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Wild Pig Damage Abatement in Texas: An Integrated Strategy of Landowner Education and Direct Control

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ABSTRACT: Texas has the largest wild pig population in the nation, estimated at 2.6 million animals. Damage to agronomic enterprises is conservatively estimated at \$52 million annually with total economic damage to agriculture and the environment in urban, suburban, and rural Texas possibly reaching 10 times that figure. In response to damage caused by this invasive exotic species, the Texas A&M AgriLife Extension Service (Extension) increased educational programming efforts and direct control of wild pigs via Wildlife Services. From 2006 -2013, earmarked grant funding (5 projects over the 8-year period) was obtained from the Texas State Legislature via the Texas Department of Agriculture. Project funding facilitated the development and deployment of an integrated strategy of direct control of wild pigs by Wildlife Services' personnel and Extension-led landowner education via one-on-one contacts, group meetings, demonstrations, and publications. Website availability and mass media contacts including television and radio interviews, newspaper articles, and magazine articles were also utilized to increase public awareness and education on wild pigs and damage abatement. Landowners participating in Extension educational events were surveyed to characterize damage and control efforts as well as measure the impacts of education efforts. Direct control via Texas Wildlife Services employed all legal methods including trapping, shooting (both ground and aerial), snaring, and dogging, focusing control efforts on areas where pig damage compromised agricultural production and threatened sensitive environmental habitats and/or endangered and threatened species. This integrated approach of public education and direct control reduced the agronomic impact of wild pigs by 66% on cooperator-controlled properties in the pilot phase (2006-2007) of the project. Additional information on methodology and impacts of education and direct control from January 2006 through November 2013 is discussed.

KEY WORDS: control techniques, damage abatement, Extension, *Sus scrofa*, swine, Texas, wild pigs, Wildlife Services

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INTRODUCTION

Pigs (*Sus scrofa*) were first introduced into the New World in the West Indies by explorer Christopher Columbus in 1493. Hernando de Soto introduced them into what is today the United States via Florida in 1539. His exploration party then brought pigs into Texas by the mid-1500s (Mayer and Brisbin 1991). Today, the wild pig is considered to be an invasive exotic species with populations estimated at 2.6 million head in Texas occupying 253 of 254 counties in the state (Timmons et al. 2012). The National Wild Pig Committee has recently adopted the term "wild pig" as the accepted common name to describe the feral pig, feral hog, feral swine, wild boar and other populations of the family Suidae, especially as it pertains to North American populations. Wild pig populations nationwide are estimated at 5 to 8 million animals and currently occupy 36 states (John Mayer, Savannah River National Lab, pers. comm.).

Wild pigs can damage wetlands, deteriorate water quality, compete with or prey directly upon native wildlife species, damage agricultural crops, predate on livestock species, damage fencing, damage forest restoration, and carry numerous parasites and diseases that are threats to human, livestock and wildlife (West et al. 2009). One estimate of agricultural and environmental damage caused by wild pigs in the United States exceeded \$1.5 billion annually (Pimmental et al. 2002, Pimmental 2007).

A survey of 775 Texas landowners in 2003-04 regarding their attitudes toward and economic impact of

wild pigs determined that the vast majority of Texas landowners viewed wild pigs as both economic and environmental liabilities (Adams et al. 2005). Average economic loss per survey respondent was \$7,515 since wild pigs first appeared on their properties. An additional average expenditure of \$2,631 was required to correct damage and/or institute control efforts.

Extrapolation of these data in 2005 revealed that a conservative estimate of wild pig damage to Texas agriculture is \$52 million annually, with additional annual expenditures of \$7 million for repairing damage and/or controlling pigs (Higginbotham et al. 2008). These economic impacts do not include damages occurring to endangered/threatened species, environmentally sensitive habitats, urban/suburban landscapes, and personal property damage/human health issues due to disease transmission and/or vehicle-pig collisions.

As wild pig populations continue to increase in Texas and other states, these economic impacts are expected to also continue to increase. Currently, the best course of action is to adopt integrated control strategies (direct control) in association with landowner education efforts (indirect control) to manage wild pig populations and the damage they cause.

BACKGROUND

The Texas A&M AgriLife Extension Service provides quality, relevant outreach and continuing education programs and services to the people of Texas. These Extension educational programs, relative to the wild pig

abatement projects, were delivered to the public by county Extension agents at the county, multi-county, regional, and state levels with the support of Extension Specialists within the Extension Wildlife and Fisheries Project Group/Department of Wildlife and Fisheries Sciences-TAMUS (Rollins et al. 2007). Direct control services relative to this project were provided by Texas Wildlife Services (TWS), a unit within the Texas A&M AgriLife Extension Service that serves urban and rural areas with technical assistance, education, and direct control in wildlife damage management in order to alleviate negative impacts of wildlife. Therefore, the Texas A&M AgriLife Extension Service is the only state agency uniquely positioned to address both the education/outreach (indirect control) and technical assistance aspects (direct control) of this project focusing on wild pigs and their damage to Texas agriculture.

Beginning in 2005, the Texas State Legislature appropriated funds during every 2-year legislative session to directly support educational efforts directed at landowners and the public at large and the removal of wild pigs from both public and private lands. This funding was specifically earmarked and appropriated to the Texas Department of Agriculture (TDA) to disburse via a competitive request for proposals (RFP) for projects that addressed wild pig damage abatement issues in Texas. The Texas A&M AgriLife Extension Service was successful in obtaining funds from the initial appropriation to conduct a pilot project that encompassed both education of and direct assistance/service to landowners negatively impacted by wild pigs. The initial pilot project was conducted from January 2006-February 2008. Subsequent project funding was obtained from additional legislative appropriations to TDA to continue agricultural damage abatement via direct control and Extension education for the public. These 4 additional grant project periods were March 2008-February 2010, March 2010-February 2011, March 2011-May 2012, and June 2012-November 2013.

