2016 International

April 17-20, 2016

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Welcome to Myrtle Beach and the 2016 International Wild Pig Conference!!

Over the past decade, the mission of the Wild Pig Conference has been to provide a venue for learning, networking, and training. As in previous years, the 2016 WPC offers all of these opportunities, and more! The all-day Technical Training was so popular at the 2014 Conference that we have endeavored to offer it again. This year, we will focus on framing a message about wild pigs to varying stakeholders and audiences. We will also learn about new technologies for controlling wild pigs, and gain an understanding of collaborative efforts among and within agencies. This year, we are pleased to announce the launching of the National Wild Pig Task Force and will kick off the efforts with an open-house style meet and greet. This format will give you the opportunity to learn about the different sub-committees and meet the Chairs of those committees. There will also be an opportunity to join and actively participate in the efforts and mission of that committee. The National Wild Pig Task Force will provide a diverse yet unified voice for combating the issues surrounding wild pig control and management.

This year, we received a record number of abstracts for oral and poster presentations. In order to accommodate as many speakers as possible, there will be concurrent sessions all day Tuesday, and most of Wednesday. Please plan to attend as many presentations as possible. We also invite you to view the many poster presentations that will be lining the hallways in front of the Ballrooms. We have several dedicated poster sessions where our presenters can answer questions.

Please welcome Edward Avalos, Under Secretary for Marketing and Regulatory Programs for the USDA. Mr. Avalos will deliver our opening remarks for the conference, with emphasis on combating the growing issue of wild pig impacts to agriculture.

We invite you to enjoy the fantastic educational and professional resources from the many presenters and sponsors at the conference. Myrtle Beach also has many great venues to experience: explore the boardwalk, take a spin on the Skywheel, or relax on the beach! If at any time you have a need or special request, one of the organizing committee members will be glad to assist you.

Thank you for attending!

Jessica Tegt

Jessica Tegt, Conference Organizer

2016 International Wild Pig Conference Agenda

Sunday, April 17, 2016	
1:00 pm to 10:00 pm	Registration *(Hotel Lobby)* Cocktail Reception in Vidalia's Restaurant

Monday, April 18, 2016	
7:00 am to 5:00 pm	Registration/ Continental Breakfast- (*Hall of Fame Hallway)*
8:00 am to 5:00 pm	**Technical Training (***Ballrooms D&E*) (See full Training Agenda page 5-6)
6:00 pm to 9:00 pm	Welcome Reception (Snacks and Drinks) (*Ballrooms D&E*)

Tuesday, April 19, 2016	
7:00 am to 8:00 am	Registration (*Hall of Fame Hallway*)
8:00 am	Conference Introductions, Jessica Tegt, Mississippi State University Extension Service *(Ballrooms D&E)*
8:00 am to 8:15 am	**Opening Remarks, Edward Avalos** **Under Secretary for Marketing and Regulatory Programs, United States Department of Agriculture**
8:20 am to 8:40 am	**Plenary Session I**: Dr. Kurt VerCauteren, National Wildlife Research Center, USDA/APHIS/WS *"Overview of research being conducted by USDA/APHIS to aid in control of feral swine"*
8:40 am to 9:00 am	**Plenary Session II**: Dr. Mark Smith, Alabama Cooperative Extension System, Auburn University *"Creating a united front through the National Wild Pig Task Force"*
9:00 am to 9:45 am	**Poster Session I/**Morning Break (*Hall of Fame Hallway*)
10:00 am to 12:00 pm	**Technical Session 1: *Human Dimensions*** *(Ballroom E)* **Technical Session 2: *Wild Pig Distribution*** (*Ballroom D*)
12:00 pm to 1:20 pm	LUNCH ON YOUR OWN
1:30 pm to 3:00 pm	**Technical Session 3: *Disease I*** *(Ballroom E)* **Technical Session 4: *Baiting*** (*Ballroom D)*
3:00 pm to 3:20 pm	Afternoon Break (*Hall of Fame Hallway*)
3:30 pm to 5:00 pm	**Technical Session 5: *Wild Pig Control*** *(Ballroom E)* **Technical Session 6: *Disease II*** *(Ballroom D)*
5:00 pm to 7:00 pm	DINNER ON YOUR OWN
7:00 pm to 9:00 pm	**"Shoot from the Hip" Session** (Light snacks and drinks) (*Ballrooms D&E*)

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Wednesday, April 20, 2016

7:00 am to 8:00 am	Continental Breakfast *(Hall of Fame Hallway)*
8:00 am to 9:30 am	**Individual State Reports** (*Ballrooms D&E)*
9:30 am to 10:00 am	**Poster Session II**/ Morning Break *(Hall of Fame Hallway)*
10:00 am to 12:00 pm	**Technical Session 7: *Wild Pig Control II*** *(Ballroom E)*
	Technical Session 8: *Wild Pig Movements* *(Ballroom D)*
12:00 pm to 1:20 pm	LUNCH ON YOUR OWN
1:30 pm to 3:00 pm	**Technical Session 9: *Wild Pig Biology/Genetics*** (*Ballrooms D&E*)
3:00 pm to 5:00 pm	**National Wild Pig Task Force Sub-committee Open House** *(Boardrooms 102-108)*
5:00 pm to 5:30 pm	Conference Wrap-up/ Closing Remarks

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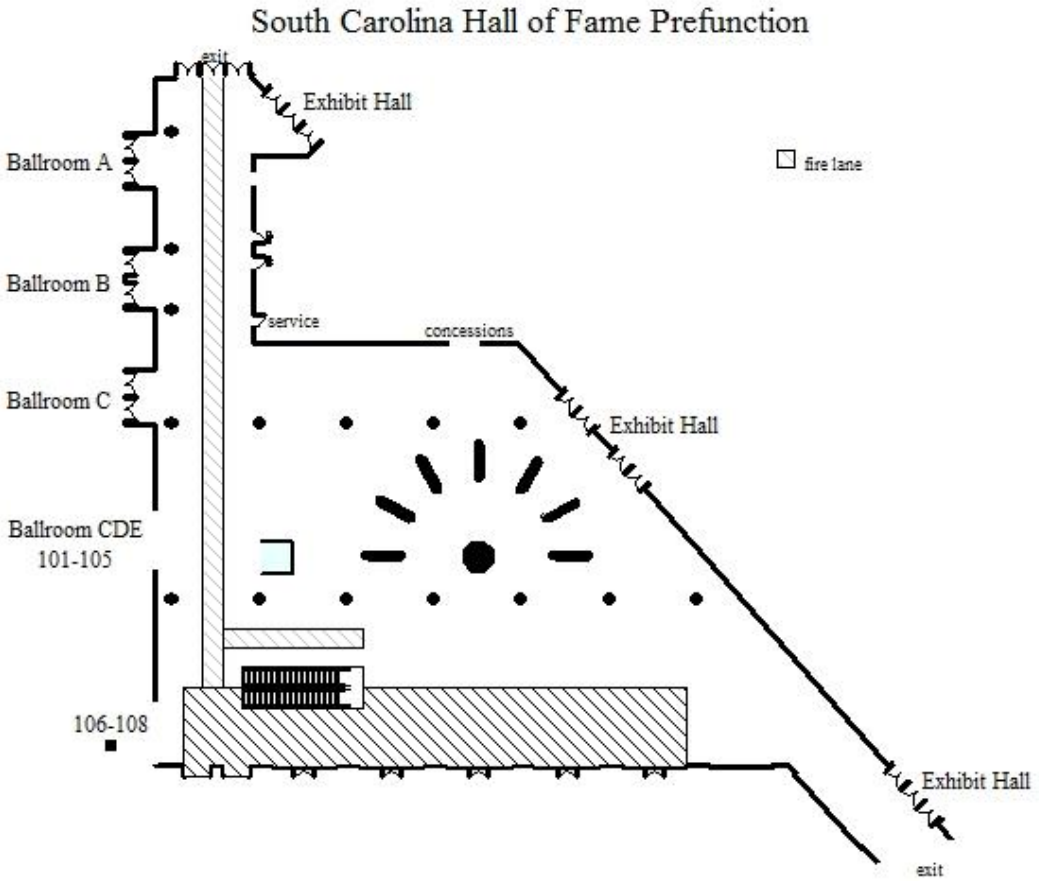
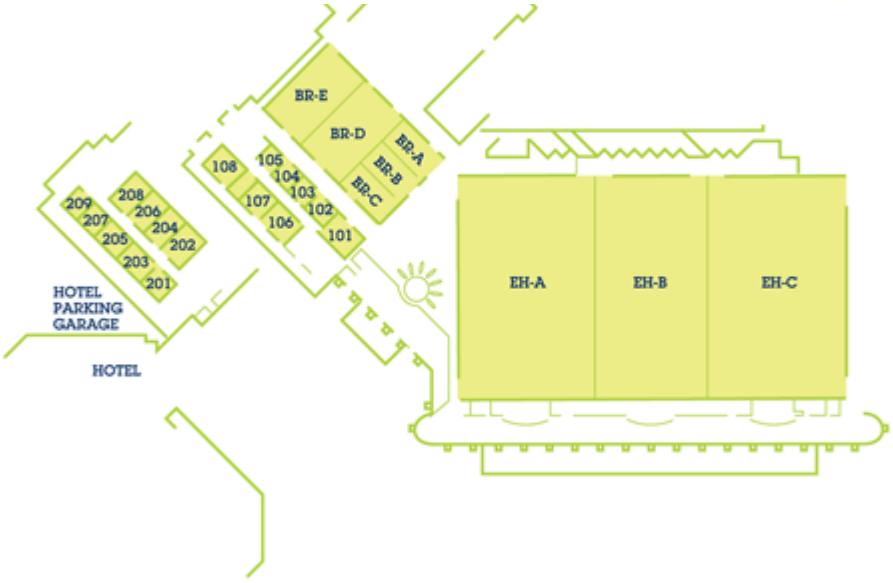
Hotel Conferencing Layout

Most Wild Pig Conference Activities will take place in Ballrooms D&E.
Please check your program for room assignments





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Monday, April 18th Technical Session Agenda

Time	Topic	Speaker(s)
8:00-8:45am	Tips for talking about feral swine "across the fence" at public meetings, and with the media Message mapping, aligning with credible sources, understanding stakeholder perspectives	Gail Keirn, USDA-APHIS Legislative and Public Affairs
8:45-9:00am	Questions	
9:00-9:45am	Building Community Support for feral swine management: case studies and lessons learned from New York and Ohio	Justin Gansowski, USDA-APHIS-Wildlife Services-NY Craig Hicks, USDA-APHIS-Wildlife Services-OH
9:45-10:00am	Questions	
10:00-10:30am	Networking Break	
10:30-12:00pm	Moderated Panel Discussion "Pigs, People, and Policies: What are the Communication Challenges?" (Gail Keirn, Moderator) *Example talking points for panel:* *~How are communication challenges different in states with high versus low feral swine populations?* *~What audiences are the biggest critics of feral swine damage management and how do you address their concerns?* *~What are the best practices/effective strategies for communicating with various stakeholders?* *~What is the role of recreational hunters in feral swine damage management?*	Chuck Yoest- Tennessee Wildlife Resource Agency Bronson Strickland- Mississippi State University Extension Service Jack Mayer- Savannah River National Laboratory, SC Mike Bodenchuk- USDA-APHIS-WS-TX Wendy Anderson, USDA-APHIS-Feral Swine Damage Management Program
12:00-1:30pm	Lunch on own	

1:30-2:15pm	Enhancing feral swine control through the "Judas pig" technique" Pros and cons	Brian Archuleta- USDA-APHIS-WS-NM Wes Gaston- USDA-APHIS-WS-AL
2:15-2:30pm	Questions	
2:30-3:15pm	Multi-agency collaborative Efforts for reducing feral swine populations: Successes and challenges from Mississippi and Missouri	Carson Nelson- USDA-APHIS-WS-MS Seth Swafford, USFWS Parker Hall, USDA-APHIS-WS-MO Alan Leary- Missouri Department of Conservation
3:15-3:30pm	Questions	
3:30-3:45pm	Break	
3:45-4:30pm	New mapping techniques for tracking feral swine	Joe Corn- Southeastern Cooperative Wildlife Disease Study Mark Lutman- USDA-APHIS-WS-NWRC
4:30-4:45pm	Questions	

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Plenary Speakers

Mr. Edward Avalos

Under Secretary for Marketing and Regulatory Programs
United States Department of Agriculture

Conference Opening Remarks
Tuesday, April 19th, 8:00am
Ballrooms D&E

Edward Avalos has served as the Under Secretary for Marketing and Regulatory Programs at the United States Department of Agriculture for over 6 years. Mr. Avalos provides leadership and oversight for the Animal and Plant Health Inspection Service which addresses animal and plant pests and diseases; the Agricultural Marketing Service, which provides standardization testing and marketing of commodities and specialty crops; and the Grain Inspection, Packers and Stockyards Administration, which promotes marketing of livestock, cereals and meats, as well as fair trade practices.

Mr. Avalos grew up on a family farm in the Mesilla Valley of Southern New Mexico. He has over 30 years of experience working with producers, shippers, distributors, processors, retailers and other stakeholders to develop domestic and international markets for livestock and agricultural products.

In addition, Mr. Avalos has worked on “buy local” initiatives, Indian agriculture and numerous promotional and trade activities with industry organizations and other stakeholder groups.

Mr. Avalos holds Bachelor of Science and Master of Science degrees in Agriculture from New Mexico State University in Las Cruces, New Mexico.

