A Cooperative Approach to Feral Swine Eradication in New Mexico

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ABSTRACT: Feral swine have been growing in both number and distribution in New Mexico (NM) for several years. Between 2004 and 2012, the number of NM counties with confirmed feral swine presence grew from 2 to 17. Likewise, concern grew among agencies that manage wildlife and habitat, as well as with ranchers and other property owners. In October 2012, the New Mexico Cooperative Feral Swine Eradication Team consisting of tribal, state, private, and federal partners was formed to pool resources and share ideas regarding how to best manage damage. Team members unanimously agreed that eradication was the preferred approach. Although there were feral swine in roughly half of the NM counties, distribution within those counties was thought to be limited due to lack of water. The team put together an estimate of the financial resources necessary to address eradication with a 6-year time line. In January 2013, the New Mexico Wildlife Services program was awarded $1 million in USDA APHIS emergency funds for a demonstration project associated with eradication of feral swine. Those funds were supplemented with additional funding and in-kind services from partner agencies in NM. In February 2013, 7 employees were hired to begin eradication efforts and 2 helicopter contracts were solicited. Work began in 3 primary areas: the Middle Rio Grande Valley, the Mescalero Apache Reservation, and the Pecos watershed eastward to the Texas state line. Methods used include corral traps, box traps, shooting, snares, and aerial removal. Radio-telemetry trap monitors were used in some areas to allow multiple traps to be checked from a single location. Radio-telemetry was also used in "Judas" hog operations to aid in locating widely scattered sounders.

KEY WORDS: cooperative program, eradication, feral swine, New Mexico, *Sus scrofa*, USDA, wild pigs, wildlife

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INTRODUCTION

Feral swine (*Sus scrofa*) populations in New Mexico (NM) rapidly expanded between 2004 and 2012 with the number of counties where feral swine presence was confirmed growing from 2 to 17 of 33 total. After the value of feral hog damage confirmed in New Mexico by USDA Wildlife Services (WS) staff increased from $300 in Fiscal Year 2005 (FY05) to $218,550 in FY08, WS began leading discussions with natural resource managers, land managers, farmers, ranchers, and others regarding rapidly growing feral swine populations and options for managing damage. Prior studies have demonstrated that even seemingly low levels of swine damage to habitat can still represent a major economic cost (Engeman et al. 2003), and greater damage levels naturally result in greater relative costs (Engeman et al. 2004). With the total annual value of agriculture production in NM exceeding $4.2 billion (NASS 2013), risks were judged to be high. An inductive model of suitable habitat for feral swine using GIS habitat data and GPS coordinates where feral swine had previously been taken by WS indicated that, based on limited data, approximately 75% of the state was suitable habitat for feral swine (Calkins et al. 2009). It was growing apparent that without aggressive action, feral swine would continue to spread and property damage, disease, and natural resources and economic impacts would be much greater. Failure to act quickly would likely mean the future cost of eradication would be significantly higher. It was also increasingly clear that sport hunting, combined with WS efforts aimed primarily at responding to feral swine damage, would not be sufficient to reduce damage or prevent further spread of feral swine in any significant way. Arguments by some that private hunting is an effective means of reducing wild pig populations may be ignoring the powerful incentive that for-fee hunting creates to establish and maintain viable pig populations on private land (Ziven et al. 1999). This is consistent with the observation that feral pig populations in California began a phase of rapid growth in both numbers and range shortly after 1960, just a few years after state wildlife managers made feral-pig hunting legal (Updike and Waithman 1996).

Less than 1% of NM is classified as riparian wetland, yet these habitats are used by 80% of the vertebrates classified as sensitive (NMDGF 2006). Damage to these fragile ecosystems could cause a significant decline or extinction of a number of New Mexico's plants and animals (Calkins et al. 2009). McKinney (1998) predicted that if biological invasions go unabated, we could eventually lose at least 30-35% of the world's species. In response to concerns regarding feral swine damage, the NM Feral Swine Eradication Team (FSET) was formed with a goal of identifying and sharing resources toward the goal of statewide eradication of feral swine. Team members and partners include NM Department of Agriculture (NMDA), NM State Land Office (NMSLO), NM Department of Game and Fish (NMDGF), NM Department of Health (NMDOH), NM Livestock Board (NMLB), NM Cattle Growers Association (NMCGA), Bureau of Land Management (BLM), U.S. Forest Service (USFS), Mescalero Apache Tribe, NM Cooperative Extension Service (NMCES), Bureau of Reclamation (BOR), several counties, and others. A statewide eradication plan and an estimate of the financial resources necessary for the team to address eradication with a 5-year timeline were prepared. The financial estimate called for approximately $6 million over 5 years with eradication to be followed by continued monitoring, especially along major natural corridors.