METHODOLOGY

Direct Control - Texas Wildlife Services

The initial 2-year pilot study conducted beginning in 2006 occurred in 4 distinct ecosystems for direct control technical assistance: Post Oak Savannah/Pineywoods (combined), Blacklands Prairie, and Coastal Prairie. These sites were selected because they were very different ecoregions within the state representing a variety of agricultural enterprises, soil types, and climates. Within each ecoregion, specific counties were chosen based on the agricultural enterprises represented and the willingness of county Extension personnel and Wildlife Services personnel to coordinate and cooperate on this project. These included Hill, Navarro, and a portion of Henderson County representing the Blacklands site; Camp County representing the Post Oak Savannah/Pineywoods site; and Matagorda County representing the Coastal Prairie site.

The initial pilot study was unique compared to all subsequent projects because cooperator/landowner listening sessions were held at each pilot site during the pre-control phase in order to characterize agricultural

damage caused by wild pigs and facilitate a tailored survey design (Appendix 1). Cells of cooperators were identified and enrolled in the project by Wildlife Services personnel. This project was also unique because all cooperators were required to provide detailed damage and economic impact information for pre- and post-abatement activities for each year of participation during one-on-one interviews. Cooperators consisted of landowners that participated in: 1) both years of the study or 2) or only one year of the study. Net Promoter Scores were collected during the survey process to determine customer satisfaction. Cooperators in these 3 identified pilot sites received direct control assistance from Wildlife Services personnel using all legal means practical and necessary to abate wild pig damage on their properties.

Following the initial 2-year pilot phase, Wildlife Services continued to provide strategic removal of wild pigs on both public and private lands statewide, with an emphasis on mitigating current or future damage to agriculture, endangered/threatened species and the environment.

Demonstration projects were established based on resources to be protected and with the input of an informal advisory committee. TWS attempted to meet the Legislature's intent for "wild pig abatement" to be administered statewide by selecting projects across all ecoregions of the state. Each project was designed to protect one or more resources and data were collected on a project-by-project basis to determine effectiveness. TWS also used grant-funded opportunities for disease monitoring projects and the development and testing of new methodology. Some of the projects were also used as sources of samples for research efforts.

A separately-funded initiative directed by TDA was to provide wild pigs to the meat market for use in food banks. TWS purchased a trailer and established a process to deliver captured wild pigs to the processors pick-up points. The processor would accept only wild pigs greater than 36 kg (80 lbs) and would transport and process the pigs for 50% of the meat. Because of the concern for food-borne pathogens, the food bank recipients of this meat agreed to use the meat only in institutional kitchens where handling and processing could be assured.

Indirect Control –Extension Education/Outreach

A second clientele group reached during the project was landowners participating in indirect control efforts. These indirect or Extension education/outreach efforts included one-on-one contacts, mass media contacts, websites, and numerous Extension educational events to provide landowners with research-based information to effectively deal with wild pig issues themselves.

One-on-one contacts were made via office and site visits, email, telephone, and publication dissemination. Mass media contacts were also utilized to reach the public including tv and radio interviews, podcasts, news releases, newspaper articles, and magazine articles. The wild pig website (<http://feralhogs.tamu.edu>) was also available as a source of information for the public.

Additional Extension educational/outreach efforts were conducted via seminars, field days, workshops,

result demonstrations, and pesticide applicator recertification trainings. Unlike Wildlife Services cooperators, the landowners obtaining Extension educational information did not receive direct one-on-one on-site technical assistance but rather were participants in educational events conducted across the state and sponsored by county Extension agents throughout the 8-year/5-project period.

All educational program participants were asked to complete a one-page survey at the conclusion of each educational event to characterize damage caused by wild pigs, identify current control methods employed, determine the economic value of information provided to them (e.g., reduced damage, increased yields), indicate knowledge gains, and calculate a Net Promoter Score as an index of customer satisfaction. (Appendices 2 and 3).

The Net Promoter Score (NPS) is a measure of an entity's or program's growth engine and efficiency (Riechheld 2006). A Likert scale ranging in value from 0 to 10 is used to identify a company's or agency's program promoters (defined here as the percent of clientele rating the Texas A&M AgriLife Extension Service as a 9 or 10) minus the program detractors (defined as the percent of clientele rating A&M AgriLife Extension as a 6 or below) using the previously described Likert Scale. Companies/agencies/programs with the most efficient growth engines and high customer satisfaction receive Net Promoter Scores of 50% or higher from their customers and/or clientele.

The survey instrument (Appendix 2) was modified in September 2007 to facilitate the collection of additional information on the: 1) type and number of management practices to be adopted and 2) knowledge gained. This survey document was then used throughout the ensuing projects, which ended in November 2013 (Appendix 3).

RESULTS

In total, the 5 grants were acquired from the Texas Department of Agriculture by the Texas A&M AgriLife Extension Service and totaled \$2,895,042 during the 8-year project period (Table 1). However, it is important to note that many additional educational and direct control activities related to wild pig damage abatement were also being simultaneously conducted by the Texas A&M AgriLife Extension Service that were separate and apart from the TDA-funded efforts. Therefore, data and activities reported in this paper addressed only those activities directly funded via TDA.

Table 1. Grant period and funding allocation for wild pig damage abatement (2006-2013).

Project Period	Total Grant Allocation	Allocation to Education	Allocation to Direct Control
2006 - 2008	\$500,000	\$151,981	\$348,019
2008 - 2010	\$1,000,000	\$60,328	\$939,672
2010 - 2011	\$422,497	\$50,050	\$372,447
2011 - 2012	\$472,545	\$51,454	\$421,091
2012 - 2013	\$500,000	\$60,000	\$440,000
Total	\$2,895,042	\$373,813	\$2,521,229
Mean / Project	\$579,008	\$74,763	\$504,246

TEXAS WILDLIFE SERVICES IMPACTS (DIRECT CONTROL)

Direct Control – Pilot Project (January 2006 - February 2008)

Because the initial 2-year pilot project collected unique data on the impacts of direct control efforts, it is reported separately here. These efforts allowed the Texas A&M AgriLife Extension Service to refine the protocol of TWS Services for future direct control efforts and Extension educational efforts to better serve clientele in the 4 subsequent funding cycles. The initial 2-year Wild Pig Abatement Project was implemented in January 2006 and concluded in February 2008. On-site technical assistance (direct control) was provided by Wildlife Services to landowners at 3 pilot sites (Post Oak Savannah/Pineywoods, Blackland Prairie, and Coastal Prairie) while group educational events (indirect control) emphasizing adoption of efficient landowner-initiated control methods were conducted statewide. Both groups of clientele participating in the project were surveyed to measure the overall economic impact of this TDA-funded initiative. Data collection spanned the period 2005-2008 in order to estimate the economic impact of technical assistance and educational programs to the agricultural community both pre- and post-project.