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Dr. Kurt VerCauteren

Research Wildlife Biologist/Project Leader
USDA/APHIS/WS National Wildlife Research Center

"Overview of research being conducted by USDA/APHIS and other partners to aid in control of feral swine"
Tuesday, April 19th, 8:20am
Ballrooms D&E

Kurt leads research on feral swine, deer and elk for the National Wildlife Research Center of the United States Department of Agriculture/Animal Plant and Health Inspection Service/Wildlife Services (NWRC). He has been with NWRC for 17 years and has conducted research that has led to improved understanding and management of human-wildlife conflict. His research focusses on wildlife damage management and diseases of wildlife that impact humans, livestock, and natural resources. His current efforts focus on methods to reduce the multitude of damage caused by feral swine, deer, and elk; diseases associated with deer and elk; and rabies in terrestrial wildlife.

Dr. Mark Smith

Extension Specialist/Associate Professor
Alabama Cooperative Extension System, Auburn University

"Creating a united front through the National Wild Pig Task Force"
Tuesday, April 19th, 8:40am
Ballrooms D&E

Mark D. Smith is an extension specialist/associate professor with the Alabama Cooperative Extension System in the School of Forestry and Wildlife Sciences at Auburn University. Mark received a B.S. in Fisheries and Wildlife from Michigan State University (1994) and after spending 2.5 years working temporary research positions with the Missouri Department of Conservation returned to academia to earn an M.S. in Wildlife Sciences (2001) and Ph.D. in Forest Resources (2004) from Mississippi State University. Since 2008, Mark's extension and research efforts now focus primarily on wild pig damage management.

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Schedule of Oral Presentations

Tuesday, April 19, 2016

10:00am-noon, CONCURRENT SESSIONS- Ballroom E
Technical Session 1: Human Dimensions of Wild Pig Management
Moderator: Bill Hamrick, Mississippi State University Extension Service

10:00 A.M. *Learning by trapping: the value of reducing uncertainty about feral swine density*
Chris Slootmaker, USDA/APHIS/WS/National Wildlife Research Center

10:20 A.M. *Evaluating risks of domestic wild boar farming as a source of feral swine in Canada*
Ryan K. Brook, University of Saskatchewan

10:40 A.M. *Mississippi public awareness and attitudes toward wild hogs*
Diana M. Neal, Mississippi State University

11:00 A.M. *The anthropogenic movement of wild pigs: causes and consequences*
Michael Tabak, USDA/APHIS/VS/Center for Epidemiology and Animal Health

11:20 A.M. *Results from a new USDA survey of feral swine damage and control in an 11-state region*
Aaron Anderson, USDA/APHIS/WS/National Wildlife Research Center

11:40 A.M. *Economic impacts of feral swine on limited-resource producers in the Southeastern United States*
Stephanie A. Shwiff, USDA/APHIS/WS/National Wildlife Research Center

10:00am-noon, CONCURRENT SESSIONS- Ballroom D
Technical Session 2: Wild Pig Distribution
Moderator: Bronson Strickland, Mississippi State University Extension Service

10:00 A.M. *Forecasting the potential distribution of Sus scrofa in North America*
Christopher L. Burdett, Colorado State University

10:20 A.M *Population density of wild pigs (Sus scrofa) in relation to landscape characteristics across the United States*
Jesse S. Lewis, Conservation Science Partners

10:40 A.M. *Territoriality among wild pig sounders in the vicinity of a rich resource*

John C. Kilgo, USDA Forest Service Southern Research Station

11:00 A.M. *Impact of environmental factors and individual-level characteristics on feral swine movement rates*
Shannon Kay, USDA/APHIS/WS/National Wildlife Research Center

11:20 A.M. *Expansion and abundance of feral swine in the United States*
Joseph L. Corn, Southeastern Cooperative Wildlife Disease Study/The University of Georgia

11:40 A.M. *Bed site selection of feral swine (Sus scrofa) in Michigan, USA*
Dwayne R. Etter, Michigan Department of Natural Resources

1:30-3:00pm, CONCURRENT SESSIONS- Ballroom E
Technical Session 3: Disease I
Moderator: Janet Paraan, USDA/APHIS/National Feral Swine Damage Management Program

1:30 P.M. *Zoonotic Pathogens in Feral Swine at Slaughter Facilities*
Kerri Pedersen, USDA/APHIS/WS/Feral Swine Damage Management Program

1:50 P.M. *Survey for selected pathogens in feral swine (Sus scrofa) from Guam, Marianna Islands, USA*
C. A. Cleveland, Southeastern Cooperative Wildlife Disease Study/The University of Georgia

2:10 P.M. *Pseudorabies (PRV) exposure and infection status in feral swine populations of Florida*
Felipe A. Hernández, University of Florida

2:30 P.M. *Pathogenesis of H1N1 avian origin influenza A viruses in feral swine*
Fred L. Cunningham, USDA/APHIS/WS/National Wildlife Research Center

1:30-3:00pm, CONCURRENT SESSIONS- Ballroom D
Technical Session 4: Baits
Moderator: Trevon Strange, Mississippi State University

1:30 P.M. *Bait preferences of feral swine*
Glen T. Gentry, Louisiana State University Agricultural Center

1:50 P.M. *The development of sodium nitrite type baits as a tool in management of feral pig populations*
Linton Staples, Animal Control Technologies Australia

2:10 P.M. *Development and evaluation of delivery devices for dispensing bait selectively to feral swine*

Michael J. Lavelle, USDA/APHIS/WS/National Wildlife Research Center

2:30 P.M. *Feral hog control using a new bait*
Richard Poché, Genesis Laboratories, Inc.

3:30-5:00pm, CONCURRENT SESSIONS- Ballroom E
Technical Session 5: Wild Pig Population Control I
Moderator: Mark Smith, Auburn University

3:30pm *Feral pig control in Hawaii: evolution of control methods*
Francis Quitazol, The Nature Conservancy of Hawaii

3:50pm *Development of a self-contained carbon dioxide euthanasia trailer for large-scale euthanasia of feral swine*
John C. Kinsey, Texas Parks and Wildlife Department

4:10pm *Water point traps to capture feral pigs and goats at a landscape scale to protect endangered species*
John Scriven, Queensland Murray Darling Committee

4:30pm *Conducting feral swine shooting operations during winter trapping*
Rod Pinkston, JAGER PRO™ Hog Control Systems

4:50pm *Sounder-based control approach provides versatile, effective means of reducing wild pig numbers*
Alexandra A. Lewis, Auburn University

3:30-5:00pm, CONCURRENT SESSIONS -Ballroom D
Technical Session 6: Disease II
Moderator: Jessica Tegt, Mississippi State University

3:30pm *Development of a rapid, simple, and specific qPCR assay for detection of pseudorabies in domestic swine herds*
Katherine A. Sayler, University of Florida

3:50pm *Disease emergence dynamics and control in feral swine*
Kim Pepin, USDA/APHIS/WS/National Wildlife Research Center

4:10pm *Use of volatile organic compounds in breath and feces to detect swine infected with Mycobacterium tuberculosis complex*
Pauline Nol, USDA/APHIS/VS/Wildlife Livestock Disease Investigations Team

4:30pm *Risk and consequences of pathogen sharing between wild pigs, livestock, poultry, and humans: implications for disease risk management of free-ranging swine in North America*

Ryan S. Miller, USDA/APHIS/VS/Center for Epidemiology and Animal Health

Wednesday April 20, 2016

8:00-9:30am
State Agency Reports, Ballroom D&E
Moderator: Jessica Tegt, Mississippi State University Extension Service

Tennessee Wildlife Resources Agency- Chuck Yoest
Missouri Department of Natural Resources- Alan Leary
Mississippi Department of Wildlife, Fisheries, and Parks- Ricky Flynt
Georgia Department of Natural Resources- Charlie Killmaster
USDA/APHIS Wildlife Services Virginia Program- Jeffrey Rumbaugh
South Carolina Department of Natural Resources- Charles Ruth (Jack Mayer presenting)
Louisiana Department of Wildlife and Fisheries- James LaCour
Alabama Department of Conservation and Natural Resources- Matthew Brock
USDA/APHIS Wildlife Services Texas Program- Michael Bodenchuk

10:00am-12:00pm- CONCURRENT SESSIONS- Ballroom E
Technical Session 7: Wild Pig Control II
Moderator: Alan Leary, Missouri Department of Natural Resources

10:00 A.M. *Inferring feral swine abundance using removal data from management actions*
Amy J. Davis, USDA/APHIS/WS/National Wildlife Research Center

10:20 A.M. *Effects of lethal population control strategies in feral swine with and without immunocontraceptive control*
Kim M. Pepin, USDA/APHIS/WS/National Wildlife Research Center

10:40 A.M. *Feral swine populations demonstrate resilience to harvest: implications for management*
Ryan S. Miller, USDA/APHIS/VS/Center for Epidemiology and Animal Health

11:00 A.M. *The efficacy of Rhodamine-B as a biomarker in wild pigs (Sus Scrofa)*
Sarah C. Webster, Savannah River Ecology Laboratory/The University of Georgia

11:20 A.M. *Control of the Barbary Boar in Morocco*
Stephen S. Ditchkoff, Auburn University

11:40 A.M. *Effects of door width on wild pig entrance into traps*
Matthew J. George, Auburn University

10:00am-12:00pm- CONCURRENT SESSIONS- Ballroom D
Technical Session 8: Wild Pig Movement
Moderator: Jack Mayer, Savannah River National Laboratory

10:00am *Empirical comparison of density estimators for wild pigs*
David A. Keiter, Savannah River Ecology Laboratory/The University of Georgia

10:20am *Home range, habitat use, and activity patterns by feral hogs in northern Texas*
Gregory A. Franckowiak, Genesis Laboratories, Inc.

10:40am *Pigs on the wing: movement ecology of translocated wild pigs*
James C. Beasley, Savannah River Ecology Laboratory/The University of Georgia

11:00am *Using environmental DNA to detect invasive species: molecular detection of feral pigs in water*
Kelly Williams, Colorado State University

11:20am *Environmental mechanisms of feral swine invasion during 3 decades in the United States inform future expansion potential*
Nathan P. Snow, USDA/APHIS/WS/National Wildlife Research Center

11:40am *Tolerance of feral swine to simulated GPS ear tag transmitters*
Paul A. Di Salvo, USDA/APHIS/VS/Center for Epidemiology and Animal Health

1:30-3:10pm – Ballrooms D&E
Technical Session 9: Wild Pig Biology and Genetics
Moderator: Jim LaCour, Louisiana Department of Wildlife and Fisheries

1:30 P.M. *Identification of molecular population structure for feral swine in the United States*
Blake E. McCann, Theodore Roosevelt National Park

1:50 P.M. *Feral hog depredation of American alligator nests in southwest Louisiana*
Kim Marie Tolson, University of Louisiana at Monroe

2:10 P.M. *Development of a comprehensive feral swine field study: population dynamics, response to culling, space-use patterns, and behavioral interactions*
Matthew L. Farnsworth, Conservation Science Partners

2:30 P.M. *DNA detection of feral swine diet*

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Antoinette J. Piaggio, USDA/APHIS/WS/National Wildlife Research Center

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Wednesday, April 20th, National Wild Pig Task Force Open House

3:30-5:00 pm

This is your opportunity to meet the NWPTF Sub-committee representatives, learn about the mission for each of the sub-committees, and join any you wish to participate in.

Room	Subcommittee	Representative
102	Research	James Beasley
103	Applied Management	Mark Smith
104	Wild Pig Conference	Jessica Tegt
106	Policy	Steve Backs
107	Communications	Jack Mayer

info@wpfeeder.com

ABSTRACTS

Technical Session 1: Human Dimensions of Wild Pig Management

Learning by trapping: the value of reducing uncertainty about feral swine density
Chris Slootmaker, Aaron Anderson, and Stephanie Shwiff, USDA/APHIS/WS National Wildlife Research Center, 4101 Laporte Avenue, Fort Collins, CO 80521

We use an economic model of feral swine management to study the tradeoffs between hunting benefits and agricultural damage when the manager is uncertain about the density of pigs on the landscape. We estimate the cost of this uncertainty and how it affects optimal management over time. We then allow the possibility that the manager can employ mark-recapture methods to learn about pig density. By contrasting this with a world without mark-recapture, we quantify the value of reducing uncertainty through such field efforts and suggest how management can leverage this learning process when forming a management plan. Finally, we show how investing in field efforts to reduce uncertainty can be especially valuable if the manager has little or bad information about initial pig density.

Evaluating Risks of Domestic Wild Boar Farming as a Source of Feral Swine in Canada
Ryan K. Brook[1], Nicole L. Michel, Michael P. Laforge, and Floris M. Van Beest[2]
[1]Department of Animal and Poultry Science, College of Agriculture and Bioresources, University of Saskatchewan, 51 Campus Drive, Saskatoon, Saskatchewan, S7N 5A8, [2] Department of Bioscience, Aarhus University, Frederiksborgvej 399, Building I1.43, 4000 Roskilde, Aarhus, Denmark

Wild hogs (*Sus scrofa*) are an invasive, exotic species that have spread through much of the US through anthropogenic means. Many states have laws and regulations aimed at reducing legal important of wild swine. Federal regulation also prohibit the movement of undocumented swine. However, in many cases, these laws have been ineffectual for stopping the anthropogenic spread of wild swine. Current efforts at eradication will only be hampered if there is a continual influx of illegally imported and released wild hog. We are currently examining various wild hog-related laws throughout the US for definitions of wild hogs; restrictiveness for wild hog-related activities; enforcement potential; and the potential for current laws and penalties associated with those laws to provide a disincentive for the illegal importation and release of wild hogs. We also discuss methods that may be developed and used to enhance efforts to reduce the anthropogenic spread of wild hogs.

