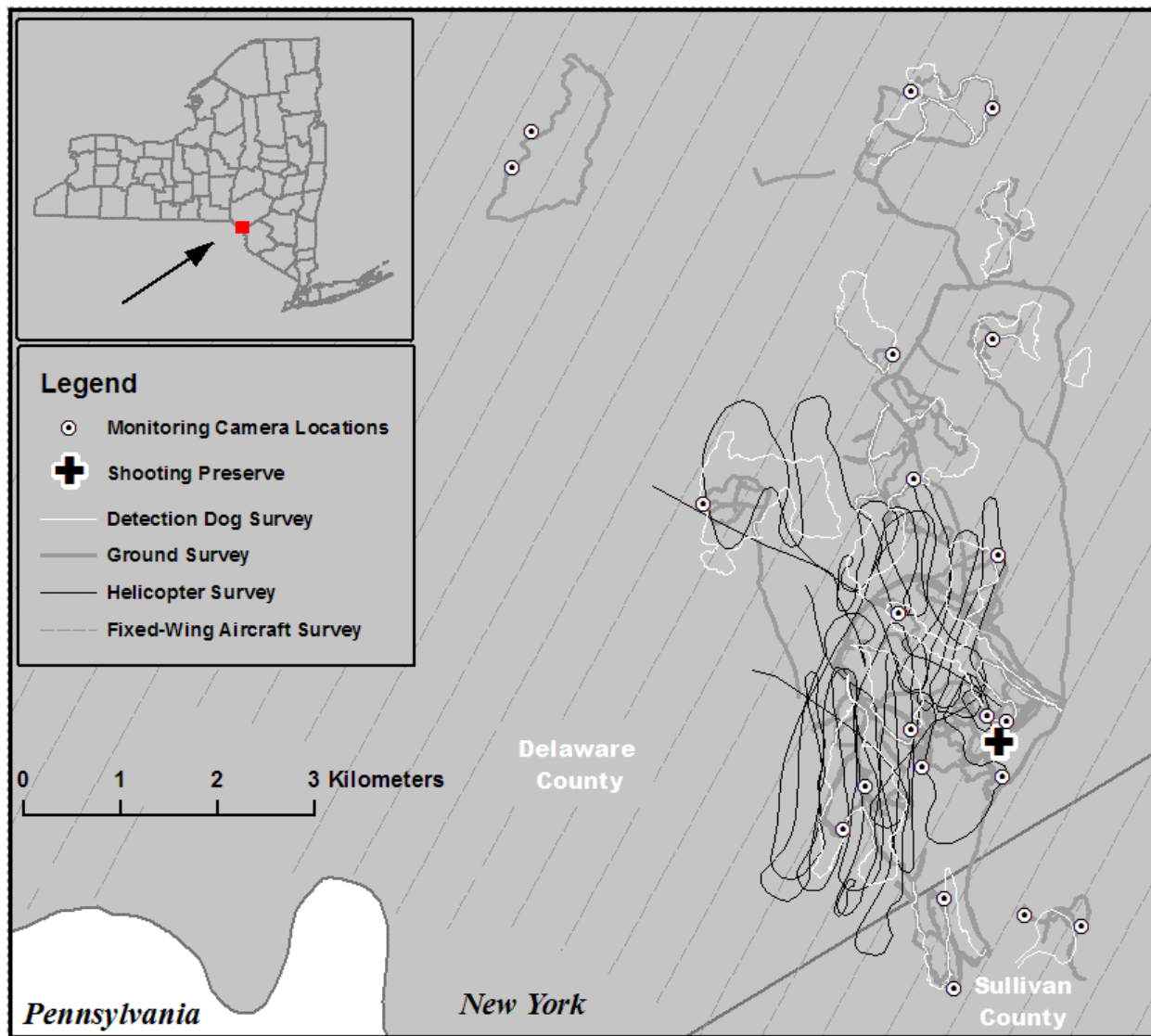


Figure 5. Sample of monitoring effort by USDA APHIS, Wildlife Services in proximity to a high-fence Eurasian wild boar shooting preserve in Delaware County, New York, 2014-2016. This figure represents two years of aerial surveillance (2014-2015), one year of ground surveys (2015), one year of detection dog surveys (2015), and two years of trail camera surveys (2015-2016). Four additional locations in the state were monitored at a similar level of intensity.

### Early Detection Network

Early detection was key to successful elimination of newly established populations of feral swine. Maintaining a system that encouraged the public to report any possible feral swine activity to wildlife agencies was a critical and cost effective component of New York's long-term monitoring plan. Residents in New York could make reports through the NYSDEC electronic feral swine reporting system, which was the foundation of the state's early detection network. From 1 January 2014 to 31 March 2016, feral swine specialists investigated 78 such reports (Figure 2). Public reports included free-roaming pig sightings, suspected pig damage, pig carcasses, footprints, and other sign. Of those reports, 12 (15%) stemmed from confirmed sightings of free-roaming Eurasian wild boar/hybrids or carcasses; all 12 cases

occurred in 2014 and resulted from escaped captive Eurasian boar/hybrids that were dispatched or returned to captivity within two weeks of being reported. The remaining reports were the result of escaped domestic pigs or potbelly pigs (39); damage, tracks, and scat from other wildlife (8); and sightings of other wildlife [black bears (*Ursus americanus*); red fox (*Vulpes vulpes*); gray fox (*Urocyon cinereoargenteus*); and eastern wild turkey (*Meleagris gallopavo silvestris*)] that were mistaken for pigs (7).