Texas Wildlife Service technicians worked with a total of 48 cooperators during the course of this initial project. However, 8 participants did not provide data for a variety of reasons for all 3 years (2006, 2007, and 2008) concerned. Data from all cooperators are included in the main body of this report as results from these 8 participants do not appreciably impact totals. The 48 participating cooperators owned or controlled 230,017 acres and estimated damages and expenditures totaling \$2,228,076 directly attributable to feral hogs at the 3 pilot sites for 2005. These same cooperators estimated a decline in damage to \$1,261,520 in 2006 as a direct result of TWS abatement efforts that included the removal of 1,930 wild pigs. In 2007, a decline in damage of \$513,935 from the previous year (2006) was noted following the removal of 1,869 pigs. As a result, cooperators saved a total of \$966,556 through the direct technical assistance provided by TWS during Year 1 and \$513,935 in Year 2 of the project for a total savings of \$1,480,491, a decline in economic impact of 66% over the 2-year pilot project, where a total of 3,799 wild pigs were removed. This economic impact estimate was considered to be conservative because a number of the cooperators had also received direct control services from TWS before the project began, thus reducing wild pig densities and therefore damage reported in the pre-control phase of the project.

The Net Promoter Score for direct control activities was calculated based on the likelihood of cooperators recommending Texas Wildlife Services to friends, family, and colleagues as a source of technical assistance for wild pig control (Riechheld 2006). An NPS of 71% among the cooperator group indicated that Wildlife Services was efficiently assisting landowners with direct control via on-site technical assistance during the 2006-2007 pilot project.

Table 2. Impact of Texas Wildlife Service removal of wild pigs via damage abatement grants (2006-2013).

Project Period	Grant Allocation Direct Control	# Wild Pigs Removed	Cost/Pig Removed	Economic Impact of Control	Benefit : Cost
2006 - 2007	\$348,019	3,799	\$91.60	\$1,480,491*	6.20 : 1.00
2008 - 2010	\$939,672	47,407	\$19.69	\$9,481,400**	10.15 : 1.00
2010 - 2011	\$372,447	21,390	\$18.70	\$4,278,000**	10.69 : 1.00
2011 - 2012	\$421,091	24,737	\$17.02	\$4,947,400**	11.25 : 1.00
2012 - 2013	\$440,000	30,207	\$22.84	\$6,041,400**	13.73 : 1.00
Total	\$2,521,229	127,540	\$19.77	\$26,228,691	-
Mean / Project	\$504,246	25,508	-	\$5,245,738	10.48 : 1.00

* Based on cooperator survey data collected post-removal of 3,799 wild pigs (2006-2007).

** Based on the Pimmental et al. (2005) damage estimate of \$200 per wild pig.

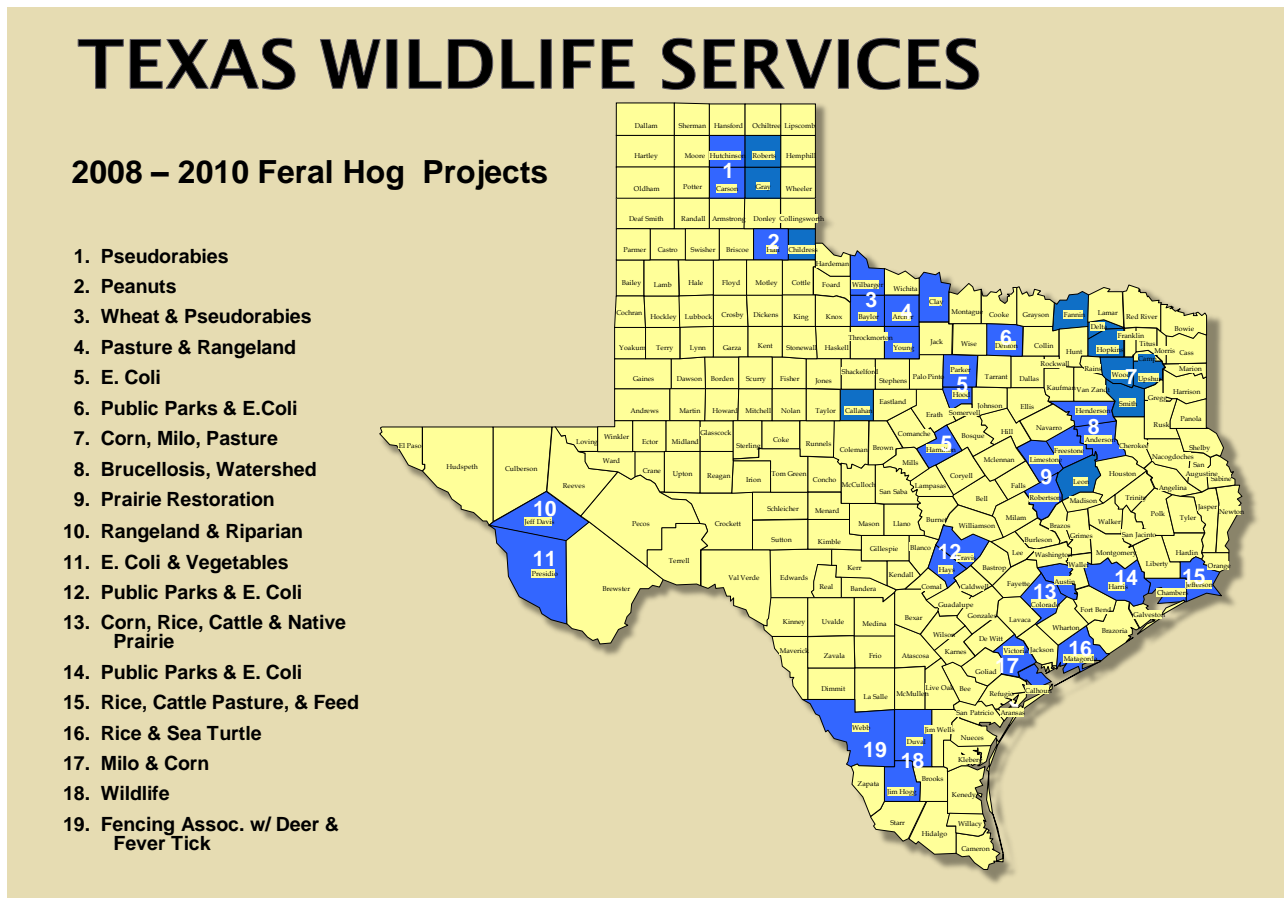


Figure 1. Distribution of TWS wild pig direct control projects by type (2008-2010 only).

