

Contract No:

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-08SR22470 with the U.S. Department of Energy (DOE) Office of Environmental Management (EM).

Disclaimer:

This work was prepared under an agreement with and funded by the U.S. Government. Neither the U. S. Government or its employees, nor any of its contractors, subcontractors or their employees, makes any express or implied:

- 1) warranty or assumes any legal liability for the accuracy, completeness, or for the use or results of such use of any information, product, or process disclosed; or
- 2) representation that such use or results of such use would not infringe privately owned rights; or
- 3) endorsement or recommendation of any specifically identified commercial product, process, or service.

Any views and opinions of authors expressed in this work do not necessarily state or reflect those of the United States Government, or its contractors, or subcontractors.

We put science to work.™



**Savannah River
National Laboratory™**

OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

A U.S. DEPARTMENT OF ENERGY NATIONAL LABORATORY • SAVANNAH RIVER SITE • AIKEN, SC

ESTIMATION OF THE NUMBER OF WILD PIGS FOUND IN THE UNITED STATES



J.J. Mayer

August 2014

SRNL-STI-2014-00292, Revision 0

SRNL.DOE.GOV

DISCLAIMER

This work was prepared under an agreement with and funded by the U.S. Government. Neither the U.S. Government or its employees, nor any of its contractors, subcontractors or their employees, makes any express or implied:

1. warranty or assumes any legal liability for the accuracy, completeness, or for the use or results of such use of any information, product, or process disclosed; or
2. representation that such use or results of such use would not infringe privately owned rights; or
3. endorsement or recommendation of any specifically identified commercial product, process, or service.

Any views and opinions of authors expressed in this work do not necessarily state or reflect those of the United States Government, or its contractors, or subcontractors.

Printed in the United States of America

**Prepared for
U.S. Department of Energy**

Keywords: *Wild Pigs, Feral Hog,
Population Size, Invasive Species*

Retention: *Permanent*

Estimation of the Number of Wild Pigs Found in the United States

J.J. Mayer

August 2014

Prepared for the U.S. Department of Energy under
contract number DE-AC09-08SR22470.



OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

This page intentionally left blank

1.0 Introduction

The population of introduced wild pigs (*Sus scrofa*) found in the United States has dramatically increased since 1990. This statement is based on the observed increase both in the numbers of these animals reported to be present as well as the areas where these pigs have been found (West et al. 2009, Mayer and Brisbin 2009, Hamrick et al. 2011). Between 2000 and 2013, wild pigs had been reported as being observed (in some cases only temporarily) in a total of 47 of the 50 U. S. states. By April 2014, wild pigs had been reported to be established in 36 states (NFSMS 2014, J. L. Corn, SCWDS, pers. comm.). With the exception of a small amount of natural range expansion, this increase has been largely man-made, being comprised of illegal releases and escaped wild pigs from fenced enclosures (Gipson et al. 1998, Mayer and Brisbin 2009, Hamrick et al. 2011). A major part of the reason for the success of this invasive species is that wild pigs are the ultimate survivors, being highly adaptable in many aspects of their biological make-up (Mayer and Brisbin 2009). On the negative side, these wild pigs are reported to annually cost the United States billions of dollars in damage and control activities (Pimentel 2007). Unfortunately, the management tools or options necessary to enable the reduction or effective control of this invasive species do not exist at this time. The current reality about the introduced wild pigs in this country is that they appear to be here to stay, at least in some of the states where these animals are presently found.

For any invasive species problem, it is important to know approximately how many individuals are present in order to develop a strategy to try to manage or control these animals. Further, the numbers of these animals can be roughly translated into the magnitude of the problem associated with this non-native species; such an assessment would constitute a basis for the level of effort and expense needed to address that invasive species problem. Such knowledge of population estimates would be essential, if not critical, in order to effectively manage an invasive species problem on a national scale. To attempt to successfully manage an invasive species problem, given that the number of these animals present is unknown, could potentially lead to both ineffective and unnecessarily costly plans and programs.

A few national and regional estimates for the population size of wild pigs in the United States had been reported during the latter half of the Twentieth Century prior to 1990 (Table 1-1). Although a couple of these were summations of regional or individual state estimates (i.e., McKnight 1964, Lewis et al. 1965), these early population approximations were largely based on anecdotal information or speculation. To that end, such estimates were questionable at best.