### Collaborating with Law Enforcement

Effective law enforcement was required to ensure that regulations New York adopted concerning Eurasian wild boar/hybrids had the desired influence. For this reason, NYSDEC and WS worked closely with law enforcement

**Table 1. Effort data for detection dog surveys to search for feral swine in five areas of New York, 2015.**

	Transects Completed		Time (hh:mm:ss)		Distance (Kilometers)	
	Total	Daily	Total	Per Transect	Total	Per Transect
<b>Cortland/Onondoga</b>	24	5.14	48:55:00	2:02:17	121.7	5.1
<b>Clinton</b>	31	3.44	58:05:00	1:52:25	160.9	5.2
<b>Delaware</b>	12	5.15	22:05:00	1:50:25	56.8	4.7
<b>Tioga</b>	10	3.75	21:48:00	2:10:48	57.6	5.8
<b>Sullivan</b>	2	6.06	2:48:00	1:24:00	8.4	4.2
<b>Total</b>	79	4.16	153:41:00	1:56:43	405.4	5.1

by assisting with investigations of potential violations and inspections of captive hunt facilities. Conservation officers were likely to be among the first to learn of feral swine sightings, illegal releases, or the presence of Eurasian wild boar/hybrids in captivity, and were therefore a valuable component of the overall monitoring strategy.

### Aerial Surveillance

Wildlife Services conducted aerial surveys to search for feral swine in New York in 2014 and 2015 (Figure 5). The 2014 survey was conducted using a helicopter and an aerial gunner to remove any feral swine that were encountered. This survey covered an area of 17,900 ha (15 flight hours) in three different areas where feral swine were previously present. The 2015 fixed-wing survey was not equipped with an aerial gunner. This survey covered five distinct areas totaling 93,000 ha in just under 24 flight hours. Both surveys were conducted in late winter so that live pigs and rooting damage would stand out against the snow cover. No free-roaming feral swine were detected in either survey. However, it was later confirmed that one free-roaming subadult pig was present in the survey area but not detected during the 2014 helicopter survey.

### Canine Surveillance

The first of two detection dog surveys was conducted in September 2015 in five areas of New York where feral swine previously occurred. A variety of wildlife and natural resource applications have employed detection dogs (*Canis lupus familiaris*) including invasive species detection, poaching and trafficking prevention, and ecological monitoring (Browne et al. 2006). The four dogs that participated in the survey were trained to alert to the scent of feral swine scat using previously collected scat from New York, Ohio, and Vermont. The dogs were also field trained and tested in Ohio in areas where feral swine were known to occur.

The detection dog survey covered 405 linear km in 79 separate transects throughout the five areas (Table 1; Figure 5). The dogs alerted to eight scats during the survey. Upon further investigation, all of these were determined to be false-positives based on visual inspection or DNA analysis. On one occasion a dog alerted to black bear scat. This was expected, however, because three of the dogs had previously trained to detect the scent profiles of other species including black bear, which were abundant in that area.

### DISCUSSION

The biological characteristics of feral swine (i.e. high fecundity, adaptability to a wide range of habitats, and lack of natural predators) pose a serious challenge to population control and eradication efforts. Most agree that these challenges can be overcome by reacting swiftly and implementing effective lethal control strategies before populations are allowed to become large and widespread. Equally if not more challenging, however, are the legal and social aspects of feral swine management. Much of the success of the New York feral swine elimination plan thus far can be attributed to the importance placed upon addressing these challenges through public outreach, coalition building, and regulatory action. The state ban on feral swine hunting did appear to increase the effectiveness of trapping efforts during the summer of 2014 by limiting the harassment of sounders by hunters. Time will tell if this measure also has the intended effect of dissuading intentional releases.

As of May 2016, there were no documented escapes of Eurasian wild boar/hybrids from high-fence shooting facilities since the ban on keeping captive Eurasian wild boar/hybrids took effect in September 2015. Some captive hunt operators, however, took advantage of an obvious loophole in the law by stocking their shooting preserves with domestic pigs and marketing them as “meat hogs.” There are no known instances of viable populations of “feral” (solely of domestic origin) pigs in New York, but the fact that these “meat hogs” are kept in large, semi-natural enclosures that are characteristic of many shooting preserves, and that pigs of any sort are likely to escape such enclosures eventually, is cause for concern and should be addressed.

While New York has taken steps to prevent the establishment of future populations from within, the natural spread of feral swine from isolated populations in adjacent states remains a threat. This speaks to the need for a large-scale and collaborative approach to feral swine management (Brook and VanBeest 2014). More immediately, New York should continue to build public awareness of feral swine, maintain the early detection network as an economic foundation for long-term monitoring, and develop a plan for managing future occurrences of feral swine.

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