Assessment of wild hog damage to Mississippi agricultural productivity
Diana M. Neal, Jessica Tegt, and Bronson Strickland, Department of Wildlife, Fisheries & Aquaculture, Mississippi State University, Box 9690, Mississippi State, MS 39762

Mississippi's agriculture producers and forestry landowners have been affected by the destructive habits and activities of wild hogs, causing damage and significant economic losses to fields, crops, timber production and other agriculture. With wild hog populations dramatically increasing statewide, it is urgent to understand wild hog impacts on Mississippi agricultural productivity. In this study, we provide an understanding of wild hog impacts and management costs, especially in produce lost, damage repaired, labor cost, and expense of wild hog control. A postcard survey was sent to 4,901 agricultural producers and forestry landowners statewide. A total of 803 respondents returned completed surveys, of which 321 reported wild hog sightings and/or damage on their properties and agreed to a more in-depth interview questionnaire. From this sample, 75 were randomly selected for face-to-face on-site field surveys of their properties. The remaining 230 respondents were selected to be contacted by phone. Results indicated that overall 74% of respondents have had wild hogs on their land and 67% with hogs reported an average annual repair cost of US$4,026 plus a labor cost of US$2,395. Twenty percent of landowners had changed commodities in the last 5 years, and half of these attributed this change to wild hog damage, with a reported financial loss of US$421,398. Eighty-eight percent of landowners with wild hogs on their land practiced control methods, with an investment and maintenance value of about US$209,015, or US$5,359 per landowner. The next step is to extrapolate these results statewide.

The anthropogenic movement of wild pigs: causes and consequences

Michael Tabak, Toni Piaggio, Holly Ernest, and Ryan Miller, USDA/APHIS-Center for Epidemiology and Animal Health, 2150 Centre Ave, Bldg B; Fort Collins, CO 80524.

The movement of wild pigs by humans is a major complication for management of this invasive species; it allows them to expand into new locations and promotes the existence of peripheral populations. While human movement of pigs is widely thought to be an important factor in facilitating their expansion, little research has been conducted to find societal factors associated with this movement. We used population genetic analytic methods to evaluate the structure of wild pig populations and probability of migration among counties in California. Then we analyzed human social factors associated with wild pig movement. We found high levels of genetic structure, suggesting that natural migration (i.e., not human-mediated) is rare. We also found that the probability of pig movement out of a county was positively associated with the number of pigs harvested by hunters, the amount of private land, and the number of game outfitters. Our results suggest that hunters might be moving pigs from counties where they are abundant and heavily hunted into other counties in California. Our results can be used to identify counties that might be sources of wild pigs, and counties that might be susceptible to their introduction in the future. While hunting culture has often been assumed to be an important component of the anthropogenic movement of wild pigs, our research appears to be the first to quantitatively document an association between hunting and the movement of wild pigs.

Results from a new USDA survey of feral swine damage and control in an 11-state region

Aaron Anderson, Chris Slootmaker, Erin Harper, Jason Holderieath, Stephanie A. Shwiff, USDA/APHIS/WS National Wildlife Research Center, Fort Collins, CO 80521

We report the results of new survey on feral swine damage and control in an 11-state region of the US. The survey was distributed by the USDA National Agricultural Statistical Service in the summer of 2015 to a sample of producers of corn, soybeans, wheat, rice, peanuts, and sorghum in the 11-state region. Producers that failed to respond to the initial mailing received multiple follow-up phone calls in an attempt to minimize non-response bias, and a total of 4,377 responses were obtained. Findings indicate that damage can be substantial. The highest yield loss estimates occur in peanut and corn production in the Southeast and Texas. Control efforts are common, and producers incur considerable costs from shooting and trapping efforts. Extrapolating crop damage estimates to the state-level in each of the 11 states yields an estimated crop loss of $190 million. Though large, this number likely represents only a small fraction of the total damage by feral swine in the 11 states because it only includes crop damage to six crops. We hope findings from this survey will help guide control efforts and research, as well as serve as a benchmark against which the effectiveness of future control efforts can be measured.

Economic impacts of feral swine on limited-resource producers in the Southeastern United States

Stephanie A. Shwiff, USDA/APHIS/WS National Wildlife Research Center, 4101 Laporte Ave, Fort Collins, CO 80521

We present results of a survey administered by 1890s Universities to limited-resource producers in the southeastern United States. 596 responses were collected by extension agents from 13 schools over two rounds in the spring and summer of 2015. Data were collected on a range of damages and values associated with feral swine, relating to: crop and livestock production, property damage, hunting, control efforts, and environmental preferences. Across the sample, 35% reported feral swine on their property in the previous three years. 40% of producers planting crops reported damage from feral swine, while 5% raising livestock reported loss to feral swine, and 30% reported property damage. A third of producers sampled have taken action to control feral swine, and report varying effectiveness across methods. We also illicit information on willingness to pay to (1) either eradicate feral swine if producers have them and do not want them, or do not have them and do not want them, and (2) willingness to accept feral swine eradication if producers have them and prefer to keep them, or do not have them but would prefer to have them.

Technical Session 2: Distribution

Forecasting the potential distribution of *Sus scrofa* in North America

Christopher L. Burdett[1], Michael A. Tabak[2], Sarah J. Garza[1], and Ryan S. Miller[2]
[1] Colorado State University, Department of Biology, Campus Delivery 1878, Fort Collins, CO 80523-1878, [2] United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Center for Epidemiology and Animal Health, Fort Collins, Colorado, USA 80524

Populations of wild pigs (*Sus scrofa)* have recently increased throughout the species' native and non-native ranges. In the United States (U.S.), the increased distribution of *S. scrofa* has been facilitated by human introductions in locations far from existing persistent populations. Such introductions circumvent natural ecological limitations associated with dispersal ability, making it critical that we better understand the potential distribution of wild pigs in North America. In this study, we compiled a global database of occurrence records from biodiversity databases, museums, mammal atlases, and surveys and used these data to forecast the climatic niche and potential distribution of *S. scrofa* in North America. We used an ensemble of several modeling methods to estimate the climatic niche of the species in its native European range and then projected this European model onto the climate of North America. We also created a reciprocal model that estimated the current climatic niche occupied by pigs in the U.S. Distributions of *S. scrofa* in both Europe and North America were more strongly correlated with seasonal extremes of temperature and precipitation than annual means. Projecting the Europe model in North America indicated that most of the U.S. and large portions of Canada represent suitable habitat for wild pigs. There was low similarity between the current and potential niches of the species in the U.S. (niche similarity relative rank test = 0.41) suggesting that, unlike Europe where the species has persisted for millennia, wild-pig populations in the U.S. are not yet in equilibrium with their environment. Although *S. scrofa* may have further climatic adaptations at a sub-species level, our results warn that wild-pig populations may be capable of becoming established nearly anywhere they are introduced in the conterminous U.S.

Population density of wild pigs (Sus scrofa) in relation to landscape characteristics across the United States

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Wild pigs exhibit a global distribution, where they are valued in their native range and regarded as a harmful invasive species in their introduced range. Throughout their distribution, wild pigs persist in a variety of landscapes, including semi-arid rangelands, productive deciduous forests, and alpine regions. Understanding the population density of wild pigs is critical for informing and prioritizing management actions targeting conservation, eradication, and control efforts. We conducted a literature search of published estimates of wild pig density from around the world, including Europe, Asia, North America, South America, and Australia. We used these global estimates to parameterize models evaluating the population density of wild pigs across their global distribution in relation to abiotic (weather, climate, and terrain) and biotic (forest cover, forage, predators) determinants. Model results were used to create a predictive map of feral swine density in the United States. Overall, densities of wild pigs were greater for island populations compared to mainland populations. For mainland populations, preliminary results indicate that wild pig density was higher in areas with greater primary productivity and lower in areas with greater annual snow cover. Using these relationships, as well as others included in the model, we mapped the predicted feral swine density across the United States to evaluate potential variations in population density. This information can be used to understand how feral swine density varies across broad areas and predict the abundance of feral swine at local to national levels. In addition, managers can use our results to prioritize control actions and increase surveillance efforts in areas having a high potential for feral swine invasion.

Territoriality among wild pig sounders in the vicinity of a rich resource

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Considerable interest has developed recently in the concept of "whole-sounder" trapping to increase effectiveness of control programs for wild pigs (*Sus scrofa*). Traditional trap designs frequently result in the capture of only a portion of a sounder when the gate is triggered before the entire group has entered the trap, resulting in incomplete control and potentially trap-shy pigs. Recently available trapping technologies allow for capture of entire sounders in one event. However, whether whole-sounder trapping can markedly improve control efficacy may depend on the degree of territoriality (exclusive space use) among sounders, which in turn may depend on resource conditions as multiple sounders converge on rich, concentrated resources. If territorial, the removal of a single sounder may result in a persistent reduction of local density. In contrast, a lack of territoriality would require more intensive and extensive control efforts, as additional sounders remain in the same area after the first is removed. Our objective was to assess the degree of territoriality among neighboring sounders, as measured by amount of territory overlap, in a landscape containing an abundant food resource, a large landfill on the U.S. Department of Energy's Savannah River Site in South Carolina. During 2014 and 2016, we outfitted adult sows from neighboring groups with GPS telemetry collars that logged locations at 2-hour intervals. We used dynamic Brownian bridge movement models for each sounder to compute utilization distributions to estimate home range boundaries and an index of home range overlap. Preliminary results indicate that sounder home ranges overlapped extensively in space, both within and outside the footprint of the landfill, but neighboring sounders partitioned space temporally, seldom occurring at the same location at the same time except within the landfill. We will discuss implications for control programs in situations where resources are similarly concentrated.

Feral swine resource selection at local and landscape scales across southern USA

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Quantifying feral swine (*Sus scrofa*) occurrence across different habitat types is an essential component to predicting areas that are most susceptible to future invasion. This can help inform management in the introductory phase of a feral swine invasion to prevent the successful establishment of new feral swine populations. Understanding resource selection processes can also identify target areas for control programs, which will aid in ongoing management actions. We examined feral swine occurrence at a landscape scale using telemetry data collected from 12 different studies across the southern U.S. over the last decade. Additionally, we investigated differences in habitat utilization at local levels by examining clusters of locations. We found that feral swine most often selected woody wetlands, shrub/scrub, and deciduous forest habitat types, followed by agricultural areas such as hay/pasture and cultivated crops habitat types, and selected developed areas least often. We also took advantage of the extensiveness of the data to compare a range of methods for approximating the underlying spatial point process governing feral swine presence including traditional methods such as the use-availability design, and a novel negative binomial approach. We evaluated methods by comparing sensitivities from location error as well as sampling schematics.

Expansion and abundance of feral swine in the United States

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The Southeastern Cooperative Wildlife Disease Study (SCWDS) began producing nationwide feral swine distribution maps in 1982 by working directly with state and territorial natural resources agencies. In 1982, 17 states reported feral swine; by 2004, 28 states were reporting feral swine. In 2008, SCWDS implemented the National Feral Swine Mapping System (NFSMS). The NFSMS is an internet-based data collection system used to collect and

display current data on the distribution of feral swine in the United States. These maps are produced using data collected from state and territorial natural resources agencies, USDA-APHIS-Wildlife Services, and other state/federal wildlife and agriculture agencies; over 240 agency representatives have passwords for access to submit data into the system. A national map identifying counties with established populations of feral swine is available to be viewed by the public on the NFSMS home page. Distribution data submitted by agency personnel are evaluated by SCWDS on a continual basis, and the map is updated with verified additions on a monthly basis. Feral swine populations and/or sightings are designated either as established breeding populations, or as sightings, but only established breeding populations are included on the map and in the total of the number of states with feral swine. Over 600 additions have been made to the national map through the NFSMS since January 2008. The NFSMS is accessed via the internet at http://swine.vet.uga.edu/nfsms. The number of states reporting established populations in 2015 was 36. Expansion of feral swine is due to several factors including intentional release of feral swine into new areas, escape of penned feral swine, and natural expansion of extant populations. We also used these maps to generate estimates of abundance of feral swine in the United States. Using published data on feral swine density and environmental factors we developed a model and generated estimates of abundance for each state in the United States. Estimates of feral swine abundance by state and nationwide are given.

Bed site selection of feral swine (*Sus scrofa*) in Michigan, USA
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Detecting and locating feral swine that exist at low density can be challenging. This is particularly important for agencies attempting to eliminate feral swine and to declare areas free of swine. Michigan is in the early stage of feral swine colonization with a few localized populations of Russian boar throughout the Lower and Upper Peninsulas. Until recently, information about presence of feral swine in Michigan has been limited to reports from the general public, extensive ground searches for sign and trail cameras. However, given the limited access to areas believed to be frequented by feral swine, presence information collected by these methods may be incomplete. Understanding the ecology and behavior of feral swine can assist in detecting animals when present. From 2014 to 2016, we captured 8 Russian boars in central Michigan and equipped them with iridium GPS collars set to collect a location every 30-minutes. Early findings from a few individuals indicated that diurnal locations were limited to a few sites in a given area and thus were assumed to be bed sites. Limited aerial and ground inspections of these sites confirmed presence of feral swine beds. We used this information to identify bed sites from location data based on time of day (diurnal or nocturnal), frequency of visiting a site and time remaining at the site. Individual feral swine maintained several bed sites in an area and used these consistently. Incorporating additional collared feral swine, we will quantify landscape variables (e.g., habitat, road density, etc.) common to bed site locations. Understanding key landscape variables for locating bed sites can inform ground and aerial searches to detect feral swine. This is particularly applicable to northern states where duration of snowfall can assist with detection of feral swine by aerial searches.