Feral swine have successfully been eradicated in other areas, primarily island habitats (Lombardo and Faulkner 2000, Kessler 2002, Cruz et al. 2005), but large-scale statewide eradication in the U.S. had not been attempted. Key to the NM plan was rapid response to prevent recolonization of areas already cleared.

The NM Secretary of Agriculture wrote a letter, to the Under Secretary of Agriculture for Marketing and Regulatory Programs, on behalf of the NM FSET, requesting support to address the growing feral swine issue in NM. USDA APHIS leadership responded by providing $1 million in contingency funds during Federal FY13 to conduct a demonstration project associated with eradication of feral swine. NM was chosen because the FSET consisting of federal and state agency leaders agreed feral swine should and could be eradicated, and because cooperative state, federal, and local funding was already in place. In January 2013, WS mobilized several wildlife disease biologists from around the country to begin the effort in NM. Seven feral swine specialists were hired and 2 helicopter contractors were selected to assist with the project which initially focused on 3 main areas, the middle Rio Grande Valley, SE NM including the Pecos River eastward to the TX state line, and the Mescalero Apache Reservation where there were reports of feral swine in springs that provided water to some rural residences. The primary objective of the project is elimination of feral swine from the state within 5 years, recognizing that to maintain feral swine free status, continuous monitoring will be necessary, especially along the TX state line and the Pecos and Canadian Rivers.

Methods used include corral traps, box traps, shooting, snares, and aerial removal. Radio telemetry trap monitors were used in some areas to allow multiple traps to be checked from a single location. Radio telemetry was also used in "Judas" hog operations to aid in locating widely scattered sounders.

In 2009, the NM legislature passed a regulation making it illegal to commercially hunt, transport, hold, breed, or sell feral swine according to NM Statutes § 77-18-6 (2014). In collaboration with the NMCES and other team members, a trifold leaflet outlining feral swine issues was prepared and distributed, and WS conducted numerous outreach programs with Cooperative Extension, NMDA, USFS, and others.

RESULTS

Between January 2013 and January 2014, over 5.1 million acres were worked and 687 feral swine were removed (Table 1). Roughly half of the feral swine taken were females. If we conservatively assume 1 litter per year and an average litter size of 6, we effectively have reduced the NM feral swine population by 2,248 pigs that won't be around this year to damage our environment, compete with native wildlife, cause damage to roads, crops, irrigation systems, spread noxious weeds, and threaten the health of people, livestock, wildlife, and pets. At an average of $200 in property damage per year per pig (Pimentel et al. 2002), we've saved over a half million dollars for NM residents since the project began. The demonstration project, led by USDA WS, is benefitting from tremendous cooperation with federal, state, tribal, and nongovernmental partners including NM Cattle Growers Association, NM Wool Growers Association, and ranchers. In addition to APHIS funding in FY13, cooperative funding and in-kind services and materials totaling approximately $200,000 were provided by 9 other Native American, state, federal, and local cooperators including high school vocational agriculture students who assisted by welding trap gates for the project. So far in FY14, partners have contributed approximately $350,000.

Table 1. Feral swine take by method (1/2013 - 1/2014).

	Aerial	Corral Trap	Box Trap	Shooting	Snare
# Taken	441	90	87	29	40
% of Total	64	13	13	4	6

Over 300 feral swine have been taken along the Pecos River watershed eastward to the Texas state line, including 23 in close proximity of lesser prairie chicken (*Tympanuchus pallidicinctus*) leks. The lesser prairie chicken is currently a candidate for listing under the Endangered Species Act. Of the 10 NM counties inhabited by lesser prairie chicken, 8 were known to harbor feral swine populations when the project began. Currently, the majority of feral swine in this area have been eliminated. Many were found a significant distance from the Pecos River and other flowing waters. They appear to be moving between stock tanks and other livestock waters while ranging over large distances. Telemetry and GPS collar data from this area indicate that feral swine may have variable home ranges of up to 250 square mi.