Table 1-1. List of Pre-1990 Published National and Regional Estimates for the Wild Pig (*Sus scrofa*) Population Size in the United States.

Reference	Area	No. of States	Population Estimate
McKnight (1964)	National	19	1,585,000+ ^a
Lewis et al. (1965)	Southeastern United States	13	34,500+
Mayer (1983)	National	19	500,000 to 2,000,000
Neetles and Erickson (1984)	National	18	>1,000,000

^a - Total of four regional estimates that were reported separately in the reference

The purpose of this report was to compile a national estimate for the number of wild pigs found in the United States. Such an estimate could then be used as a basis to evaluate the magnitude of this national problem and develop the appropriate scale of management plans to address this matter.

2.0 Methodology

Similar to the estimation methodology noted above, this effort would be based on a compilation of the individual state-by-state estimates to then collectively derive a national approximation of the number of wild pigs found in the United States. Unfortunately, no uniform estimation method was available for each of the states. In fact, such estimates ranged from specific published statewide estimates (e.g., Stevens 2010, Timmons et al. 2012) to states with nothing reported other than the fact that these animals were present. The resolution to this inconsistency of estimates was to develop the individual state estimates based on one of three approaches. Where possible, these individual state approximations were given as minimum, mean and maximum population estimates to provide an encompassing range for the national figure. An earlier variation of this compilation estimate was provided in Mayer and Brisbin (2009). The approaches used are described in the following three paragraphs:

- 1) **Reported Estimates** - These would encompass population estimates that were reported by either an agency (e.g., state or federal) or an academic or extension researcher for the state in question. These would variously include estimates that were reported in a publication, official web site, quoted in a secondary source (e.g., news media), or personally communicated to myself. The bases for these individual estimates varied, but were not either evaluated for accuracy or validated within the context of this report. Rather, these estimates were simply accepted as provided. These estimates varied from (1) a single estimate, (2) a minimum-maximum (min-max) range of estimates, and (3) a mean with a min-max range of estimates also being provided. For those states with a single reported estimate, that same number was used for each of the minimum, mean and maximum entries on the state-by-state summation table. The states with a min-max range were included as those estimates (i.e., minimum as the minimum and maximum as the maximum); the mean for those states was included as the arithmetic average (rounded to the nearest hundredth, thousandth, ten thousandth, etc. as appropriate) of the reported minimum and maximum estimates. Finally, the states with minimum, mean and maximum population estimates were included as reported for those categories in the summation table.
- 2) **Harvest Based Estimates** – Several states annually report a statewide sporthunting harvest of wild pigs. Similar to the reported population estimates, the methodologies used to determine these estimated annual harvests are also varied. Most, however, were based on post-season surveys or tag returns to estimate the statewide annual harvest. Based on fourteen percentages from the literature (Table 2-1), the mean sporthunting harvest is estimated to remove about 23% of a wild pig population annually. The percent removal used to estimate the minimum and maximum population estimates entailed one standard deviation (SD) on either side of the mean as follows: the mean plus one SD would result in an annual removal of 37 percent (i.e., the highest percent removal), which would then be used to calculate the smallest or minimum population estimate; the mean minus one SD would result in an annual removal of 9 percent (i.e., the smallest percent removal), which would then be used to calculate the largest or maximum population estimate. Again, these calculated estimates were rounded to the nearest hundredth, thousandth, ten thousandth, etc. as appropriate.
- 3) **Bounding Estimates** – Lastly, several other states have reported the presence of these animals, but have not officially/formally estimated either the number of animals present or wild pigs annually harvested by sporthunters. In a few cases, either informal or anecdotal estimates of the numbers of

these animals present have been noted. These unofficial estimates included numbers present or population sizes such as “a few,” “a couple of dozen,” “45 or fewer,” or “several hundred.” None of these casual estimates have resulted in large totals of animals (e.g., into the thousands or tens of thousands of wild pigs). In other cases, the occurrence of these animals is temporary or even questionable (i.e., there may in fact be no wild pigs left at present in the areas in question). To account for these imprecise numbers of wild pigs in these states, “bounding” estimates were compiled to encompass the numbers associated with the presence of these animals in those states.