Technical Session 3: Disease

Zoonotic Pathogens in Feral Swine at Slaughter Facilities
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Feral swine carry a wide variety of bacterial and viral pathogens and parasites that can be transmitted to humans, domestic livestock, and pets. Humans with the potential for recreational or occupational exposure to feral swine are at the highest risk of becoming infected. After a Food Safety Inspection Service inspector and a plant employee became infected with *Brucella suis* at two different facilities that slaughter feral swine, there was an interest in better understanding the risk posed to abattoir workers. Although the primary pathogen of interest was *Brucella suis*, additional serum samples were collected to test for exposure to other zoonotic diseases including toxoplasmosis, trichinellosis, influenza A virus and leptospirosis. Various lymph nodes and tissues, urine, nasal swabs, and blood were cultured for *Brucella* spp. Preliminary results indicate that exposure to the pathogens that cause these diseases is widespread with the exception of trichinellosis, and that many of the feral swine that are processed at slaughter facilities are culture positive for *Brucella suis*. This suggests that abbatoir workers and others with occupations or

recreational activities that involve feral swine are at high risk of exposure and steps should be taken to ensure they are aware of the risk and can recognize the potential symptoms of infection.

Survey for selected pathogens in feral swine (*Sus scrofa*) from Guam, Marianna Islands, USA

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Pigs (*Sus scrofa*) were introduced to the United States Territory of Guam in the late 1600's and are now feral, widespread and present in high densities on parts of the island. Feral swine are reservoirs for pathogens of concern to domestic animals and humans, yet there are no data on pathogen exposure of feral pigs on Guam. Previously, a serosurvey for nine pathogens of domestic swine in 1999 found only exposure to parvovirus. The close proximity of humans, domestic animals, and feral swine on Guam, combined with the liberal hunting regulations of feral swine, result in frequent opportunities for pathogen transmission. From February-March 2015, serum, tissue and ectoparasite samples were collected from 46 feral swine. Serologic testing found exposure to numerous pathogens including *Toxoplasma gondii* (20%), pseudorabies virus (63%), porcine reproductive and respiratory syndrome (PRRS) virus (13%), porcine parvovirus (89%), and *Brucella* spp. (2%). Eleven (13%) samples had low titers (1:100) to 1+ *Leptospira interrogans* serovars including Bratislava (n=6), Icterohaemorrhagiae (n=6), Pomona (n=2), and Hardjo (n=1). Kidney samples available from nine pigs with *Leptospira* antibodies were negative for *Leptospira* antigens by immunohistochemistry. Few gross lesions were noted but numerous pigs had *Metastrongylus* worms in the lungs, three had *Stephanurus dendatus*, and one had a liver abscess with intralesional nematode larvae. *Hematopinus suis* lice and *Amblyomma breviscutatum* ticks were found on 12 and seven pigs, respectively. We did not detect antibodies to Influenza-A virus in any samples. In contrast to the previous survey of domestic swine, we found evidence of numerous pathogens in feral swine including new reports of pseudorabies virus, PRRS virus, *Brucella*, and *Leptospira* in pigs on Guam. These findings highlight that precautions are needed when handling feral swine to minimize the risk to people and domestic animals.

Pseudorabies (PRV) exposure and infection status in feral swine populations of Florida

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Feral swine (*Sus scrofa*) are the most widely distributed invasive wild ungulate in the United States and there are estimated to be > 500,000 individuals in Florida. This species is the disease reservoir for pseudorabies virus (PRV), which is deadly to native wildlife and causes economic losses to the swine industry worldwide. To evaluate the PRV exposure and infection status in feral swine populations of Florida, we sampled blood, nasal, oral and genital swabs from 522 individuals at 41 public and private sites during 2014-2015. Animals were euthanized as part of population control efforts by USDA/WS/NWDP or collected by hunters. Glycoprotein B enzyme-linked immunosorbent assay (gB ELISA) and real-time polymerase chain reaction assay (gB qPCR) were conducted to assess PRV exposure and viral shedding, respectively. Of 411 feral swine tested for PRV exposure, 217 (53%) were PRV-antibody positive, and 37 of 522 (7%) feral swine were viral-DNA positive. Sub-adults had higher PRV infection rates than adult and juvenile feral swine (12% vs. 6% and 3%, respectively), and females had higher viral-DNA prevalence than males (9% vs. 4%). Of 409 feral swine tested for both PRV exposure and infection, 14 (3.4%) animals were PRV-antibody negative and PRV-DNA positive (38% of qPCR positive samples), suggesting that animals actively shedding the virus may be underestimated by only considering PRV seropositivity. Twelve (2.9%) animals were both PRV-antibody and PRV-DNA positive (32% of qPCR positive samples), suggesting an advanced or stress-reactivated viral infection. A relatively high number of animals, 203 (49.6%), exhibited detectable PRV-antibodies, but not viral-DNA, which would indicate that these individuals were either exposed but not infected or had latent infections. Spatial analysis showed that extrinsic factors (hunting, land cover) might influence the persistence and reactivation of PRV, increasing the likelihood of disease transmission among feral swine and other domestic and wildlife species.

Pathogenesis of H1N1 avian origin influenza A viruses in feral swine

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The objectives of this project are to study the infectivity of H1N1 avian influenza A viruses in feral swine. A total of 12 influenza A virus negative feral swine captured in wild were randomly divided into two groups, the infection group containing 8 pigs and the control group containing 4 pigs. Pigs in infection group were intranasally inoculated with 1 mL 10^6 $TCID_{50}$ avian influenza virus A/mallard/Wisconsin/A00751454/2009(H1N1) whereas those in the control group with 1 mL PBS. Infected pigs and control pigs were housed in two individual rooms. To evaluate the virus shedding in feral swine inoculated with virus, nasal washes and fecal swabs collected daily from 1 to 10 days post inoculation (DPI) were inoculated in both MDCK cells and specific pathogen free embryonated chicken eggs for viral detection. Results indicated that only two pigs showed virus shedding in nasal washes at 2 DPI and no virus was recovered from fecal swabs. During the infection experiment, neither fever nor clinical signs were observed. In addition, H1N1 virus infection did not affect the weight of the feral swine from the treatment group when compared to those from the control group. Serum was collected at 0, 10, 14 and 21 DPI to estimate the humoral immunity response. Two treated and one control feral swine were euthanized at 5 and 7 DPI, respectively. Pathogenesis analysis indicated that lung and tracheal tissues did not show any pathogenic changes. Two of the remaining 4 treated feral swine seroconverted with an HI titer of 1:40 at 21 DPI. Our conclusion is that avian influenza virus, A/mallard/Wisconsin/A00751454/2009(H1N1) can infect feral swine but replication is very limited and the virus induced a limited immunity response.

Technical Session 4: Bait/Toxicants

Bait preferences of feral swine

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The determination of a bait flavor that attract feral pigs and a bait matrix that is conducive to palatability, delivery, stability and shelf life are all requirements for the successful development of sodium nitrite laced baits for feral pigs. Very little non-biased information exist in the scientific literature on the flavor preferences of feral pigs. Therefore, preference trials have been conducted and are still on-going to determine flavor(s) that influence consumption in feral swine. To accomplish this, feral pigs were captured using commercial type traps and transported to the Bob R. Jones – Idlewild Research Station and held in a 1 ha holding pen with access to ad libitum whole shell corn and ad libitum water. On treatment days, individual pigs were placed in pens and offered differing ingredients/flavors and whole-shelled corn (WSC) in a paired crisscross design. Consumption was monitored via surveillance cameras. Recorded footage was reviewed and preference was determined based on the percent of total time feeding on each bait offered. Each the trial was considered complete when one bait was completely consumed. Bait flavors/ingredients tested included white oak acorns, fresh strawberry, marshmallows, peanut butter, grape jelly, WSC and maple syrup, fresh bass, fish meal, dehydrated bass and dehydrated pogie. To date, feral pigs preferred WSC compared with white-oak acorns, fresh strawberry, marshmallows, peanut butter, grape jelly, fish meal and WSC and maple syrup. There was no preference between fresh bass and WSC, however, pigs preferred dehydrated bass and dehydrated pogie to WSC. Results from this study will be utilized in the development of a toxic feral pig bait.

The development of sodium nitrite type baits as a tool in management of feral pig populations

Linton Staples[1], Kurt Vercauteran[2], Nathan Snow[2], Simon Humphrys3, Duncan McMoaran[4], and Justin Forster[5]
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Feral pigs pose major agricultural and disease threats in several countries but Australia and the USA have particular problems with population estimates of 5 to 20 million spread over vast geographical distribution. Populations and ranges are increasing in both countries and traditional controls including trapping and shooting, while useful, are not adequate. Since pigs are vulnerable to methaemoglobin forming agents since pigs are relatively deficient in protective methaemoglobin reductase. A joint IA-CRC, USDA, TPWD and ACTA research project has explored the use of sodium nitrite, a food preservative in low doses, as an active ingredient in a targeted bait product to be called HOGGONE. As sodium nitrite is unstable and its degradation products are unpalatable the work has required development of new bait composites to achieve stability and news bait delivery system and delivery hoppers to maximise target specific delivery and to minimise risks to non-target species. Over 90% knockdown has been proven in GLP pens studies even when captured feral pigs have access to alternate palatable feed. The mode of action is fast and humane and has negligible risk of accumulation or secondary poisoning. This paper will update on the joint project and outline the pathways to regulatory approvals, scale up and distribution in Australia and USA in relation to other initiatives for feral pig management.

Development and evaluation of delivery devices for dispensing bait selectively to feral swine

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There is an increasing need for effective means for delivering pharmaceuticals to free-ranging feral swine, while excluding non-target species. The foraging strategy of rooting by pigs is relatively unique and can be exploited to facilitate delivery with a well-thought-out bait station design; however, there are several wildlife species that pose a challenge to insuring swine-specific access. We resumed the challenge of development of such a device and present the results of several stages of our ongoing development. First, we determined that raccoons, the primary non-target species, could not access a bait station if the lid exceeded 10.2 kg of resistance. Second, we determined the lifting abilities of the presumably least-capable pigs likely to visit bait stations alone (20-40 kg) to insure most could exceed the resistance required to exclude raccoons. Pigs that were willing to access (40%) gained access under both 13.6 and 18.1 kg of resistance. Next, we evaluated several sizes and arrangements of bait stations to identify specific design characteristics that would enable more individuals to feed simultaneously while minimizing the number of pigs willing to provide access. We concluded a trough-style bait station with a low front, 2 elongated (1.1 m) reservoirs positioned back-to-back and covered by overhanging lids that open in opposing directions provided the most potential. Most recently, we proceeded into the field to evaluate bait stations with these characteristics and constructed of steel or plastic. Our findings emphasize group dynamics and pig behavior will be primary factors in determining overall success in maximizing the number of individuals gaining access to bait stations. Although current results are telling, there is more to be learned in completing the development of the ultimate swine-specific bait station.

Feral hog control using a new bait

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An EPA Experimental Use Permit was obtained to conduct a field trial using a novel bait to control feral hogs. The product, 12-years under development, was used to determine the efficacy against feral hogs on test sites 50 miles east of Plainview, Texas. Two paraffin bait formulations were tested, containing 0.005% and 0.01% warfarin. Hog activity was monitored pre- and post-treatment using trail cameras near feeders, VHF and GPS transmitting equipment, and bait consumption. Bait was applied in modified commercial feeders with heavy lids. Bating

initiated on June 1 and terminated June 30, 2015. After the 30-day exposure period efficacy on the 5-km treatment plot baited with 0.005% warfarin was 100%, 98.6%, and 97.8% using radio-tracking, trail camera images, and bait consumption. Efficacy on the 0.01% warfarin bait plot was not as effective. Ninety-seven non-target searches were conducted during the treatment and post-treatment phases to examine for mortality, for which none were found. The low warfarin concentrate bait proved effective in eliminating wild hogs while posing minimal exposure to non-target wildlife.

Technical Session 5: Control Measures I

Feral Pig Control in Hawaii: Evolution of Control Methods
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The Nature Conservancy of Hawaii manages preserves on all of the major Hawaiian Islands, effectively protecting over 36,000 acres. Through the development of partnerships, TNC has fostered and cared for over 200,000 acres of watershed lands throughout the state. Hawaii's native forests evolved without the presence of large mammals. In Hawaii, there are only 2 native species of mammals: the Hawaiian hoary bat and the Hawaiian monk seal. The historical lack of large native mammals has left Hawaiian native forests vulnerable, unable to evolve defenses and recover from damage caused by feral pigs and other introduced ungulates. Feral pig control in Hawaii is challenging because of the remoteness of the rainforest locations with diverse topography and constantly changing weather conditions. These challenges, among others, have forced managers to integrate and utilize many different methods of control in order to maintain zero-tolerance levels within TNC preserves and throughout the managed watershed areas.