In what appears to be an interesting adaptation to intense summertime heat, feral swine in SE NM were observed loafing in "dugouts" primarily high on the northeast facing slopes of sand dunes. Of three dugouts measured, the average size was 103 × 54 × 35 inches. Feral swine are believed to have created these dugouts for cool shaded areas to rest.

No feral swine were found in the Middle Rio Grande Valley, despite several unconfirmed reports and multiple trail camera photos of a single large dark boar. This area is of significant concern because of numerous small irrigated farms and its proximity to more remote forested areas to the west, which would make eradication both difficult and costly. Monitoring is continuing in this area. Over 130 feral swine have been taken on the Mescalero Apache Indian Reservation and adjacent areas. More work remains, especially on the Lincoln National Forest, to prevent repopulation of this area. There are unconfirmed reports of feral swine within the nearby White Mountain Wilderness on the Lincoln National Forest, and WS has confirmed feral swine outside the NE boundary of the wilderness. Surveillance is ongoing in this area.

Large portions of the Canadian River watershed and adjacent areas have been cleared with over 140 feral swine taken. Work in this area is ongoing.

Over 70 feral swine have been removed from the Lincoln National Forest (LNF) and adjacent areas. Portions of the Capitan Wilderness within the LNF have

Table 2. New Mexico disease surveillance and results (2007 - 2013).

	CSF	PRV	SB	SIV (serum)	Toxo.	Lepto.	HEV	Trich.	*E. coli*	Non-0157 STEC	Salm.	Giar.	Crypto.
Positive	0	17	2	2	3	8	3	4	1	3	7	1	1
Negative	383	461	331	171	145	46	78	107	15	13	9	26	26
% Positive	0	3.7	0.6	1.2	2.1	17.4	3.8	3.7	6.7	23	43.8	3.8	3.8

CSF- Classical Swine Fever
PRV - Pseudorabies virus
SB - Swine brucellosis
SIV - Swine influenza virus
Toxo. - Toxoplasmosis
Lepto. - Leptospirosis
HEV - Hepatitis E virus
Trich. - Trichinosis
E. coli - *Escheria coli*
Non-0157 STEC - Non-017 Shiga toxin-producing *E. coli*
Salm. - Salmonella
Gia.r - Giardia
Crypto. - Cryptosporidiosis

been flown twice, and although no pigs were found within wilderness, 10 were taken within a quarter-mile of the wilderness boundary.

WS has conducted disease surveillance in NM feral swine populations since 2007 (Table 2). Positives for pseudorabies, swine brucellosis, hepatitis E, leptospirosis, toxoplasmosis, crytosporidia, giardia, salmonella, and *E. coli* have been found in multiple counties. This information is passed along to public health professionals, veterinarians, ranchers, and county officials to help create an increased awareness.

DISCUSSION

Bomford and O'Brien (1995) suggested 3 criteria must be met for successful eradication of vertebrate pests. Those criteria are: 1) rate of removal exceeds rate of increase, 2) immigration is prevented (sometimes requires control in margins), and 3) all reproductive animals must be at risk.

There is no estimate of the number of feral swine in NM. However, the arid climate and desert landscape would seem to limit available habit and hence numbers of feral swine distributed throughout the state. Three consecutive years of drought, 2010-2013, have likely helped limit the rate of feral swine spread within NM. While it might seem important to have a population estimate before beginning eradication, wildlife biologists and land managers considering potential environmental and economic consequences in NM felt the need to act quickly to prevent further spread of feral swine. Feral swine are very fecund animals with up to 2 litters per year and an average of 6-8 per litter. Populations can grow very rapidly.

To determine if eradication was feasible, WS began feral swine control in a limited area in SE NM during 2012. Intensive ground and aerial lethal removal, monitoring with trail cameras, and observation by a network of landowners, lessees, and wildlife managers and other agency staff quickly revealed eradication would be achievable. After the first 6 months of focused feral swine removal in this area, very few additional swine could be found. Large sounders were nonexistent, and the few remaining feral swine were either single boars or small groups of 2-3 pigs. So although we could not confirm that the rate of removal exceeded the rate of increase in this area, we felt strongly that we were winning the battle. In marginal feral swine habitat, such as most of NM where water availability is a limiting factor, having population estimates may not be necessary from a biological perspective. However, population estimates may be an important component for legislators and agency administrators making decisions regarding financial commitments.