Table 2-1. Reported Annual Sporthunting Harvests of Wild Pigs (*Sus scrofa*) at Several Locations Given as a Percent of the Population.

Reference	Location	Percent Annual Harvest of the Population ^a
Barrett 1978	Dye Creek Ranch, CA, USA	20
Bridgland 2010	Germany	18
Bridgland 2010	Tuscany, Italy	20
Crossland 2009	Germany	23
Degner et al. 1983	Florida, USA	21
Devitt 1984	Area around Monticiano, Italy	50
Law Environmental, Inc. 1989	Immokalee Ranch, FL, USA	5
Mayer In Press	Savannah River Site, SC, USA	8
Pine and Gerdes 1973	Hunter Liggett Military Reservation, CA, USA (1966-67)	9
Pine and Gerdes 1973	Hunter Liggett Military Reservation, CA, USA (1967-68)	19
Pine and Gerdes 1973	Hunter Liggett Military Reservation, CA, USA (max. est.)	31
Saez-Royuela and Telleria 1988	Burgos Province, Spain	50
Spitz et al. 1984	Gresigne Region, France	40
Timmons et al. 2012	Texas, USA	11
	Mean Annual Sporthunting Harvest Percent	- 22.8
	1 SD	- ±14.1

a – Most percentages were calculated from the estimated sporthunting and population numbers reported

This is the least precise of the three approaches employed in this report for estimating the numbers of wild pigs. As an example, if an anecdotal estimate states that there “may be a couple of dozen wild pigs present in an area,” then the summation table entry would be as follows: minimum - 0, mean - 25, and maximum - 50. These numbers would bound the anecdotal estimate of “a couple of dozen.” It would also recognize the often temporary nature of these small populations or groups of wild pigs by including as the minimum estimate the potential that no animals were left in that area (i.e., the minimum estimate would then equal “0” animals). Similarly, “several hundred animals” would be estimated as follows: minimum - 100, mean - 250, and maximum - 500; recognizing that these animals purportedly exist in the hundreds of individuals, a minimum estimate of “0” would be inconsistent with this informal approximation. Lastly, aside from the

minimum estimate of “0,” such components of the bounding estimate approach, generally being low in number, were rounded to nearest fifth, tenth hundredth, etc. as appropriate.

For states with more than one set of information that could support the use of two or more of the three population estimation approaches described in this report, a prioritized hierarchy for which approach to use was employed as follows: first or highest priority - Reported Estimates, second or next priority - Harvest Based Estimates, and last or lowest priority - Bounding Estimates.

3.0 Results and Discussion

The compilation of the state-by-state listing of the population estimates for wild pigs in the United States is provided in Table 3-1. Per the previous methodologies defined, for each state minimum, mean and maximum estimates were included as well as the estimation approach that was used to derive the listed population size. Overall, 37 states had estimated population sizes listed. Thirteen states had no animals listed as being present. Ten of those 13 had previously reported the presence of wild pigs in their state. These occurrences consisted of anywhere from one wild pig up to small numbers of these animals found in a localized area. Currently, these ten states report that all of these animals have been eradicated and that there are no wild pigs remaining within their state’s borders. Only three states (i.e., Delaware, Rhode Island and Wyoming) have never reported the presence of any wild pigs to date. Thirty of the 50 estimates were based on reported numbers of animals, while nine were based on reported harvest numbers and eleven were bounding estimates.

Table 3-1. State-By-State Breakdown of the Population Estimate for Wild Pigs (*Sus scrofa*) in the United States.