Development of a Self-contained Carbon Dioxide Euthanasia Trailer for Large Scale Euthanasia of Feral Swine
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Range expansion of feral swine (*Suss scrofa*) continues to be pervasive in the United States. Lethal control of feral swine is an accepted management practice throughout the nation. Indirect lethal control measures (e.g. trapping) often require euthanasia and methods used must be humane, safe, and economical. Though cranial gunshot is an accepted method of euthanasia, in some cases it is not safe, legal for use, or practical. Additionally, an alternate means for euthanasia of wildlife research subjects are needed at the Feral Swine Research Facility on the Kerr Wildlife Management Area (KWMA), Hunt, TX. Institutional Animal Care and Use Committee (IACUC) protocol at KWMA requires humane euthanasia of test subjects upon completion of their respective research trials. The American Veterinary Medical Association (AVMA) Guidelines for Euthanasia of Animals approves a gradual fill method of carbon dioxide (CO^2) euthanasia for some laboratory animals and livestock species, including domestic swine. Previous research has identified the use of an enclosed dump-bed truck or trailer as a CO^2 chamber for efficient means of euthanizing and disposing of large numbers of domestic swine, however, there is no documentation on the efficacy of such methods on wildlife species. We manufactured a self-contained CO^2 euthanasia chamber on a 4.27m (14') dump trailer for the euthanasia of feral swine. Three euthanasia trials of 5 feral swine (N=15) were conducted at the KWMA. Carbon dioxide administration began immediately post-loading and commenced for 5 minutes at an average of approximately18% chamber volume per minute. A 20 minute observation period followed each 5 minute CO^2 wash-in period. Group behavior was monitored through 3 viewing ports on top of the unit. Recorded mortality rates were 100%. Results of this study may have wide spread impacts on wildlife euthanasia protocols for wildlife researchers and state game agencies across the nation.

Water point traps to capture feral pigs and goats at a landscape scale to protect endangered species
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The aim of the project was to efficiently and effectively eliminate significant numbers of Feral pigs and goats from large tracks of dense vegetation on a Property in outback North West New South Wales, Australia. The impact of Feral Pigs & Goats on local flora and fauna – including The Mallee Fowl (endangered species) was well documented. The project was funded by Biodiversity Funds & the Invasive Animals CRC. Project Manager & Associate Researcher Jason Wishart, subcontracted QMDC to construct 6 water point traps (3km of mesh) to trap feral goats & pigs. This presentation is about the success of Water Point Traps and the unique traps mechanisms (designed by the author) that were engineered to trap the feral pigs and goats. An incentive for the land manager to participate was revenue from the sale of the Feral Goats. The environmental impact of trapping Feral Pigs included a decrease in Mallee Fowl eggs and nest being destroyed; and the trapping of Feral Goats minimised damage to the native vegetation. The project involved a team of three who camped out on the property and constructed the Water Point Traps using 3km of mesh (100 x 30m rolls), 12 pig trap doors, 12 goat doors, 6 access gates, 1000 iron posts, and 6 coils of plain wire. Outcomes of the project included: 6 water point traps completed in which 1000 goats were successfully trapped and 150 Pigs that were trapped. These pigs were used for a new toxin trial of sodium nitrate (Hoggone).

Conducting feral swine shooting operations during winter trapping
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Current peer-reviewed and published research indicates non-trapping techniques such as opportunistic shooting (day or night) significantly alters the behavior of feral swine and may subsequently reduce trapping success. Our data and field experience will demonstrate how advanced shooting methods can positively alter feral swine behavior to greatly increase winter trapping success. The JAGER PRO definition of Integrated Wild Pig Control (IWPC) is a strategic approach using a series of innovative lethal control methods and technologies implemented in a specific sequence based on seasonal food sources. Emphasis is placed on efficient removal of the entire sounder at one time to eliminate escapes, method education and reproduction. The control strategies continually change throughout the various seasons to effectively target adaptive survivors. The IWPC model determines it is sometimes necessary to conduct feral swine shooting operations during winter trapping efforts. This presentation will provide detailed results (capture percentages, camera to kill ratios, etc.) and photo/video documentation of three innovative methods known as QRF Baiting™, Fatal Funnel™ and Dumbing The Sounder™. The IWPC whole-sounder performance standard was implemented to eliminate 624 feral pigs in 76 events within the 4,816-acre target area of the Georgia Environmental Protection Division's 319(h) grant project.

Sounder-based control approach provides versatile, effective means of reducing wild pig numbers
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Previous efforts to reduce wild pig (*Sus scrofa*) numbers suggest targeting entire sounders for removal may reduce numbers with greater efficacy and efficiency compared to individual-based trapping, shooting, or hunting methods. However, this approach was tested on a single population of wild pigs in a predominantly forested landscape (Fort Benning, GA), leaving the applicability of a sounder-based control strategy across a wider range of habitat types, resource availability profiles, and population densities in question. Therefore, we examined if a sounder-based approach could be used to reduce a wild pig population in central Alabama surrounded by a greater percentage of agricultural lands and believed initially to be at a density different from Fort Benning. To do this, we surveyed using game cameras the pig population on two study areas on Lowndes Wildlife Management Area, Alabama from November 2014 to present. From the resulting image data we identified sounders present and estimated abundance in each study area. We then targeted sounders for removal on one study area while capturing and fitting adult sows on the other area with GPS collars to monitor their movements on and off the study area. Trapping efforts and pig movements were recorded to be compared with those from the Fort Benning study. Preliminary results indicate similarity of trapping success and pig movements at the sounder level between the former (Fort Benning) and current (Lowndes WMA) study sites. Early results also indicate pig population density does not impact the efficacy or efficiency of a sounder-based control strategy. Identifying and targeting entire sounder units for removal is likely

a viable, relatively efficient approach for the long-term maintenance of a low wild pig population—even eradication—under a wide variety of habitat conditions.

Technical Session 6: Disease II

Development of a rapid, simple and specific qPCR assay for detection of pseudorabies in domestic swine herds

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Pseudorabies virus or PRV (also known as Aujeszky's disease or Suid herpesvirus 1) is a significant disease of domestic pigs worldwide. This virus is a neurotropic alphaherpesvirus that can cause fatal disease in newborn pigs, respiratory disorders in fattening pigs and reproductive failure in sows resulting in significant economic losses. Despite successful eradication of PRV in the United States commercial pig industry in 2004, large populations of feral swine present in certain areas of the U.S. act as wildlife reservoirs for the virus. Due to this threat of reintroduction of the virus in domestic herds, rapid, reliable, easily implemented diagnostic assays are needed for PRV. Although a real time PCR (qPCR) assay has already been developed (Ma et al. 2008, Zanella et al. 2012), improvements in real time PCR technology and a greater understanding of diversity of PRV strains worldwide allows for the development and implementation of a more specific assay (diagnostic specificity of previous assay: 64.0-77.3%, 95% CI). In this study we developed a single tube, rapid qPCR that is capable of detecting 10 copies of the gB gene per 20 microliter reaction. The analytical specificity of the assay was high, as only PRV gB DNA was detected and the diagnostic specificity neared 100%, as PRV was not detected in domestic pigs where disease is known to be absent. When combined with a commercially available internal extraction control, this assay allows for detection of virus in a simple, relatively inexpensive format that can allow for high-throughput screening of samples while still accounting for differences in nucleic acid recovery efficiency. The assay is a useful tool for early detection of neurologic domestic animals in order to protect herds in the case of an outbreak situation.

Disease-emergence dynamics and control in feral swine

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Once a pathogen is introduced in a population, key factors governing rate of spread include contact structure, supply of susceptible individuals and pathogen life-history. We examined the interplay of these factors on emergence dynamics and efficacy of disease prevention and response. We contrasted transmission dynamics of livestock viruses with different life-histories, foot-and-mouth disease virus (FMDV) and classical swine fever virus (CSFV), in hypothetical populations of feral swine with different contact structures (homogenous, metapopulation, spatial and network). Persistence probability was near 0 for FMDV under a wide range of parameter values and contact structures, while persistence was probable for CSFV. There were no sets of conditions where FMDV persisted in every stochastic simulation. Even when population growth rates were up to 300% annually, FMDV persisted in < 25% of simulations regardless of transmission rates and contact structure. For networks and spatial contact structure, persistence probability of FMDV was always < 10%. Because of its low persistence probability, even very early response to FMDV in feral swine was unwarranted highly inefficient while response to CSFV was generally effective. When pre-emergence culling of feral swine caused population declines, it was effective at decreasing outbreak size of both diseases by ≥ 80%.

Use of volatile organic compounds in breath and feces to detect swine infected with *Mycobacterium tuberculosis* complex

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Detection of diseases in wildlife is generally done through techniques such as hunter-kill surveys, road-kill surveys, or actively capturing and/or killing animals for serologic testing and /or postmortem examination. There is need for less invasive, less expensive techniques to remotely detect disease in wild populations. Analysis of volatile organic compounds in breath and feces may be used to identify disease in individuals and populations and could provide a solution for remote surveillance of wildlife. Bovine tuberculosis is endemic at low prevalence in feral swine populations on the island of Molokai, Hawaii and threatens to spill back to domestic cattle on that island. In addition, bovine tuberculosis is present in cattle herds in Mexico, where it has potential to be transmitted to feral swine populations of the southern United States, as it has been transmitted to wild boar populations in several European countries. In order to evaluate the feasibility of using volatile organic compounds to detect *M. tuberculosis* Complex infection in swine, we collected and analyzed breath and fecal volatile organic compounds from tuberculosis-positive and negative wild boar (n=57) in Doñana National Park, Spain, where the disease is endemic, as well as in feral swine (n=29) experimentally infected with *Mycobacterium bovis* in a vaccine study. Research is in progress and the latest data will be presented.

Risk and consequences of pathogen sharing between wild pigs, livestock, poultry, wildlife, and humans: implications for disease risk management of free-ranging swine in North America

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Diseases transmitted between humans, wildlife, and domestic animals are increasingly challenging for public and veterinary health systems. In North America, it is estimated that at least 79% of reportable domestic animal diseases have a putative wildlife component associated with the transmission, maintenance, or life cycle of the pathogen, and at least 40% are zoonotic. Recently, wild swine in North America have become of increasing concern as a potential veterinary and public health threat. Currently, there are no robust assessments of the potential risk of pathogen transmission between wild swine, livestock, and humans. Here we present a risk assessment of the pathogens that can be shared among these species groups, evaluate the current status of these pathogens in North America, investigate the potential impact on agricultural exports, and illustrate the potential risk to United States agricultural and human health. We identified 34 known swine pathogens (bacterial, viral, and parasitic) that cause clinical disease in livestock, poultry, farmed wildlife species, and humans. On average 73% of bacterial, 39% of viral, and 63% of parasitic pathogens were shared between swine and other species groups. Livestock in the family Bovidae (cattle, sheep, goats) had the most pathogens (82%) shared with swine. Only 45% of currently reportable domestic swine diseases had published surveillance studies for wild swine. Investigation of economic impacts found a median export decline of 18% after a reportable disease outbreak that translated into $2.8 billion in United States agricultural exports. The co-occurrence of wild swine and farms increased at an annual mean rate of 1.2% with as much as 57% of all farms and 77% of all agricultural animals residing in counties with wild swine. Our risk assessment identified significant gaps in knowledge required to inform surveillance, risk assessments, scientific studies, and risk mitigations for diseases of wild swine. We provide a discussion of these needs in the context of feral swine range overlap with agriculture in the United States.

Technical Session 7: Control II

Inferring feral swine abundance using removal data from management actions
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Feral swine can cause a tremendous amount of environmental and economic damage. To evaluate effectiveness of feral swine population management programs, estimates of population size before and after management activities are essential. However, many methods of estimating population size are too labor intensive and costly to implement, posing restrictive levels of burden on operational programs. Removal sampling is a reliable method to estimate population size that takes advantage of commonly collected management data (removal events), thus posing a reduced burden on managers who assist in data collection while improving efficiency of management programs. We developed a Bayesian hierarchical model to estimate population size from removal data accounting for varying levels of effort. We used simulations to assess the conditions under which reliable population estimates can be evaluated. We applied this model to estimate population sizes of feral swine (*Sus scrofa*), using removal data from aerial gunning work in 59 sites throughout Oklahoma and Texas, U.S.A., which ranged in area from 480 to 19,600 acres. Estimated population sizes varied considerably among sites from 20 feral swine (95% credible interval: 13, 30) to 1334 (95% credible interval: 1112, 1567). Simulations showed that population size estimates were generally unbiased when effective removal rates (removal rate accounting for total effort) were above 0.75. Our analyses showed that to improve the probability of accurately estimating population size using this removal modeling framework it is important to 1) have multiple removals (3+) within a small time frame (<3 months), 2) increase total sampling effort (8+ hours across all sampling passes is recommended for feral swine aerial removals), 3) increase the removal rate, and 4) collect auxiliary information related to removal probability.

Effects of lethal population control strategies in feral swine with and without immunocontraceptive control
Kim M. Pepin, Amy J. Davis, Fred L. Cunningham, Doug C. Eckery

The development of effective eradication programs for invasive species such as feral swine (*Sus scrofa*) is often resource-limited. Strategic planning of how to optimally implement multiple control methods can be critical for allocating limited resources effectively. One aspect of management planning that is understudied includes how to maximize eradication rates by varying the frequency at which different control techniques should be applied given species-specific population biology. To address this gap, we used a stochastic population model of feral swine to: 1) evaluate different culling patterns that have been used previously in Texas, USA over the last 10 years, 2) identify culling frequencies that increase rates of local eradication, and 3) identify combinations of culling patterns and immunocontraceptive use that could further increase rates of eradication. Specifically, we compared infrequent removal of many individuals (e.g., aerial gunning) to frequent removal of a small number of individuals (e.g., trapping, or ground shooting). When aerial gunning-type events resulted in the removal of a large proportion of the population removed early during a sequence of culling events, the population could be eradicated using this type of strategy (i.e., infrequent removal of many individuals). However, trapping-type strategies, which involved consistent removal of a small number of individuals, performed better at decreasing population growth under all other conditions. Applying an immunocontraceptive in addition to culling, allowed eradication when culling alone was insufficient and accelerated time to eradication when capture probabilities depended on population density. We suggest that applying a bait-based immunocontraceptive concurrently with regular culling may help allow or shorten time to eradication especially in populations that have been reduced to levels where individuals are difficult to find for culling.