Direct Control – All Projects

In total, TWS removed 127,540 wild pigs on TDA-funded projects during the 8-year period from January 2006 to December 2013 (Table 2). Of the wild pigs removed, 46% were by aerial shooting (primarily via helicopter but included fixed wing). Other methods of wild pig removal included snaring – 20%, corral trapping – 19%, shooting (day and night but excluding night vision) 9%, night vision shooting – 5%, and other (e.g., drop netting, dogging) – 1%.

The cost per pig removed by TWS averaged \$19.77 by all control methods employed. The high cost per pig removed (\$91.60) during the 2006-2007 pilot project resulted from two factors: 1) control efforts were limited only to cooperator properties during the pilot study, and 2) as previously discussed, a number of the cooperator

properties subjected to control efforts during 2006-2007 had received previous control services in 2005, which resulted in reduced pig densities and lower return on control efforts in 2006-07.

Survey data during the 2006-2007 pilot project indicated that the economic benefit of removing 3,799 pigs from cooperators properties was \$1,480,491, which equated to \$389.71 in damage per pig. However, since detailed pre/post-control survey data were not collected from cooperators in the 4 subsequent projects, an estimate of economic impact of pig removal had to be calculated. Pimmental et al. (2005) estimated that economic damage per wild pig averaged \$200, and we elected to use this more conservative damage estimate to assess the impact of pig removal in subsequent projects from 2008-2013. Figure 1 shows the initial distribution of projects as well

Table 3. Impacts of Extension Educational Programming via individual contacts, mass media, and the wild pig website.

Project Period	Individual Contacts	Mass Media Contacts	Website Unique Visitors	Website Pages Accessed
2006 - 2008	2,339	31	31,374	76,830
2008 - 2010	2,483	48	49,840	108,447
2010 - 2011	1,351	33	14,042	40,997
2011 - 2012	954	40	29,429	70,414
2012 - 2013	1,161	38	74,981	91,062
Total	8,288	190	199,666	387,750
Mean / Project	1,658	38	39,933	77,550

as the resources protected during this phase of the TDA grant.

The removal of 123,741 wild pigs during these 4 subsequent projects had an economic impact of \$24,748,200. When combined with the pilot project pig removal and damage estimate derived from survey data, the 5 projects resulted in the removal of 127,540 wild pigs, which provided a direct control economic impact of \$26,228,691. Overall, the benefit-to-cost ratio of direct control efforts was 10.48:1.00, or \$10.48 in benefits for each \$1.00 invested in the 5 projects covering the 8-year project period.

In addition to demonstration projects, TWS utilized the grant to support disease surveillance, methods development, and research. TWS employees in the Kerrville District developed and tested the Kerrville Star drag system (Sandoval 2012) for snares, which allows the captured wild pig to move away from a fence eliminating fence damage. Texas Wildlife Services employees in 3 Districts tested the Australian-developed HogHopper™ as a potential method of reducing nontarget exposure to controlled chemicals such as toxicants or antifertility drugs (Campbell et al. 2012). Drop nets, remote monitored and activated gate systems, night vision, and trailer-style trap systems were tested for wild pig capture.

Disease surveillance mainly consisted of supplying samples from swine removed to the Wildlife Services National Wildlife Disease Program for monitoring of 18 different diseases and to collect genetic samples for additional research projects. During the grant periods, TWS collected 15,600 disease samples. Unique results included identification of the pandemic H1N1 strain in wild pigs in one area in Texas, the identification of *Brucella abortus* in wild pigs in one county in southern Texas, the collection of long-term PRV prevalence in an area of north Texas, and the identification of high prevalence (>40%) of swine influenza antibodies in an area with high incidence (>40%) of avian influenza presence. TWS also conducted targeted removals to support TB monitoring, identify and manage potential *Brucella* sources for dairy cattle, and to provide *E. coli* samples for bacterial source tracking efforts in impacted watersheds.

One project was conducted specifically to reduce the risk of wild pig-vehicle collisions on a newly constructed toll road. TWS employees removed 114 wild pigs in a 4-night period of time, working all of the road segment except that within city limits of one town, where the police refused access to the program. When the toll road opened later that week, 3 wild pig-vehicle collisions occurred on the road – all within the city limits.

The Food Bank initiative resulted in only 19 wild pigs hogs being delivered to processors in a 3-month period. The majority of wild pigs captured by TWS were not taken in live traps during this period, but rather were removed by shooting and with snares. Wild pigs removed by these methods were unsuitable for human consumption. Additionally, because of the processors weight restriction, few of the hogs captured in live traps met the weight requirement. Finally, the cost of transportation made taking a single wild pig to the delivery point inefficient.

EXTENSION EDUCATION PROGRAMMING (INDIRECT CONTROL)

Information on wild pigs and abating their damage was distributed to 8,288 individuals via office and site visits, email, publications, and telephone contact during the 8-year period (Table 3).

A wild pig website (<http://feralhog.tamu.edu>) was developed and maintained to provide the public and media with information on wild pig life history and control as well as the status of the abatement project. During the 8 years covering 5 projects, there were a total of 199,666 unique hits and 387,750 pages accessed from the website (Table 3).

Media interest in wild pigs, their damage, and the Wild Pig Abatement Pilot Project remained high throughout the entire project. Extension wildlife specialists were charged with the responsibility of providing interviews upon request to various newspaper, magazine, podcast, and local and national television and radio outlets (Figure 2). A total of 190 contacts with mass media outlets were made during the project period (Table 3).