State	Population Estimate			Estimation Approach		
	Minimum	Mean	Maximum	Reported	Harvest Based	Bounding
Alabama	90,000	195,000	300,000		X	
Alaska	0	0	0	X		
Arizona	200	400	600			X
Arkansas	60,000	130,000	200,000		X	
California	70,000	110,000	275,000		X	
Colorado	100	200	400			X
Connecticut	0	0	0	X		
Delaware	0	0	0	X		
Florida	500,000	750,000 ^a	1,000,000	X		
Georgia	600,000	1,000,000	2,700,000		X	
Hawaii	10,000	16,000	40,000		X	
Idaho	0	25	50			X
Illinois	0	40	80			X
Indiana	3,000	3,000	3,000	X		
Iowa	25	40	100		X	
Kansas	500	750 ^a	1,000	X		

Table 3-1. State-By-State Breakdown of the Population Estimate for Wild Pigs (*Sus scrofa*) in the United States. (Continued)

State	Population Estimate			Estimation Approach		
	Minimum	Mean	Maximum	Reported	Harvest Based	Bounding
Kentucky	1,000	1,000	1,000	X		
Louisiana	500,000	500,000	500,000	X		
Maine	0	5	10			X
Maryland	0	0	0	X		
Massachusetts	0	0	0	X		
Michigan	1,000	2,000 ^a	3,000	X		
Minnesota	0	0	0	X		
Mississippi	190,000	300,000	800,000		X	
Missouri	10,000	10,000	10,000	X		
Montana	0	0	0	X		
Nebraska	0	0	0	X		
Nevada	200	250	300			X
New Hampshire	500	500	500	X		
New Jersey	0	40	80			X
New Mexico	500	750	1,000			X
New York	100	150	200			X
North Carolina	1,000	1,500 ^a	2,000	X		
North Dakota	0	50	100			X
Ohio	1,000	1,000	1,000	X		
Oklahoma	430,000	500,000	1,600,000	X		
Oregon	1,000	3,000 ^a	5,000	X		
Pennsylvania	2,000	2,500 ^a	3,000	X		
Rhode Island	0	0	0	X		
South Carolina	95,000	160,000	400,000		X	
South Dakota	0	0	0	X		
Tennessee	1,000	1,500 ^a	2,000	X		
Texas	1,800,000	2,600,000	3,400,000	X		
Utah	50	75	100			X
Vermont	0	0	0	X		
Virginia	2,000	3,000 ^a	4,000	X		
Washington	0	0	0	X		
West Virginia	140	200	360		X	
Wisconsin	100	100	100	X		
Wyoming	0	0	0	X		
Totals	4,370,415	6,293,075	11,253,980	30	9	11

^a – Calculated average of the minimum and maximum estimates

Collectively, 99 percent of the total numbers of wild pigs (i.e., for each of the minimum, mean and maximum estimates) were from only 10 of the 50 states including Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas. The population sizes for these states were based on either the reported (N=4) or harvest based (N=6) estimation approaches. As an individual state, Texas had the largest numbers comprising 41 percent of the total nationwide population size for the mean estimate, and 30 percent and 41 percent for the maximum and minimum estimates, respectively. Most of the remaining states that had wild pigs (i.e., 13 of 27) consisted of estimates that were reported. Of the other 14 states, three had estimates that were harvest based, while the rest were bounding estimates. On average, the reported estimates accounted for 69.6 percent of the total, with harvest based estimates encompassing 30.4 percent. The bounding estimation approach, admittedly the least reliable of the three, collectively accounted for only 0.03 percent of each of the total nationwide estimates (i.e., minimum, mean and maximum).

4.0 Summary

Based on a compilation of three estimation approaches, the total nationwide population of wild pigs in the United States numbers approximately 6.3 million animals, with that total estimate ranging from 4.4 up to 11.3 million animals. The majority of these numbers (99 percent), which were encompassed by ten states (i.e., Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas), were based on defined estimation methodologies (e.g., density estimates correlated to the total potential suitable wild pig habitat statewide, statewide harvest percentages, statewide agency surveys regarding wild pig distribution and numbers). In contrast to the pre-1990 estimates, none of these more recent efforts, collectively encompassing 99 percent of the total, were based solely on anecdotal information or speculation. To that end, one can defensibly state that the wild pigs found in the United States number in the millions of animals, with the nationwide population estimated to arguably vary from about four million up to about eleven million individuals.