Feral swine populations demonstrate resilience to harvest: Implications for management
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Increasing population densities and range expansion of feral and wild swine globally have led to increased damage to agricultural crops and natural ecosystems, and may have contributed to the spread of zoonotic diseases. These problems, as well as potential influences of climatic changes, accentuate the need for effective control of wild pig populations, particularly in regions where they are an invasive species. Where feral swine are pioneering new, previously unoccupied habitats, the population is inherently in an unstable demographic condition, making the

application of classic population models tenuous. We investigated short-term population dynamics using vital rate data from 63 wild pig populations and transfer functions used in tandem with Leslie matrix models. Population dynamics were examined over 2, 5, and 10 years—timeframes of relevance to wildlife managers, and also potentially important to understanding invasion dynamics. Our analysis indicated that the survival and fecundity of juveniles (<1 year old) may be critical for determining the success of population establishment, in particular the upper and lower range of potential growth rates and population densities that may be achieved. Feral swine populations in the United States had a 0.935 probability of having a population growth rate above net zero. Perturbation analysis using transfer functions found that the mean reduction in survival required across all age classes to bring population growth to net zero was 34% and ranged from 25% to 100%. Populations that experienced harvest had a 66% chance they would increase up to 8-fold greater than prior to harvest. In general all of the feral swine populations we investigated demonstrated significant resilience to harvest. We also found that preferential harvest of juveniles may provide the largest immediate reduction in short term growth rates and that management of juvenile fecundity (i.e. immunocontraception) may also yield the largest reductions in population growth. These findings underscore the importance of managing even small or newly establishing populations of wild pigs, particularly if eradication or invasive species management is a goal.

The efficacy of Rhodamine-B as a biomarker in wild pigs (*Sus Scrofa*)

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Worldwide, there is growing interest in the use of pharmaceutical baits to control populations of wild pigs (Sus scrofa). In a two-part study we evaluated the efficacy and persistence of Rhodamine B (RB), a chemical marker commonly used in wildlife research and management, as a potential biomarker for quantifying bait uptake in wild pigs. In part one, thirty wild pigs were live-trapped, transported to a captive facility on the Department of Energy's Savannah River Site during autumn 2013, and administered RB orally at a dosage of 30mg/kg. Eight vibrissae and guard hairs were collected pre- and post-RB exposure (7 or 14 days) and evaluated for the presence of RB using fluorescence microscopy. We observed no fluorescent marking in the pre-RB exposure samples. In contrast, 98% of vibrassae and 100% of guard hairs collected post-RB exposure exhibited RB marks. Furthermore, phase two evaluated the efficacy of RB at varying dosage levels and the persistence of the dosage levels over a 12 week period. Fifteen wild pigs of varying ages and sexes were live-trapped, transported to the same captive facility used in part one, administered RB orally at dosages of 5mg/kg, 15mg/kg, or 30mg/kg (5 individuals per treatment group) during summer 2014. Vibrissae were collected pre-RB exposure and every two weeks post-RB exposure for 12 weeks total. Of all vibrissae collected throughout the 12 week sampling period, 73% exhibited RB marks. Additionally, all pigs in the 15mg/kg and 30mg/kg treatment groups exhibited RB presence at 12 weeks, while only 1 out of 5 pigs in the 5mg/kg group had RB presence at 12 weeks. The uniform detection of RB among individuals given dosages of 15mg/kg and 30mg/kg (in both parts of the study) in vibrissae indicate that RB may be an effective biomarker for use in developing baiting programs to deliver pharmaceutical baits to wild pigs.

Control of the Barbary Boar in Morocco

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The Barbary boar (*Sus scrofa algira*) is native to North Africa, and is found in Tunisia, Algeria, and Morocco. Unlike the majority of large faunal species in the region that were extirpated or driven to extinction through overexploitation and habitat alteration, the Barbary boar has maintained a foothold in remote mountainous areas of this region. Although Morocco is classified as a semi-arid environment, the Moroccan economy relies heavily upon agriculture where 45% of the working population is employed. Moreover, small-scale subsistence farming contributes a significant source of nutrition to local residents and commerce to barter economies. The Barbary boar causes significant damage to agriculture in areas when present, and there is pressure on the government to reduce these damages, especially in rural, subsistence-based farming communities. Because of the environmental conditions of the region, population growth of the Barbary boar is relatively slow compared to other wild pig populations, suggesting that lethal control could be an effective mechanism for controlling populations. However,

tight gun control and religious views on consumption of pork make hunting a non-viable alternative. In 2012, we studied the population of Barbary boar on 4 study sites in south-central Morocco, and examined the efficacy of whole sounder removal. We conducted systematic camera surveys in each study area to locate, identify, and estimate the abundance of Barbary boar. We documented a total of 58 individual Barbary boar at the 4 study sites (range = 3 – 40), suggesting that densities are far less than are found in North America. Low densities, dependence on anthropogenic food sources, and documented willingness to enter corral traps suggest that whole sounder removal could be very effective at controlling damage. We will discuss the social, economic, and biological challenges associated with management of Barbary boar in Morocco and provide a mechanism for controlling agricultural damage.

Effects of door width on wild pig entrance into traps

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Wild pigs (*Sus scrofa*) are arguably one of the greatest wildlife management challenges facing natural resource professionals and landowners in the United States. Lethal removal by trapping is often the most cost- and time-effective means for managing wild pigs. Whereas numerous studies have examined the effects of trap type, trap door designs, and baits, no studies have examined the effects of trap door width on wild pig entrance into corral style traps. Granted, there is much debate regarding the width of trap doors relative to the entrance rates of wild pigs into corral style traps with many trappers suggesting wider doors facilitate greater entrance rates into traps. Our objective was to determine entry rates of wild pigs into standard 3-panel corral traps with wooden guillotine trap doors of either 0.81- or 1.22-meter opening width. We placed these doors on 12 traps at 2 study areas in east-central Alabama from June-September of 2013 and 2014. We positioned a motion-sensitive game camera on each trap to record wild pig visitation behavior and then began baiting each trap. We recorded the time when wild pigs initially visited the trap site, frequency and duration of subsequent visits to the trap, time until the first pig entered the trap, approximate age of the pig that first entered the trap and the maximum number of pigs within the trap at any time during the visit. We used camera imagery data collected from 25 boars and 47 sounders to determine how trap door width may affect the frequency that wild pigs enter into corral traps.

Technical Session 8: Wild Pig Movement and Range

Empirical comparison of density estimators for wild pigs

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Estimating abundance of invasive wild pigs (*Sus scrofa*) is notoriously difficult, yet knowledge of animal abundance or density is critical to management and ecological research. We compared six methods of estimating wild pig density in three habitat types in South Carolina. These methods included use of camera traps for spatially-explicit capture-recapture (SECR) analysis, consumption of a biomarker, removal models created through trapping and euthanasia, SECR analysis incorporating trapping data, a Lincoln-Petersen estimator using camera and trap data, and scat collection for genetic capture-mark-recapture analysis. Additionally, we simulated known population densities and ecological processes and compared performance of non-genetic density estimators relative to the simulated truth. We found that SECR analysis using camera data produced the most realistic results based upon historic trapping data within our study area, while the biomarker method, removal model, and Lincoln-Petersen estimator estimated lower densities. SECR models performed better when corral trap capture locations were also incorporated. Removal models performed poorly when capture numbers were low. The non-camera methods estimated abundance and an area adjustment was necessary to obtain densities. The lower density estimates of these models relative to the camera models may imply that our method of converting abundance to density requires refinement. Genetic analysis has not yet been concluded, preventing explanation of these results. We found that density of pigs was fairly constant across the three habitat types measured (estimated 2.5 pigs/km^2), according to the best SECR model. Our data suggest that piglets are not independent of adults, and may influence results if this lack

of independence goes unconsidered. Simulation results suggest that modelling camera and trap data in a spatially-explicit framework is likely to result in fairly accurate estimates of pig density. Overall, this study should allow managers and researchers to make informed choices when selecting a method of monitoring wild pig populations.

Home Range, Habitat Use, and Activity Patterns by Feral Hogs in Northern Texas

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The feral hog (*Sus scrofa*) distribution throughout United States is steadily expanding as a result of their high reproductive rates and translocation by humans. With the state of Texas estimating to harbor > 2 million feral hogs, wildlife managers are challenged with the issue of maintaining a balance between providing opportunities for the recreational hunting of feral hogs, and reducing the negative effects feral hogs have on natural systems and economic assets. Using supplemental data from a feral hog toxicant field study we investigated space use of 9 radio-collared feral hogs across the checkered landscape of conservation land, natural vegetation, and cropland in the panhandle of Texas. We calculated the home range, habitat selection, and daily activity patterns of feral hogs in 10 land cover types found in our study area. Mean (± *SE*) 95% and 50% fixed kernel density home ranges were 6.95 ± 1.35 km^2 and 1.04 ± 0.33 km^2, respectively. These means are similar to that of previous studies. Using composition analysis, we found woody and floodplain shrublands were the most preferred land cover types, and CRP (conservation reserve program) land, water, and barren lands were the most avoided land cover types when looking at both for both home range densities. Daily activity shows that throughout a 24-hour period, feral hog locations are primarily in the woody shrub land cover type, but usage of row crops increases from night into early and late morning.

Pigs on the wing: Movement ecology of translocated wild pigs

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Population size and geographic distribution of invasive wild pigs (*Sus scrofa*) has increased in recent years as a result of intentional, and often illegal, translocations. As such, increased knowledge of pig movement patterns following translocation is necessary to assess disease transmission risks and potential for population establishment. Our objective, therefore, is to elucidate the movement of wild pigs subsequent to translocation. We placed GPS collars on wild pigs in both areas of preferred and marginal habitat on the Savannah River Site in Aiken, SC; a subset of pigs from each habitat were translocated to the reciprocal habitat an average of 15.6 km from their point of capture. We monitored pigs up to 6 months, and for both *in situ* and translocated pigs we used a 15-day moving window analysis to quantify area used, average daily movements, and maximum distance travelled from their capture/release location. In the first 14 days subsequent to translocation, pigs exhibited extremely large use areas, with 95% home ranges more than 10 times larger than those of individuals not translocated. However, after 60 days the area used by translocated animals gradually decreased and was similar to that of resident pigs. Translocated pigs also moved greater distances from release points (6,241.7 m) and exhibited greater daily movement rates (326.1 m/day) than resident animals (distance from release = 4,199.2 m; daily movement = 269.6 m/day). Our results clearly indicate translocated pigs make extensive movements from their release point and thus 1) have a high potential to encounter other individuals, which may increase probability of population establishment, and 2) pose a substantial risk of disseminating pathogens to wildlife and domestic livestock in the surrounding area.

Using environmental DNA to detect invasive species: molecular detection of feral pigs in water

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Feral pigs are considered to be one of the most widespread invasive vertebrate species worldwide. Due to the negative impacts of feral pigs on agricultural and natural ecosystems, and their continued expansion, management efforts are being focused on reducing feral pig populations. Management of this species can be challenging when

abundance is low, either at the tail end of an eradication effort or in the beginning stages of an invasion. Successful management of feral pigs requires detection and elimination of individuals before they increase in numbers and spread to new areas. When a pig wallows or drinks, DNA is shed into the environment. Using this environmental DNA (eDNA), we have developed a tool to assess effectiveness of management practices in addition to identifying locations that require control efforts. We have optimized this method of detection to be efficient in the field by minimizing equipment and cold chain storage of samples.

Environmental mechanisms of feral swine invasion during 3 decades in the United States inform future expansion potential

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Identifying the ecological drivers of invasion can help predict where exotic species will become established. An approximate 3-fold increase in distributed range of feral swine (*Sus scrofa*) in the continental US during the last 3 decades has created uncertainty about any spatial and temporal bounds of invasion. We used dynamic, spatiotemporal models to examine the invasion by feral swine and the associated influences from global change, landscape, climate, human presence, and mammalian biodiversity during 1982–2012. We found that the probabilities of invasion and associated influences were dynamic through time, and could be attributed to expansion into northern and western regions of the US. Probabilities of invasion increased in more agricultural areas until much of the agricultural-Midwest was occupied, then continued northward without the influence of agriculture. Feral swine continually expanded into cooler areas, and more recently into drier regions of the western states. In the most recent years, the probabilities of expansion increased where average summer temperatures declined and winter precipitation decreased; both indications of expanding north and west. These trends indicate that feral swine will likely continue expanding into unoccupied regions, and there is little indication that environmental bounds for the ongoing invasion exist. Thus, human intervention is needed to curtail the invasion and reduce impacts from feral swine on natural, agricultural, and other valued resources. This research provides new insight for evaluating an ongoing biological invasion and for prioritizing the highest risk areas for invasion if control measures are not implemented.