Figure 2. A television station interviews a Texas landowner in a wild pig-damaged hay meadow.

Another major component of the Wild Pig Damage Abatement Project conducted by the Texas A&M AgriLife Extension Service was Extension education/outreach programming conducted statewide by county Extension agents, Extension wildlife specialists and TWS biologists and technicians. At many educational events conducted as workshops, seminars, and field days, a multi-agency approach was utilized to deliver information to clientele. An example of a particularly successful program format included presentations made by A&M AgriLife Extension faculty/staff, Wildlife Services personnel, Texas Parks and Wildlife (Wildlife and Law Enforcement Division personnel), and Texas Animal Health Commission representatives. Additional speakers utilized when appropriate included wild pig buyers representing various processors and local private trappers. Information delivered included wild pig biology and life history, damage recognition, control techniques, disease transmission, and marketing opportunities.

A total of 206 Extension-sponsored educational events were conducted for 18,354 participants over an 8-year period from January 2006-November 2013 (Table 4). The one-page survey was administered to attendees at all Extension educational programs with wild pig damage abatement presentations totaling one hour or more.

Surveys were distributed to attendees following the formal program and then collected at the conclusion of each educational event. A total of 9,208 surveys were completed by program participants for a return rate of 50%. The survey return rate could have been even higher, but multiple program participants often represented the same landholding (e.g., families). However, as expected, not all survey respondents answered all questions on the survey.

Survey respondents reported that the most common types of agricultural negative impacts caused by wild pigs were to pastures (75% of respondents), loss of owner/employee time (39%), and damage to fences, water troughs, or other improvements (37%). Additional damage types included growing/planting commodity crop losses (27%), loss of land value (23%), loss of lease value and/or damage to food plots and wildlife feeders (21%), damage to wetlands (21%), damage to agricultural equipment and vehicles (19%), growing or planting specialty crop losses (16%), livestock injury, diseases or death (11%), damage to stored commodities (5%), and personal injuries (3%) (Figure 3). Damage reported here is consistent with the types of agricultural damage in Texas noted by Rollins (1993), Beach (1993), and Nunley (1999).

Table 4. Extension educational events and their impacts on knowledge and practice adoption.

Project Period	# Educational Events	# Event Attendees	% Increasing Knowledge	Mean # Practices Adopted
2006 - 2008	67	5,197	—	3.2
2008 - 2010	22	3,882	98%	3.6
2010 - 2011	43	2,975	98%	3.5
2011 - 2012	42	4,000	99%	3.5
2012 - 2013	32	2,300	99%	3.9
Total	206	18,354	—	—
Means	41	3,671	98%	3.5

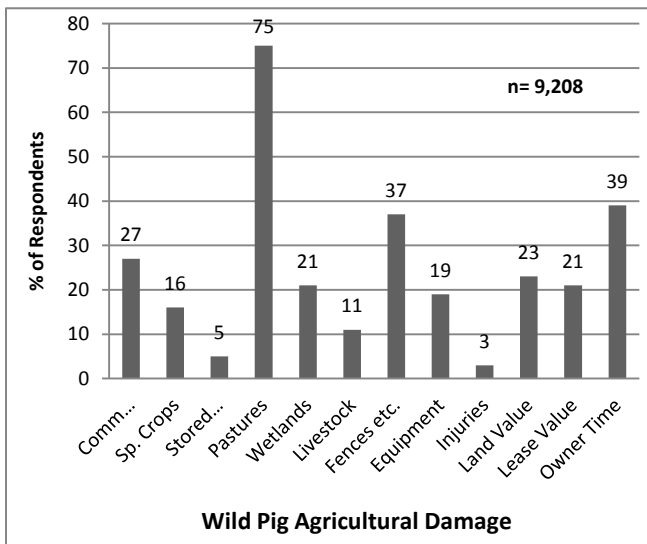


Figure 3. Agricultural damages reported by landowners participating in Texas A&M AgriLife Extension group educational events (2006-2013).

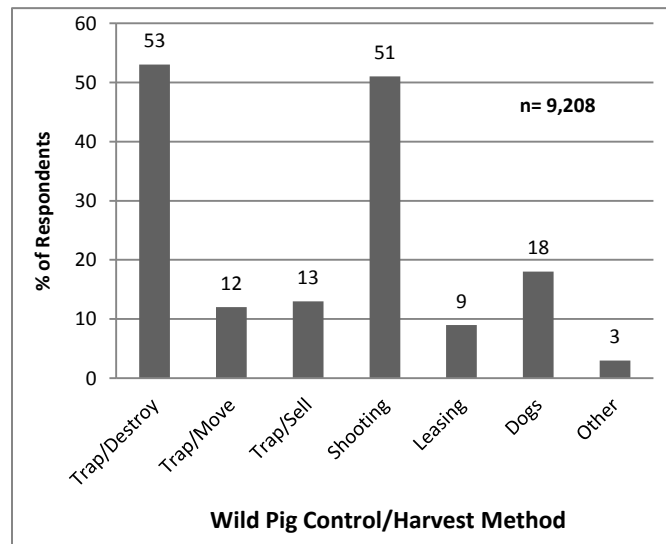


Figure 4. Control methods utilized by landowners participating in Extension educational programs conducted in 2006-2013.



Figure 5. A large corral-style wild pig trap. Note tear-drop shape to facilitate loading pigs to sell at a wild pig buying station.



Figure 6. Landowners inspect a wild pig trap during a multi-county field day.

Respondents indicated that control efforts of trapping/destroying wild pigs (53% of respondents) and landowner hunting (51%) were utilized, making them the most common control methods employed to abate wild pig damage (Figure 4). Despite being extremely popular, recreational hunting is known to be a highly inefficient method of controlling wild pig populations. Recreational hunting often causes wild pigs to become more nocturnal and/or more difficult to control by more efficient techniques. However, strategic shooting at night, often using firearms equipped with night vision technology, was an important method to achieve damage abatement.

Landowner-initiated trapping using recommended equipment and techniques has also proven to be a very effective method for wild pig removal. Much of the positive feedback from program participants centered upon information delivered relative to the efficient and economical design and use of large corral-style traps, bait selection, training pigs to bait, and determining the most effective locations to place traps (Figures 5 and 6).