The second criteria, prevention of immigration from other areas, was addressed by conducting feral swine removal in a 10 to 20-mile buffer zone in key areas of adjacent states, with special attention given to better habitat such as the Canadian River corridor extending into Texas. An extremely important component of the NM feral swine eradication plan involves working in conjunction with adjacent states to build and maintain buffer zones.

In addition to the "must have" criteria discussed above, Bomford and O'Brien (1995) described 3 additional "desirable" criteria including: 1) animals can be detected at low levels, 2) discount benefit-cost analysis favors eradication over control, and 3) a suitable socio-political environment.

Use of trail cameras, bait stations, and aerial hunting incorporating the "Judas" technique (using radio-collared sows to help locate additional sounders), has helped ensure detection of animals at low densities. While benefit-cost analysis was not conducted, WS and the cooperating FSET members felt it was intuitive that eliminating feral swine while population densities were relatively low and widely scattered would be preferable to allowing populations to increase unchecked. Widespread state and federal agency support, and support from the agriculture industry and sportsman's organizations bolstered by public education, helped to ensure that the socio-political environment was suitable to support feral swine eradication. Cooperating state and federal agency staff members gave numerous presentations and worked together to prepare and distribute information regarding feral swine in NM. Successful eradication efforts recognize feral swine as an unwanted non-native invasive pest that negatively impacts desirable native wildlife species, habitat, water quality, and human, pet, and livestock health.

CONCLUSION

A strong public education campaign in states with emerging populations of feral swine is an important component of any feral swine eradication or control effort. Local outreach helps hunters and landowners understand negative impacts associated with feral swine and may help to deter translocation of feral swine into

new areas. Knowledge of damage and disease may help local municipalities and state governments develop appropriate policies and regulations associated with non-native invasive feral swine. Elucidating the dynamics and long-term ecological effects generated by pigs is a crucial step towards increasing our understanding and more effectively managing biotic interactions (Nogueira et al. 2009). Over 50 newspaper, radio, television, magazine and journal interviews regarding feral swine were provided in New Mexico during the first year of eradication.

More challenging, is gaining access to private lands where control methods should be implemented. While outreach, particularly though the NM Cooperative Extension Service, has helped, some landowners and public lands lessees have denied WS access to critical areas. In NM, private lands are often interspersed with BLM and state trust lands on individual ranches. While we have chosen not to challenge the wishes of landowners or lessees, we have been hampered by some who deny access in areas critical to feral swine removal efforts. Ultimately, pressure from neighboring ranches may cause some of these individuals to change their minds as progress in made in these adjacent areas. Reasons for denying access to agencies conducting feral swine eradication vary. Some want to remove the feral swine themselves; others want to maintain local feral swine populations for sport hunting by family and friends, while others have a genuine distrust of the federal government. WS is currently working with cooperators to gain access to key areas where access has previously been denied.

Locating and removing small pockets of feral swine scattered over large areas of public and private land is time consuming and costly. Feral swine home ranges in arid habitat can be large and public hunter success is poor. Home ranges of GPS collared sows have varied from 6 square miles in mountainous areas near water to over 250 square miles in desert habitat of SE NM. Use of radio-telemetry for trap monitors, as well as on Judas swine, can save significant time and expense in locating and removing wide-ranging isolated sounders or lone boars.

Agency personnel, hunters, landowners, and lessees must be willing to share information regarding feral swine locations and numbers in order to be successful. And lastly, rapid deployment of agency resources to reduce or eliminate feral swine populations must take into account delays associated with state and federal government procurement of equipment and supplies as well as aerial contracting. Government agencies need better processes to eliminate or reduce these delays, which ultimately cause an increase in eradication costs.

The NM Cooperative Feral Swine Eradication Project made tremendous progress in Year 1. Removal efforts have been conducted in 15 of the 17 counties thought to have feral swine in NM, with eradication near complete in at least 10 of those counties. Although much work remains, especially in remote and rugged forested areas of the state, complete eradication of feral swine is achievable within the 5-year time frame initially projected. Additional tools, including registered toxicants and associated bait delivery systems, would make feral swine eradication, especially in remote inaccessible areas, much more efficient. Use of radio-collared Judas swine has been particularly valuable in NM, with 15 collars deployed between February 2013 and February 2014. Approximately 35% of 687 total feral swine killed were taken with the aid of Judas swine, and 64% were taken through aerial shooting.