Tolerance of Feral Swine to Simulated GPS Ear Tag Transmitters

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Feral (free-ranging) swine (*Sus scrofa*) are highly successful invasive mammals found in at least 41 U.S. states and three Canadian provinces. They cause ecological and agricultural damage and can carry diseases that threaten wildlife, domestic animals, and people. Lack of data on feral swine population behavior in North America hampers efforts to quantify risks and mitigate damages. Traditional neck collar tracking devices are problematic in feral swine due to their anatomy and seasonal fluctuations in neck circumference and body mass. To address this problem, we assessed the feasibility of ear tag GPS units by placing simulated transmitters of different weights (35 g, 50 g, and 65 g) on twelve captive-bred, juvenile feral swine. Three treatment groups and one control group were confined and monitored for one week without tags and four weeks with tags. Generalized linear models were used to estimate the probability of poor ear condition score and ear damage. Behavioral acclimatization to weighted tags occurred within one week. Over the course of the study, five (56%) of nine pigs with weighted tags sustained ear damage and four (44%) pigs lost their weighted tags. Statistical modeling estimated a 0.54 probability of ear damage for 50 g tags. The probability of poor ear condition score increased as tag placement became more distal (OR=7.06). These results with captive pigs may be considered a worst-case situation and 50 g GPS transmitters are likely to be successfully used on wild swine with ear area ≥ 88 cm^2. Ideal tag placement is near the base of the ear, equidistant from the lateral edges. The ear morphology of captive feral swine and free-ranging swine in Florida were similar. Therefore, we plan to conduct field studies in Florida to assess the integrity of GPS ear tag transmitters on animals of different age, sex, and ear sizes.

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Technical Session 9: Biology/Genetics/Behavior

Identification of Molecular Population Structure for Feral Swine in the United States

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Feral swine (*Sus scrofa*) are damaging pests that have invaded most U.S. states, and their invasive range continues to expand throughout North America. Given the ecological and economic threats posed by increasing swine abundance, it is imperative to develop an understanding of current population genetics to aid management. To elucidate population structure, we conducted spatial and non-spatial Bayesian clustering analyses of 88 single nucleotide polymorphism loci from 916 feral swine in 34 U.S. states, including 43 Eurasian wild boar from Iran and Spain as known outgroups for comparison. Our objective was to identify molecular population structure for feral swine nationwide. Spatial and non-spatial analyses returned 53 and 65 molecular clusters, respectively, with 33 groups shared in consensus. Based on correspondence of geography with molecular groupings, and stronger differentiation for spatial results, we selected the spatial partition as the best representation of population structure overall. Among these 53 groups, 45 corresponded to local-scale geography within the United States, and most were supported by biological, geographic, and historical information. Findings of this study are relevant to national feral swine management efforts, because discrete genetic units may be targeted for eradication and gene flow may be tracked to elucidate patterns of natural and anthropogenic dispersal of the species. Ongoing molecular investigations with high density sampling across the invasive range of feral swine in the United States are warranted.

Feral Hog Depredation of American Alligator Nests in Southwest Louisiana

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The American alligator (*Alligator mississippiensis*) is managed as a commercial, renewable natural resource in Louisiana. Conservative estimates have valued this resource at 80 to 90 million dollars annually, providing significant, direct economic benefit to Louisiana (Louisiana's Alligator Management Program, 2014-2015 Annual Report). American alligator nests in Cameron Parish, Louisiana were monitored during the summers of 2014 and 2015 for evidence of depredation by feral hogs. Remote game cameras were deployed during the month of July on 17 nests in 2014, and again on 10 nests in July of 2015. All cameras were retrieved in the month of September after hatching had occurred. Additionally, in 2015, two sham nests embedded with a player broadcasting recorded sounds of alligator hatchlings were monitored by the same technique. During the 2014 nesting season, 14 of the 17 nests were successfully monitored for the duration of the project. Of these 14 nests, eleven (78%) had hog visits documented on camera. Three of those eleven nests visited by hogs had evidence of successful hatching. The average number of hog visits was 1.64 visits/nest, and ranged from 1 to 3. During the 2015 nesting season two corrupt SD cards resulted in 8 of the 10 cameras producing photographic data on nests for the duration of the project. Five of these eight nests (63%) were visited by hogs, and two of those five nests had evidence of successful hatching. The average number of hog visits was 5.2 visits/nest, with a range of 2 to 14. One of the two sham nests with the player broadcasting hatchling calls was visited 30 times by hogs.

Development of a comprehensive feral swine field study: population dynamics, response to culling, space-use patterns, and behavioral interactions

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Although feral swine have occurred in the United States for centuries, relatively little is known about their basic ecology in many environments, including population dynamics, space-use patterns, and habitat selection. Furthermore, few studies have evaluated how feral swine populations respond to management activities, which are increasingly common to mitigate their negative impacts on natural and agricultural resources. USDA-APHIS recently began a national, integrated damage management program to control feral swine populations across the United States. A collaboration among USDA-APHIS, Conservation Science Partners, the Tejon Ranch Conservancy, and the University of Florida was launched in 2014 to understand how management activities influence feral swine populations. In 2015 we established two study areas, the Tejon Ranch in California and Buck Island Ranch in Florida, to evaluate feral swine population density and dynamics, space use and habitat selection, and intra- and interspecific interactions. We deployed grids of motion-activated cameras and marked pigs with GPS collars (locations recorded every 30 minutes), ear tags, VHF collars, and colored collar bands to identify individuals. We are using mark-resight models and time spent on grid techniques to estimate population density. Baseline data on these populations is being collected through 2015 and 2016 and a proportion of populations will be removed through management activities in late 2016 and into 2017 to evaluate the influence on demography, density, and space-use patterns. We have developed a comprehensive SQL database for processing and storing the 200,000+ images acquired each month from motion-activated cameras in each study area. Preliminary results have revealed the timing of birth pulses, occupancy and detection probability of feral swine and the wildlife community across our camera grids. Additionally, we have begun estimating home range size, its configuration, and interannual variability of feral swine fit with GPS collars using contemporary Brownian Bridge movement models.

DNA detection of feral swine diet

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Feral pigs are omnivores that are believed to impact many plant and animal species through behavior (foraging, browsing, and rooting) and direct consumption. Through traditional diet analysis they have been shown to eat newborn domestic livestock new, white-tailed deer, crop plants, ground nesting birds, amphibians and reptiles. It is of critical importance to determine the impacts of feral swine to threatened and endangered species, game species, invasive plants, and crops. The goal of our study was to use a metabarcoding approach to identify DNA from items in feral swine fecal samples collected either fresh from the ground or from intestines of individuals removed during control efforts. To detect animal species we developed a new method; plant species were detected using an already published method. We collected samples from California, Florida, and Texas with our hypothesis being that if our methods were refined enough we should see differences in the overall diet composition between these areas. Further, our Texas samples were collected at a time when Quail (*Colinus virginianus*) were nesting and in areas where they were known to nest. Our goal was to see if we detected this ground-nesting bird species in the diet of feral swine. We found that there were differences in plant and animal diet across the regions and we confirmed predation of quail through our analyses. We will present this and our next steps for applying this technology.

Poster Sessions

Effect of differing concentrations of sodium nitrite on feral swine

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Feral hogs are responsible for a negative economic impact of $74 million in Louisiana and $1.5 billion across the nation. Therefore, the objective of this study was to determine the effective lethal dosage of sodium nitrite. To this end, feral pigs were captured using commercial type traps and transported to the Bob R. Jones – Idlewild Research Station and held in a 1 ha holding pen with access to ad libitum whole shell corn and ad libitum water. On treatment days, pigs were transported to the LSU AgCenter's Isolation Facility in Baton Rouge, LA. Pigs were individually weighed, snared, gavage volume calculated and sodium nitrite administered at one of six concentrations (120, 135, 150, 165, 180 and 210 mg/kg). Fifty-three feral pigs with an average body weight of 28 kg (range: 10 kg – 84 kg) were tested resulting in a 45% mortality with pigs dying an average of 2.5 h after dosing across all nitrite concentrations. Based on probit analysis, the LD_{50} was determined to be 149 mg/kg and mortality did not appear to be biased by gender or weight with 52% of females (average body weight: 36 kg; range: 11 – 55 kg) and 69% of males (average body weight: 25 kg; range: 15– 49 kg) expiring compared with 48% of females (average body weight: 22 kg; range: 13– 45 kg) and 31% of males (average body weight: 39 kg; range: 22– 49 kg) not expiring. Our results show that pig mortality at sodium nitrite concentrations of 120, 135, 150, 165, 180 and 210 mg/kg were 25%, 45%, 63%, 43%, 90% and 100% and time to death was 2.1, 2.5, 2.3, 2.4, 2.1 and 2.9 h, respectively. Results from this study will be utilized in the development of a toxic feral pig bait.

Saving insular sea turtle nests: improved efficiencies in feral hog removal

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Feral hog removal from Cayo Costa and Keewaydin Islands, Florida resulted in very substantial improvements in sea turtle and shorebird nests success, and extraordinary benefit-cost ratios for the control. Both of these islands are <2500 acres. Now, we are removing hogs from St. Vincent Island, which is over 12,000 acres. New technologies and method applications have resulted in a very rapid reduction in hog abundance. The availability of control options and new tool capabilities today far exceed what we had at our disposal just a few years ago. Recent advancements in remote activated trap doors and cellular cameras have resulted in significant improvements in our feral hog control strategy. These technologies combined with the aggressive use of night vision and thermal optics have made elimination from insular environments a reality. Helicopter aerial gunning was also utilized to eliminate feral hogs from the more remote and difficult to access areas of the island. Relative abundance indices are being calculated from camera data 4 times/year and track plots twice/year. Camera data are currently being analyzed while the 2015 track index dropped precipitously from 2.34 in March prior to initiating control to only .53 by September.

Societal influences on management of the wildlife-agricultural interface: the case of feral swine in the United States

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Increasing conflicts between wildlife and agriculture are challenging policy makers and the development and execution of methods to mitigate consequences. Studies have suggested strong dependence of policy on public sentiment towards issues (e.g., climate change). We examined the influence of public sentiment and changes in farm operations located in regions with feral swine on policy targeting feral swine in the U.S. We compiled 30-years of data describing the annual frequency of federal congressional actions for feral swine management from the U.S. Government Publishing Office. Data describing the annual number of U.S. farms in regions with feral swine were developed using agricultural statistics data and available feral swine distribution data. The annual frequency of

media coverage for feral swine was generated from four newspaper consolidator databases, and a textual sentiment analysis algorithm was used to measure the how negative or positive the news reporting was for feral swine. We fit logistic regression models relating annual frequency of federal policy activity to frequency of negative newspaper articles and the proportion of the U.S. farms in regions with feral swine. We found that the annual number of states with negative news, negativity of news, and increases in number of farms in regions with feral swine all influenced policy activity. These effects translated to 8.7% increase in policy activity for every additional state with negative news; a 10% increase in the number of negative news articles resulted in a 20.4% increase in policy activity. Increases in the number of farms in regions with feral swine had the largest effect, for every 1% increase in the number of farms in regions with feral swine the log odds of policy activity increases by 7.48. These results suggest that negative media coverage and the number of farms impacted may act as drivers for wildlife-agricultural policy development. Our findings have implications for identifying emerging policy issues and understanding policies intended to mitigate wildlife-human conflicts.

Improving methods for loading feral hogs from corral traps
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Texas Wildlife Services (WS) employees occasionally have a need for live feral hogs. Over the last several years WS has been loading and hauling live feral hogs for research purposes. WS has spent countless hours of loading feral hogs ineffectively. After employing different techniques WS has developed a combination of methods to increase feral hog loading efficiency. These methods include: a trailer with a guillotine gate, loading ramp, corral trap with a flat side and the placement of the corral trap. By using these methods feral hog loading efficiency has been improved by over seventy five percent.

The role of feral swine in production diseases of cattle in south-central Florida
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Feral swine in the United States are known to harbor pathogens of humans and livestock such as *Brucella suis* and pseudorabies virus, and they may play a role in the transmission and distribution of multiple tick-borne pathogens. Florida is estimated to have more than 500,000 feral swine, with the highest densities in south-central Florida where the majority of cow-calf operations are located. Pathogen transmission can occur when feral swine come into direct contact with cattle on rangelands or when vectors such as ticks transmit pathogens from one animal to another. We surveyed feral swine, cattle, and deer for ticks and collected biological samples including blood, nasal, oral, and genital swabs in order to understand pathogen exposure, prevalence, and transmission among animals on a 10,000 acre working cattle ranch in South Central Florida. Beginning in May of 2015 and continuing to present, we have sampled more than 70 feral swine, more than 450 cattle, and six deer. We were able to collect samples from more than 250 cattle and at least 10 feral swine at two different time points. Preliminary PCR and qPCR results show the presence of *Ehrlichia* spp. and pseudorabies virus on the ranch, respectively. Serology results indicate that roughly 30% of cows surveyed have antibodies to *Anaplasma* spp. Data collection and laboratory analyses are still in progress. We will continue to screen biological samples for a variety of tick-borne pathogens including *Ehrlichia* spp., *Anaplasma* spp., and *Rickettsia* spp. and also for wildlife-borne pathogens such as pseudorabies virus.