The use of result demonstrations to show landowners the proper design and employment of traps proved to be

an excellent tool for increasing landowner-initiated reduction of wild pigs. Landowners could, in a field day format, actually see for themselves the proper design and use of traps that were successfully removing pigs from the landscape. By witnessing what designs and protocol worked best as employed by other landowners in the area, adoption of techniques to successfully capture wild pigs increased substantially.

One metric used to gauge educational event impact was whether landowners increased their knowledge by participating in Extension programming. A total of 6,794 of 6,895 survey respondents (98%) indicated that they had increased their knowledge of wild pigs and their control by attending a Texas A&M AgriLife Extension Service-sponsored educational event (Table 3, Figure 7).

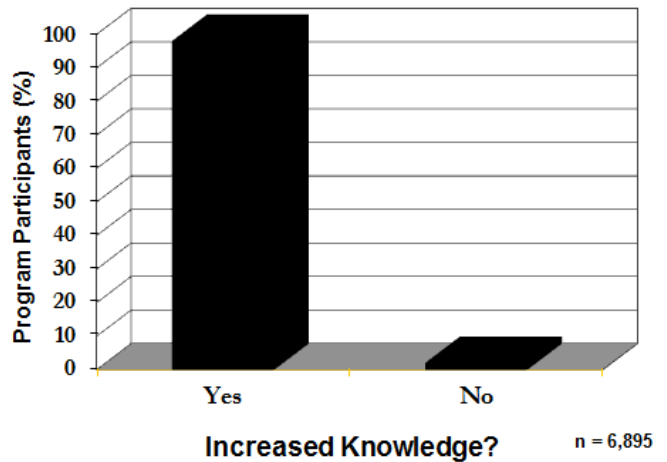


Figure 7. Ninety-eight percent of post-program survey respondents increased their knowledge of wild pigs and their control.

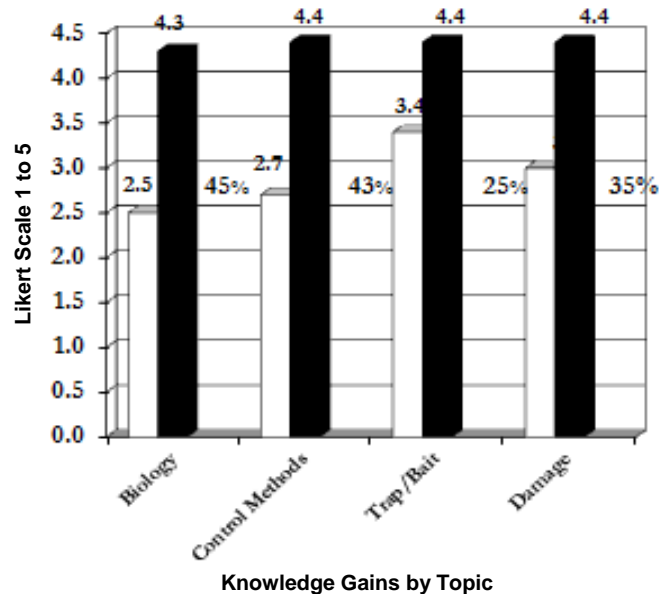


Figure 8. Knowledge gained (%) on 4 topics based on educational program participant survey score results (n = 7,510).

Educational event participants were also asked to rate their knowledge levels pre- and post-program on 4 different topics using a Likert Scale with ratings of 1 through 5 (where 1 = no knowledge, 3 = some knowledge, and 5 = a high level of knowledge). Percent knowledge gains by topic were 35% for learning to recognize the types/extent of damage, 43% for identifying and understanding the legal control options, 45% for wild pig biology, and 25% for efficient trapping/baiting techniques (Figure 8).

When asked which new practices they planned to adopt, 53% of survey respondents indicated they planned to use larger traps, 49% planned to pre-bait traps to encourage consistent pig visits, 48% planned to scout for wild pig sign, 39% planned to market trapped pigs to processors to recoup at least a portion of their economic losses, 38% planned to use baits with scent appeal, 35% planned to set traps whenever fresh sign appeared, 31% planned to vary baits at different trap locations, and 18% planned to wear protective eyewear and gloves when field-dressing wild pigs to avoid the potential for disease transmission. Overall, respondents planned to adopt an average of 3.5 new practices of the 8 practices identified to better manage wild pigs (Table 3, Figure 9).

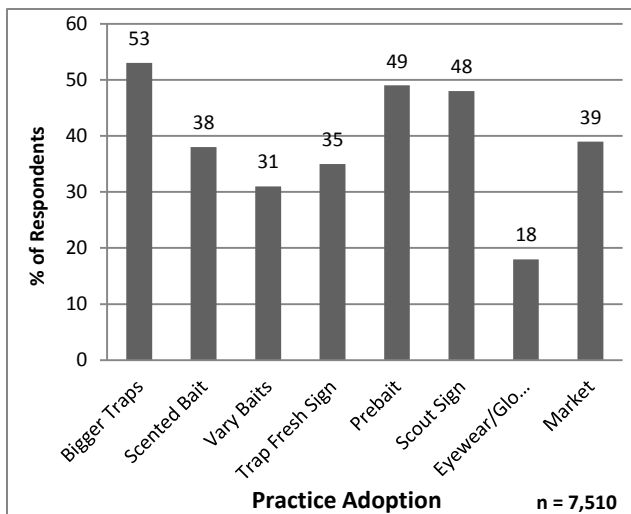


Figure 9. Percentages of respondents planning to adopt selected management practices after attending a Texas A&M AgriLife Extension Service educational program, 2006-2013. Adoption Rate of 3.5 Practices/Landowner.

Program participants were asked to rate the likelihood of them recommending the Texas A&M AgriLife Extension Service to family, colleagues, and friends as an information source on wild pigs in order to calculate a Net Promoter Score (NPS) (Riechheld 2006). The mean NPS the Texas A&M AgriLife Extension Service received from participants in these wild pig abatement educational programs was 60%, indicating that indirect control efforts through educational programming were effective (Table 5). However, as expected these NPS were lower than the 71% NPS from cooperators receiving direct control assistance from Wildlife Services.