Feral swine eradication in states with emerging populations is achievable and almost certainly less costly than long term environmental and property damage that occurs when populations grow unchecked. Strong state, tribal, and federal agency partnerships and wide-spread landowner cooperation are essential for successful feral swine eradication campaigns.

LITERATURE CITED

Bomford, M. and P. O'Brien. 1995. Education or control for vertebrate pests? Wildl. Soc. Bull. 23(2):249-255.

Calkins, M. T., K. G. Boykin, and M. C. Andersen. 2009. Invasive potential of feral pigs in New Mexico: Preliminary assessment and future directions. New Mexico Cooperative Fish and Wildlife Research Unit, Technical Assistance Report. 18 pp.

Cruz, F., C. J. Donlan, K. Campbell, and V. Carrion. 2005. Conservation action in the Galapagos: Feral pig (*Sus scrofa*) eradication from Santiago Island. Biol. Conserv. 121:473-478.

Engeman, R. M., H. T. Smith, R. G. Severson, M. M. Severson, S. A. Shwiff, B. Constantin, and D. Griffin. 2003. Amount and economic valuation of feral hog damage to a unique basin marsh wetland in Florida. Florida Park Service, 2003 "Partnership" Technical Report. Tallahassee, FL. 5 pp.

Engeman, R. M., H. T. Smith, R. Severson, M. A. Severson, S. A. Shwiff, B. Constantin, and D. Griffin. 2004. The amount and economic cost of feral swine damage to the last remnant of a basin marsh system in Florida. J. Nature Conserv. 12:143-147.

Kessler, C. C. 2002. Eradication of feral goats and pigs and consequences for other biota on Sarigan Island, Commonwealth of the Northern Mariana Islands. Pp. 132-140 *in*: C. R. Veitch and M. N. Clout (Eds.) Turning the tide: The eradication of invasive species. Proceedings of the International Conference on Eradication of Island Invasives. Occ. Paper of the IUCN Species Survival Commission, No. 27. IUCN, Gland, Switzerland and Cambridge, UK.

Lombardo, C. A., and K. R. Faulkner. 2000. Eradication of pigs (*Sus scrofa*) on Santa Rosa Island, Channel Islands National Park, California. Pp. 300-306 *in*: Proc. Fifth California Islands Symposium. OCS Study MSS99-0038, U.S. Department of the Interior, Mineral Management Services Pacific, OCS Region, Washington D.C.

McKinney, M. L. 1998. On predicting biotic homogenization: Species-area patterns in marine biota. Global Ecol. Biogeog. Letters 9:297-301.

NASS 2013. New Mexico 2012 Agricultural Statistics. NMDA/NASS. 65 pp.

NMDGF (New Mexico Dept. of Game and Fish). 2006. Comprehensive Wildlife Conservation Strategy for New Mexico. New Mexico Dept. of Game and Fish. Santa Fe, NM. 526 pp + app.

New Mexico Statutes. 2014. 2014 New Mexico Statutes: Ch. 77 - Animals and Livestock, Sec. 18 General Animal Regulations, Sec. 77-18-6 Feral hogs; prohibition; penalty.

Nogueira, S. L., S. C. Nogueira, and J. M. Fragoso. 2009. Ecological impacts of feral pigs in the Hawaiian Islands. Biodiv. Conserv. 18(14):3677-3683.

Pimentel, D., L. Lach, R. Zuniga, and D. Morrison. 2002. Environmental and economic costs associated with non–indigenous species in the United States. Pp. 285-303 *in*: D. Pimentel (Ed.), Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species. CRC Press, Boca Raton, FL.

Updike, D., and J. Waithman. 1996. Dealing with wild pig depredation in California: The strategic plan. Proc. Vertebr. Pest Conf. 17:40-43.

Ziven, J., B. M. Hueth, and D. Zilberman. 1999. Managing a Multiple-Use Resource: The case of feral pig management in California rangeland. J. Env. Econ. Manage. 39:189-204.