Screening for selected zoonotic and enzootic pathogens in feral hog serum samples from Oklahoma, USA
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The feral hog populations in the United States are a growing concern as they continue to increase and expand in their range. There is also great controversy surrounding feral hogs and their impact on our environment, the economy, and human health and safety. One specific area of concern is the potential of feral hogs to harbor

infectious pathogens and the risk of those pathogens being spread to human and livestock populations. As part of a five year project, we are screening feral hog serum samples from Oklahoma, USA to look for antibodies against a variety of zoonotic pathogens such as brucellosis (*Brucella* spp.), Chagas disease (*Trypanosoma cruzi*), and tularemia (*Francisella tularensis*), as well as two enzootic pathogens, porcine reproductive and respiratory syndrome virus (PRRSV) and pseudorabies virus (PSRV). Enzyme-linked immunosorbent assays (ELISA) are being used to detect antibodies for *T. cruzi*, PRRSV, and PSRV. Rose Bengal card tests are used to detect the presence of antibodies for *Brucella* spp. and slide agglutination testing are performed to detect the presence of antibodies for *F. tularensis* and confirmed by tube agglutination. From 2015 samples, we detected *Brucella* spp. antibodies in 5.7% of our samples, *T. cruzi* in 22.9%, *F. tularensis* in 8.6%, PRRSV in 2.9%, and PSRV in 14.3% of our samples. It is important that we are aware of the infectious pathogens in our feral hog populations so that we are able to better control the spread of such infectious agents to human and livestock populations around the country. Screening for infectious pathogens, such as that being done in this study, is an important tool to aid in the management of such infectious agents and feral hog populations.

Potential resource competition between feral swine and white-tailed deer on Florida rangelands

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Given the high population densities and large amount of niche overlap between white-tailed deer and feral swine on Florida rangelands, it is likely that these two species are undergoing resource competition. We used camera traps to test our hypothesis of small-scale competitive exclusion and/or niche partitioning of white-tailed deer and feral swine on the rangeland habitat of Buck Island Ranch in Lake Placid, Florida. Camera traps were placed over an area of 35km^2 at naturally occurring food sources (acorn-producing Oak trees) and human-placed food sources (supplemental feeding stations). We used a series of exclosure experiments to test our hypothesis that feral swine consume a disproportionately large amount of supplemental feed intended for deer, and used occupancy analysis to test whether feral swine activity at Oak trees negatively impacts acorn availability and use of Oak hammocks by deer. We also analyzed activity patterns of each species in shared vs. non-shared habitats and used occupancy analysis to test our hypothesis that deer alter their land use behaviors to avoid feral swine both spatially and temporally. Data collection and statistical analyses are currently still in progress but will be completed before the start of the conference to allow us to generate conclusions.

Home range, habitat selection, movement patterns and spatial overlap of feral wild boar (*Sus scrofa*) with domestic swine in southern Saskatchewan

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In the 1980's and 1990's, domestic wild boar from Europe were introduced across Canada as part of an agriculture diversification initiative to promote production for the meat market, breeding stock and fenced-in hunting opportunities. Escapes and intentional releases from domestic boar farms have occurred regularly however, and some feral boar populations have become established. Through media reports, trail camera surveys and rural municipality surveys it is apparent feral wild boar are wide spread throughout many areas of western Canada and vary in abundance. There is minimal peer reviewed scientific literature that provides insight into the ecology of feral wild boar on the Canadian prairie and the risks they pose to agriculture, native wildlife populations and the environment. Our study area is in southeastern Saskatchewan, Canada, in an agriculture-dominated prairie landscape that includes Moose Mountain Provincial Park (40,000 hectares). The park is a protected area that rises 200 meters in elevation above the surrounding plains and is dominated by deciduous forest, wetlands and lakes. The objectives of this research project (currently in progress) are to gain a better understanding of the ecology of feral wild boar on the northern prairie and the risks they pose to agriculture. Through GPS satellite collars on feral wild boar, this research delineates home range use; determines seasonal habitat selection; discerns daily movement patterns; and identifies areas of spatial overlap between feral wild boar and agricultural production/domestic swine operations. The results of this research will provide novel information that is critical to feral wild boar management and will benefit diverse stakeholders. Provincial governments can utilize the information when developing coordinated and comprehensive management plans and will enable them to control feral wild boar populations more

effectively. Furthermore, an increased understanding of feral wild boar interactions at domestic swine facilities will contribute towards improved on-farm biosecurity.

Evaluation of Feral Hog Gastric Contents in Louisiana

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Feral hogs (*Sus scrofa*) are a non-native species originally introduced to North America in the 1500's, and have been part of the Louisiana landscape for hundreds of years. They cause severe damage to native flora and fauna, the habitats in which they live, agricultural lands, and compete with native wildlife for foodstuffs. The goal of this study is to characterize the diet of feral hogs in Louisiana and determine if diet differences exist between 5 habitat types: bottomland hardwood; pine; mixed pine / hardwood; swamp; and coastal. Feral hog stomachs (n=95) were collected opportunistically by ground and aerial gunning from 2010 to present. We measured the total volume of the gut content, next the entire contents of the stomach were washed through a series of 5 sieves to separate contents into 7 categories: 1) vegetation; 2) mast; 3) mammalian; 4) reptile/amphibian; 5) invertebrate; 6) avian; and 7) corn/bait. Categorical contents were measured by volumetric displacement. All mammal, reptile, amphibian, invertebrate and avian matter were then identified to lowest possible taxonomic level. Categorical occurrence was calculated for each habitat type. Vegetation comprised 0% to 91.9% in bottomland hardwood, 0% to 95% in pine and mixed pine / hardwood, 54.5% to 99.4% and 36.7% to 94.3% in swamp and coastal habits respectively. Mast ranged from 0% to 70.6% in bottomland hardwood, 0% to 47.5% in pine, 0% to 43.7% in mixed pine / hardwood, 0% to 1.5% and 0% in swamp and coastal habits respectively. Mammalian matter only occurred in hog stomach from bottomland hardwood (0% to 10.4%) and coastal (0% to 33.5%) habitats. Avian matter, a turkey egg containing a poult, occurred in one stomach from mixed pine / hardwood habitat and constituted 0.75% of total gut content. Reptile matter ranged from 0% to 2.9% in bottomland hardwood, 0% to 0.18% in pine, 0% to 0.29% in swamp and 0% to 6.5% in coastal habits. Invertebrate matter ranged from 0% to 19.2% in bottomland hardwood, 0% to 3.5% in pine, 0% to 6.6% in mixed pine / hardwood, and 0% to 0.01% and 0% to 0.21% in swamp and coastal habitats respectively. Slight differences were detected in diet items by habitat type. However, these may be a result of other factors such as seasonality, population, or heterogeneous nature of habitats, all factors we will consider as this study continues.

Efforts to prove feral swine elimination in New York

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Wild pigs were first detected in New York in 2007. Since that time, as many as four distinct populations have been documented, all of them the result of Eurasian boars escaping high-fence shooting preserves and breeding facilities, and possibly from intentional releases to establish new hunting opportunities. Due to the fact that these populations remained relatively small and isolated, wildlife managers determined that elimination was feasible, and represented the best course of action to protect natural resources, agriculture, and human health and safety in New York. Following a very successful population reduction campaign, USDA Wildlife Services worked with state and local agencies to develop and implement a five-prong approach to remove the last remaining wild pigs, prove that full elimination had been accomplished, and ensure that wild pigs do not become a problem for New York again in the future. The major components of this plan are on-the-ground management and surveillance, aerial surveillance, canine surveillance, an early detection network, and cooperation with law enforcement. While this approach should by no means be viewed as an over-arching solution to the growing threat from invasive pigs this country is facing, it is proving to be a successful framework for New York, where wild pigs have not been detected since October 2014. This approach was developed by reviewing wild pig management strategies throughout the country, considering emerging strategies, and adapting those strategies to meet challenges unique to New York. We provide an overview of our management strategy so that those dealing with wild pigs in the future may use it as a resource.

Population assessment of wild boar (*Sus scrofa*) in Singapore's Central Catchment Nature Reserve
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Eurasian wild boar (*Sus scrofa*) is a native terrestrial mammal in Singapore. Although widespread now, they were thought to be extinct on the mainland till they were sighted in the early 2000s. It is speculated that the wild boars swam from Peninsular Malaysia and other off-shore islands and re-colonised mainland Singapore. Due to their highly adaptable nature and the lack of apex predators in Singapore, they have quickly spread to most forested areas including the nature reserves. Population estimate of wild boar in Singapore has been restricted to small scale student projects or density estimation based on Malaysian studies. Thus we aimed to conduct a complete assessment of wild boar population in the Central Catchment Nature Reserve (CCNR). We used distance sampling from line transects and camera trap counts to estimate the population. i) A total of 10 transects were chosen throughout CCNR and wild boar group size and perpendicular distance from transect were recorded. A total of 18 sightings have been obtained so far and transect surveys are in-progress. Preliminary analysis in DISTANCE 6.2 resulted in boar population density of 11.5±4.2 boars/km^2. ii) 24 camera trap locations were randomly chosen within CCNR and were deployed for a period of 3 months. A total of 188 wild boar photos were obtained and further analysis is in-progress. Rare incidences of human-wild boar conflict have been recorded in Singapore urging population control measures. The results of this study would provide population estimates to devise management strategies driven by scientific evidence.

Estimation of the number of wild pigs found in the United States
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The population of introduced wild pigs (*Sus scrofa*) found in the United States has dramatically increased since 1990. Concurrent with this increase has been an increase in the damage that these invasive animals cause. The purpose of this study 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. This effort was based on a compilation of individual state approximations, each estimated on one of three approaches, to then collectively derive a national estimate. The three estimation approaches included reported estimates, harvest-based estimates and bounding estimates. Where possible, these individual state approximations were given as minimum, mean and maximum population estimates. Overall, 37 states had estimated population sizes of wild pigs; the remaining 13 other states had no animals listed as being present. 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 harvest-based numbers and eleven were bounding estimates. 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. Ninety-nine percent of these numbers, 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).

An individual-based model for feral hogs in Great Smoky Mountains National Park
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The expansion of feral hog (Sus scrofa) populations in the United States has resulted in increased efforts to develop and implement control strategies designed to minimize the impacts done by this invasive species. We describe an individual-based model for feral hogs in Great Smoky Mountains National Park (GSMNP). The objectives of the model are to provide an understanding of the population dynamics of this feral hog population and to determine the efficacy of the annual harvest as a population control method. Results suggest that the dynamics of the population

are driven by fall hard mast production and the GSMNP harvests currently limit growth of the population, but these control efforts have not reduced the population.

Using detection dogs to verify elimination of Eurasian swine in New York State
Daniel Hojnacki, Justin Gansowski, and Mark Jackling, USDA-APHIS Wildlife Services

In 2008, four breeding populations of feral swine were discovered in six counties of New York State. Through new regulations and extensive elimination efforts by USDA Wildlife Services and New York State Department of Environmental Conservation, New York's feral swine populations have been reduced significantly if not eliminated. Confirming elimination became the priority, and because any one surveillance method has its limitations, Wildlife Services in New York developed a five-prong monitoring program: on the ground management and surveillance, an early detection network, collaboration with law enforcement, aerial surveillance, and canine surveillance. This presentation addresses the fifth prong: canine surveillance. Wildlife Services initiated the canine surveillance component of its monitoring program in August 2015. Working Dogs for Conservation was contracted by USDA Wildlife Services to help confirm elimination of Eurasian swine from the landscape. The detection dogs were trained in advance to alert to feral swine scat and possibly other swine-related scents. Surveys were conducted in seven counties in NY and in one bordering county in Pennsylvania, where feral swine populations had previously known to exist. Seventy-nine transect surveys were conducted in 19 calendar days, with each day deploying two or three teams. The survey teams traveled a total of 405 km in 153 hours 41 minutes, whereas the detection dogs traveled a total of 470 km. The dogs alerted to 8 detected scats but 4 of them were false detections and 1 was too decomposed for further analysis. A total of 3 scats were submitted for DNA analyses which were determined not to be from feral swine. Although, only the first of two years of detection dog trials has been completed, detection dogs could be a useful tool in the future to help determine if feral swine have been eliminated in an area.

Diseases of feral swine
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Feral swine populations in the United States serve as hosts, carriers, and dispersers of disease agents (pathogens) that can have significant impacts on agriculture, human health, wildlife health, or a combination of these. Pathogens associated with feral swine are numerous, and include various bacteria, parasites, and viruses. Among these pathogens are *Brucella suis* (Brucellosis), *Leptospira interrogans* (Leptospirosis), *Francisella tularensis* (Tularemia), *Toxoplasma gondii* (Toxoplasmosis), Influenza A virus (Flu), and Suid Herpesvirus 1 (Pseudorabies/Aujeszky's Disease/Mad Itch). A basic introduction to these pathogens associated with feral swine is important for those working with state, Federal, or non-governmental organization feral swine programs. An understanding of the rudimentary aspects of feral swine pathogens such as transmission, public health and agriculture risks, and impacts to wildlife may help foster safer work practices for those engaged in feral swine work in addition to providing a broader grasp of the detrimental impacts of feral swine in the United States. The proposed presentation will discuss major bacterial, parasitic, and viral pathogens and diseases associated with feral swine, and their impacts on agriculture, human health, and wildlife health. In addition to the didactic portion of the presentation, the recently published *Diseases of Feral Swine* brochure will also be discussed.

NWRC Feral Swine Genetic Archive: status and how it is being used
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Feral pig origins after an invasion of a new area are difficult to ascertain. Further, understanding dispersal patterns and history is critical to designing appropriate management strategies. Wildlife Services has been collecting feral swine hair samples from across the invasive range within the United States and depositing these samples to a genetic archive housed at the National Wildlife Research Center (NWRC) for about three years. Our goal is to use the archive to answer questions about origin and dispersal history through DNA methods. The goal of this poster is to update the feral pig community on the status of the archive and our initial studies.