5.0 Literature Cited

- Barrett, R. H. 1978. The feral hog on the Dye Creek Ranch, California. *Hilgardia*, 46(9):283-355.
- Bridgland, F. 2010. Boar wars: wild pigs are running riot through Europe's towns and forests. *The Herald-Scotland*. <http://www.heraldscotland.com/news/world-news/boar-wars-wild-pigs-are-running-riot-through-europe-s-towns-and-forests-1.1068162>. (Accessed on 1/6/2014)
- Crossland, David. 2009. Climate change's clear winners: Europe's wild boar population exploding. *Der Siegel International*. Nov. 25. <http://www.spiegel.de/international/zetgeist/0,1518,663411,00.html> (Accessed on 1/14/2010)
- Degner, R. L., L. W. Rodan, W. K. Mathis and E. P. J. Gibbs. 1983. The recreational and commercial importance of feral swine in Florida: relevance to the possible introduction of African Swine Fever into the U.S.A. *Preventive Veterinary Medicine*, 1:371-381.
- Devitt, J. 1984. All-Italian boars. *BBC Wildlife Magazine* December: 604.
- Gipson P. S., B. Hlavachick, and T. Berger. 1998. Range expansion by wild hogs across the central United States. *Wildlife Society Bulletin*, 26:279-286.
- Hamrick, B., M. D. Smith, C. Jaworowski and B. Strickland. 2011. A landowner's guide for wild pig management: practical methods for wild pig control. Publication 2659. Mississippi State University and Alabama Cooperative Extension System. Mississippi State University, Mississippi State.
- Law Environmental, Inc. 1989. Wildlife assessment for citrus grove conversion. Project No. 55-7608.01. Law Environmental, Inc., Kennesaw, Georgia.
- Lewis, J. C., R. Murray, and G. Matschke. 1965. Hog subcommittee report to the chairman of the forest game committee. Southeastern Association of Game & Fish Commissioners.
- Mayer, J. J. 1983. Wild pigs in the United States: their history, comparative morphology, and current status. Ph.D. Dissertation. The University of Connecticut, Storrs.
- Mayer, J. J. In Press. Wild pigs of the Savannah River Site. SRNL-RP-2014-00295. Savannah River National Laboratory, Aiken, South Carolina.
- Mayer, J. J., and I. L. Brisbin, Jr., (eds.). 2009. Wild pigs: biology, damage, control techniques and management. SRNL-RP-2009-00869. Savannah River National Laboratory, Aiken, South Carolina.
- McKnight, T. 1964. Feral livestock in Anglo-America, University of California Publications in Geology, Vol. 16. University of California Press, Berkeley and Los Angeles.
- Nettles, V. F., and G. A. Erickson. 1984. Psuedorabies in wild swine. *Proceedings of the Annual Meeting of the U. S. Animal Health Association*, 88:505-506.
- NFSMS (National Feral Swine Mapping System). 2014. <http://www.feralswinemap.org> (Accessed on April 20, 2014).

Pimentel, D. 2007. Environmental and economic costs of vertebrate species invasions into the United States. Pp. 2-8. In G. W. Witmer, W. C. Pitt, and K. A. Fagerstone (eds). *Managing Vertebrate Invasive Species: Proceedings of an International Symposium*. USDA/APHIS. Wildlife Services, National Wildlife Research Center, Fort Collins, Colorado.

Pine, D. S., and G. L. Gerdes. 1973. Wild pigs in Monterey County, California. *California Fish and Game*, 59(2):126-137.

Sáez-Royuela, C., and J. L. Telleria. 1988. Las batidas como metodo de censo en especies de caza mayor: Aplicacion al caso del jabali (*Sus scrofa* L.) en la provincia de Burgos (norte de Espana). *Doñana, Acta Vertebrata*, 15(2):215-223.

Spitz, F., G. Janeau, and G. Valet. 1984. Elements de demographie du sanglier (*Sus scrofa*) dans la Region de Gresigne. *Acta Oecologica*, 5(1):43-59.

Stevens, R. L. 2010. *The feral hog in Oklahoma*. Second Edition. Samuel Roberts Noble Foundation, Ardmore, Oklahoma.

Timmons, J. B., B. Higginbotham, R. Lopez, J. C. Cathey, J. Mellish, J. Griffin, A. Sumrall and K. Skow. 2012. Feral hog population growth, density and harvest in Texas. SP-472. Texas AgriLife Extension, Texas A&M University, College Station.

West, B. C., A. L. Cooper and J. B. Armstrong. 2009. *Managing wild pigs: a technical guide*. Human-Wildlife Interactions Monograph, 1:1-55.