Education/outreach program participants were also asked to rate the economic impact or value of the infor-

mation they received while participating in a group educational event. Respondents estimated the total economic impact of wild pig damage incurred in the previous year (prior to attending the program) at \$22,081,745. They anticipated damage to decrease during the upcoming year to a total of \$12,064,669, based on their knowledge gains and the information they received (Table 5). Therefore, as a result of what they learned at these programs, participants valued the information received at \$10,017,076 – resulting in an estimated 45% decrease in anticipated economic losses attributable to Texas A&M AgriLife Extension’s indirect control efforts via educational programming (Figure 10).

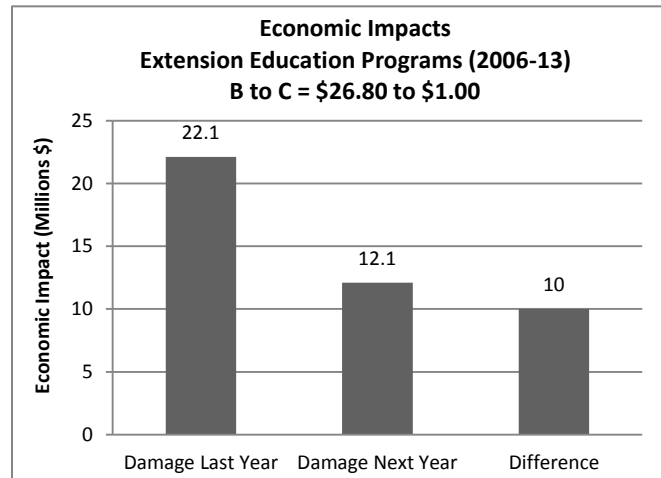


Figure 10. Economic impact values program participants placed on information received at Extension-sponsored educational events (2006-2013).

A total of \$2,895,042 in funding was provided by TDA during the 5 project periods (2006-2013). Of this total, \$373,813 or 13% was allocated for Extension educational programming and outreach efforts. This resulted in a benefit to cost ratio of 26.80:1.0, or \$26.80 in return on every \$1.00 invested in Extension education (indirect control efforts) over the 8 years of project funding (2006-2013) (Table 6).

Interest in these abatement projects among other states was also extremely high. These states ranged from those with no wild pig populations present to those, like Texas, that have almost all available wild pig habitat occupied with well-established, increasing populations. A variety of agencies, societies, and associations dealing with wild pig damage abatement contacted Texas A&M AgriLife Extension for additional information and updates on the design and results of the Wild Pig Damage Abatement Projects. In addition to 13 presentations made at state-wide conferences/annual meetings in Texas, the co-principal investigator made international and national presentations at the International Wild Pig Conference, the International Association of Fish and Wildlife Agencies, 4 National Symposia on Wild Pigs, the Society of Range Management annual conference, the Vertebrate Pest Conference, The Wildlife Society annual conference, the Quality Deer Management Association national meeting, and the National Invasive Species Conference.

Table 5. Qualitative value and program participants placed on information received and Net Promoter Scores of educational programs conducted to abate wild pig damage.

Project Period	Estimated Damage Last Year	Estimated Damage Next Year	Program Impact (= Last - Next Year)	Net Promoter Score (NPS)
2006 - 2007	\$6,252,044	\$3,273,223	\$2,978,821	51%
2008 - 2010	\$4,795,510	\$2,674,955	\$2,120,555	56%
2010 - 2011	\$5,466,960	\$3,024,590	\$2,442,370	67%
2011 - 2012	\$3,965,460	\$2,292,850	\$1,672,610	64%
2012 - 2013	\$1,601,771	\$799,051	\$802,720	75%
Total	\$22,081,745	\$12,064,669	\$10,017,076	-
Mean/Participant	\$3,273	\$1,788	\$1,485	60%

Table 6. Funding allocations, economic impacts and benefit to cost ratios of Extension education and outreach efforts during the 5 Wild Pig Damage Abatement Projects (2006-2013).

Project Period	Allocation to Education	Economic Impact	Benefit : Cost
2006 - 2008	\$151,981	\$2,978,821	19.60 : 1.00
2008 - 2010	\$60,328	\$2,120,555	35.15 : 1.00
2010 - 2011	\$50,050	\$2,442,370	48.8 : 1.00
2011 - 2012	\$51,454	\$1,672,610	33.41 : 1.00
2012 - 2013	\$60,000	\$802,720	13.48 : 1.00
Total	\$373,813	\$10,017,076	-
Mean	\$74,763	\$2,003,415	26.80 : 1.00

SUMMARY

The 5 Wild Pig Damage Abatement Projects conducted by the Texas A&M AgriLife Extension Service received a total funding of \$2,895,042 from the Texas Department of Agriculture from 2006-2013, with 13% or \$373,813 of these funds earmarked for Extension educational efforts and 87% or \$2,521,299 for direct control efforts by Texas Wildlife Services.

Direct control by Texas Wildlife Services addressed damage caused by wild pigs to agriculture, threatened or endangered wildlife, watersheds, and human health and safety. Conducting these projects allowed TWS to demonstrate the practicality of wild pig control, evaluate newly emerging technology, support research and protect valuable crops, wildlife, and property. Texas Wildlife Services direct control efforts removed 127,540 wild pigs by all control methods employed at an average cost of \$19.77 per pig removed. The cost to the state of wild pig abatement through direct control in this period was \$2,521,229, while the benefits were conservatively estimated at \$26,228,691 for a 10.48:1 benefit-to-cost ratio.

Education/outreach efforts reached 8,288 clientele by individual contact and 18,354 additional clientele via 206 educational programs. Clientele attending educational events valued the information received at \$10,017,076, resulting in a benefit-to-cost ratio of 26.80:1.00, or \$26.80 return for each \$1.00 of grant funding invested in education. A total of 98% of educational event attendees increased their knowledge of wild pigs and planned to adopt an average of 3.5 new management practices each.

In total, the abatement study provided \$36,245,767 in direct economic benefit at a total cost of \$2,895,042. This resulted in an overall combined education and direct control benefit to cost ratio of 12.52:1.00, or \$12.52 for every \$1.00 invested in the 5 projects over an 8-year period.

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Blackland Prairie Site 2007 Economic Impact Survey Feral Hog Management Pilot Program

The initial survey you completed in 2005 and the follow up survey you completed last year, 2006, established baseline estimates of economic losses and estimates of economic losses following control measures in 2006. We now need estimates of economic losses on your property and of costs associated with control measures used throughout 2007.

This survey is for you to share information about control and management measures employed on your property and the economic value of losses you observed during 2007.

As before, all individual information remains confidential. Reports will include only summaries of landowner information. Contact information is necessary to insure participants receive all correspondence and reports associated with the project. ***YOUR PARTICIPATION IN THIS PROJECT IS APPRECIATED.***

Contact _____ Farm Name _____

Address _____ City _____ Zip _____

Office Phone _____ Email _____

Please provide as much detail as possible about the control measures used on your property and the best estimate of your losses documented for the entire year 2007.

Control Activities during 2007

Control measure	Estimated number of hogs removed	Estimated number of events
Trapped & destroyed		
Trapped & moved from premise		
Trapped & sold		
Owner & employee hunting		
Lease hunting		
Use of dogs		
Flown with helicopter		
Other:		
Other:		

Please list any other control measures that have been taken that are not accounted for in the above table:

Economic Losses during 2007

Please provide as much detail about economic losses in your crop and livestock enterprises during 2007. Note additional information concerning crop, commodity or property losses and additional expenditures and time spent to repair damages attributed to feral hogs that are not reflected in the table. Information you provide this year will be compared with previous surveys to evaluate the impact of control measures. Please be as realistic as possible so we get an accurate account of what is happening on your property, whether positive or negative.

<i>Crop and commodity losses in 2007</i>				<i>Livestock, property and other losses in 2007</i>			
Crop or Commodity	Total Net Loss (\$)¹	Addnl losses (\$)²	Addnl owner and unpaid labor (hrs)	Property or Livestock	Total Net Loss (\$)¹	Addnl losses (\$)²	Addnl owner and unpaid labor (hrs)
Corn				Pasture			
Grain Sorghum				Other Land			
Peaches				Wetlands			
Pecans				Fences			
Other Orchards				Livestock specify type:			
Hay				Disease transmission			
Stored commodities				Equipment: (specify type)			
Specialty crops				Vehicles			
Other				Personal injury			
				Water losses			
				Loss of land value			
				Other			

Make any additional notes on bottom or back of this page

¹Total losses minus payments from insurance plus cost of insurance premiums

²Additional cash expenses not included in crop or commodity losses, such as farm operations to level land, repair levees, repair equipment, etc.

TEXAS COOPERATIVE EXTENSION - FERAL HOG SURVEY-INDIRECT CONTROL

You have recently participated in a program on feral hog life history, behavior and control information hosted by Texas Cooperative Extension. Please complete the following on the economic impact of feral hogs and the value of information you received. Your survey will assist us in planning future programs.

1. Place a check mark next to all the areas in which feral hogs had a negative impact on your property(s) *in the past year*.

- | | |
|--|--|
| <input type="checkbox"/> Growing or planting commodity crop losses | <input type="checkbox"/> Fences, water troughs, or other improvements |
| <input type="checkbox"/> Growing or planting specialty crop losses | <input type="checkbox"/> Equipment or vehicles |
| <input type="checkbox"/> Stored Commodities | <input type="checkbox"/> Personal injuries |
| <input type="checkbox"/> Pastures | <input type="checkbox"/> Loss of land value |
| <input type="checkbox"/> Wetlands | <input type="checkbox"/> Loss of lease value, damage to food plots/feeders |
| <input type="checkbox"/> Livestock (injury, deaths, diseases) | <input type="checkbox"/> Owner or employee time |

2. Place a check mark next to all the control methods you use on your property(s).

- | | | |
|---|---|--|
| <input type="checkbox"/> Trapped & destroyed | <input type="checkbox"/> Trapped & Sold | <input type="checkbox"/> Lease hunting |
| <input type="checkbox"/> Trapped & moved from premise | <input type="checkbox"/> Owner/Employee hunting | <input type="checkbox"/> Use of dogs |
| <input type="checkbox"/> Other (snares, aerial gunning) | | |

3. "I estimate my total economic losses due to feral hogs during the **previous year** to be about \$_____ on all my property(s). This includes all items checked above in Question 1.

4. **As a result of implementing what I learned at Texas Cooperative Extension workshop(s)**, I expect my losses due to feral hogs to be approximately \$_____ during the **upcoming year**.

5. Did you increase your knowledge of feral hogs & control by attending this program? Yes___ No___

6. Rate your knowledge **before and after** the program on these subjects. Circle only one number for each answer choice with 1 = no little knowledge, 3 = some knowledge, 5 = high level of knowledge.

A. Feral hog biology	Before	1	2	3	4	5
	After	1	2	3	4	5
B. Legal control options	Before	1	2	3	4	5
	After	1	2	3	4	5
C. Efficient trap/bait techniques	Before	1	2	3	4	5
	After	1	2	3	4	5
D. Types/extent of hog damage	Before	1	2	3	4	5
	After	1	2	3	4	5

7. Please place a checkmark by all practices that you plan to adopt in order to better manage feral hogs on your property:

- | | |
|---|---|
| <input type="checkbox"/> Use larger traps | <input type="checkbox"/> Pre-bait traps to encourage consistent hog visits |
| <input type="checkbox"/> Use baits with scent appeal | <input type="checkbox"/> Scout for hog sign (tracks, wallows, rubs, hair) |
| <input type="checkbox"/> Vary/change baits at different locations | <input type="checkbox"/> Wear eyewear and gloves during field dressing |
| <input type="checkbox"/> Set traps whenever fresh sign appears | <input type="checkbox"/> Market trapped hogs to processors to recoup losses |

8. Based on the information provided at the program, what is the likelihood that you would recommend Texas Cooperative Extension (includes Wildlife Services) to your family & friends as a contact for information on feral hogs & their control? Circle one number below with 0 = not likely and 10 = likely.

0 1 2 3 4 5 6 7 8 9 10

Not Likely **Likely**